

OXFORD ENGLISH FOR CAREERS



OIL AND GAS¹

Lewis Lansford

With additional material by Peter Astley

Teacher's Resource Book

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Introduction

Oil and Gas is aimed at preparing students who intend to get a job in the oil and gas industry. It presents them with English from a wide variety of oil and gas industry fields and situations, develops their communication skills, and provides them with background in major oil and gas concepts.

Kick off

This is designed as a warm-up activity to the unit. It usually consists of a number of pictures, and often introduces key vocabulary or concepts. It should be used to get students to focus on the topic.

It's my job

These occur in most units, either as a reading or listening exercise. They are designed to be of interest to the students as they stand with only minimal tasks. Students will read about a variety of people in different oil and gas environments and gain insight into the skills required.

General focus questions for *It's my job* are: What do you think his / her job involves? What skills and experience does he / she need? Would you like to do it?

Number talk

Most students will be developing the necessary numeracy for their chosen profession. However, they will need to learn to speak about numbers and equations in English. The *Number talk* feature gives students practice with speaking about numbers, measurements, and calculations.

Top margin

This top part of the page contains definitions for difficult words or phrases which are important to understand a text which appears on the same page. It also includes notes on words and phrases that are different in American English (Am E) and British English (Br E). Occasionally, there are optional extras such as facts and illustrations that can be used to add variety and interest to your lessons. Ways of exploitation include asking whether your students are surprised by the facts and whether they can supply any additional facts related to the topic.

Vocabulary

Students meet a large amount of vocabulary during the course. It is important to encourage good learning skills from the start, for example:

- organizing vocabulary into word sets and word groups rather than simple alphabetical lists
- understanding the context of vocabulary and whether it is a key word needed for production or for comprehension
- checking and learning the pronunciation of a word or phrase.

Language spot

This focuses on the grammar that is generated by the topic of the unit and concentrates on its practical application.

If your students need revision after completing the *Language spot*, direct them to the *Grammar reference*, which provides a handy check.

There is also one photocopiable *Language test* for each unit in this Teacher's Resource Book.

Listening, Reading, Speaking, Writing

These activities give realistic and communicative practice of language skills needed in the oil and gas industry.

- In the listening activities, students are exposed to situations related to oil and gas, including toolbox talks, conversations with colleagues, and telephone calls. They also hear a variety of English accents, both native speaker and non-native speaker.
- In the reading sections, students meet a variety of oil and gas-based texts.
- In the speaking sections, try to ensure the use of English during activities, particularly those involving some discussion. Encourage this by teaching or revising any functional language students may need. The photocopiable activities in this Teacher's Resource Book also provide additional, freer discussion activities.
- Practice with writing is designed to help students feel confident doing very basic tasks such as writing a phone message or filling in a form with personal details.

Pronunciation

This practises aspects of pronunciation which are of maximum importance for intelligibility.

You can repeat the recordings in *Pronunciation* as often as you like until you and your students feel confident they have mastered a particular sound or feature.

Project

This encourages students to take an active role in the learning process, both in terms of their English language work and the subject of oil and gas itself.

Projects can be set as homework assignments, but it is worth spending time in class preparing students for the task. Students are usually required to find basic information on a given topic. Help can be given by brainstorming some standard places where they can gather information, for example finding material on the internet using their native language rather than English. This will make the information more accessible to learners with a relatively low level of ability in English.

Checklist

This allows students to check their own progress. You may want to get students to grade or assess how well they can perform each of the 'Can do' statements, e.g. 'easily', 'with difficulty', or 'not at all'. They can also test each other in pairs, by giving examples from the unit of each of the 'Can do' statements.

Key words

These are the main items of oil and gas vocabulary introduced in the unit. A definition of each of these words appears in the *Glossary*. You should certainly check students' pronunciation, including the stress, of words likely to be used orally.

Writing bank

This is in the middle of the book and gives more in-depth skills practice in basic writing for oil and gas. It can be used throughout the course, either in class or as self-study or homework. There are recommendations for when to use the different exercises in the teaching notes in this Teacher's Resource Book. There is also an *Answer key* in the Student's Book to encourage students to check their work, but it is important for you to check extended written answers with reference to the models provided.

Speaking activities

This section contains one or more parts of the information gap activities from the main units (see *Speaking*).

Irregular verbs

This is a list of the most common irregular verbs in English, including ones not used in the book. Students can use it as a reference and may find it especially useful for writing and project exercises.

Abbreviations

This is a list of common oil and gas abbreviations and their meanings.

Grammar reference

This can be used together with the *Language spot* as a handy check or revision. It shows the form of a particular grammar point, briefly explains its use, and provides example sentences as well as indicating likely student errors.

Listening scripts

This is a complete transcript of all the recordings. Direct students to it for checking answers after they have completed a *Listening* task, or allow weaker students to read it as they listen to a particular recording, perhaps for a final time.

Glossary

This is an alphabetical list of all the *Key words*. The section begins with a phonetic chart, with an example word from oil and gas to illustrate each of the sounds. Each word in the glossary is followed by the pronunciation in phonetic script, the part of speech, and a definition in English.

1 An international industry

Background

The oil and gas industry recruits workers from all over the world. The first priority for any oil or gas company is to employ locally where possible. By encouraging companies to employ locally in contracts and legislation, governments help to fulfil the aspirations of their own people and improve their long-term national economy.

The industry comprises nationally owned and independent oil companies exploring and producing oil and gas, contractors and service companies providing design, drilling and marine services, and specialist suppliers selling equipment, materials, and tools to the industry. In all these areas, companies are keen to recruit locally in order to grow. The industry also provides opportunities to live and work in countries across the world. There are over forty oil-producing countries in the world with substantial oil and gas industries.

Expertise from developed countries where the industry is well established, such as the United States and the United

Kingdom, is in demand in countries where the oil industry is less developed. In Middle Eastern countries, there are small countries with small populations and large oil reserves that need to bring in qualified and skilled people as well as manual labour. In India, for example, which has a significant oil and gas industry of its own, accounting for 15% of its Gross Domestic Product, its nationals at all levels are also employed in many different countries.

English is used as the common language in the work environment. It is important that verbal communication skills in basic areas such as numbers and the names of tools and equipment are practised to a degree that helps to minimize mistakes in understanding. Some mistakes can have serious consequences for safety when handling hydrocarbons. Wrong assumptions can also be made in reading and writing numbers, for example there are differences in conventions in writing dates and filling in forms which can lead to misunderstandings.

Additional activity

Ask students to look at the map and name as many of the oil-producing countries as possible. Can they name the top ten oil producing countries? They are (in 2010):

- 1 Saudi Arabia – 11 million barrels per day (13.9% of estimated world total)
- 2 Russia – 9.9 million bpd (12.5%)
- 3 the United States – 8.3 million bpd (10.5%)
- 4 Iran – 4.2 million bpd (5.3%)
- 5 Mexico – 3.8 million bpd (4.8%)
- 6 China – 3.7 million bpd (4.7%)
- 7 Canada – 3.1 million bpd (3.9%)
- 8 Norway – 3 million bpd (3.8%)
- 9 Venezuela – 2.8 million bpd (3.6%)
- 10 Kuwait – 2.7 million bpd (3.4%).

Source:

<http://internationaltradecommodities.suite101.com>

Kick off

- In **1**, check answers by asking students to say them. In **2**, ask six students each to read one of the sentences aloud. Call the students' attention to the diagram that explains the meaning of *oilfield*, *offshore well*, *onshore field*.

Key 1 1 Students' own answers

- 2 a Africa
- b South America
- c North America
- d Asia
- e Asia
- f the Middle East
- g Europe
- h North America

3 Possible answers

China, Iraq, Italy, Kuwait, Libya, Mexico, Nigeria, Russia, Saudi Arabia, Venezuela

(For a full list, see <http://tinyurl.com/oilstates>)

*** Tip**

technician – a person whose work involves practical skills, especially in industry or science

control room – a room with equipment to operate and monitor the machinery in a refinery, drilling rig, etc.

plant – a place where an industrial process takes place, for example a refinery

*** Tip**

technical department – the part of a company that is responsible for the practical side of the day-to-day work in a plant

Additional activity

Vary **4** by starting with the spelling and asking for the word, for example *What does M-A-N-A-G-E-R spell?*

Additional activity

Certain numbers have special pronunciation when speaking on a radio, to avoid similar-sounding numbers being confused. If your students will be using radios in their work, teach these special pronunciations.

3 = tree

4 = fower (like flower without the l)

5 = fife

9 = niner

*** Tip**

store – the building or room where tools and materials are stored

It's my job

- Do **1**, then ask students to check their answers in pairs.
- For **2**, ask seven students each to read one of the questions aloud. Play the recording and tell the students to listen for the answers to the questions. Then check answers with a partner. Check by asking students to say their answers.
- Do **3** in pairs.

- Key**
- 1 UAE [✓] plant [✓] outside [✓]
 - 1 because every day is different
2 He's outside.
3 five
4 three
5 One is from the USA and two are from India.
6 They use radios.
7 Emirati, American, British, Canadian, Egyptian, Indian, and many more

Language spot**a / an / the**

- Elicit or teach the rules for using *a*, *an*, *the* (turn with the students to *Grammar reference* p.118 and introduce this section of the book). Do the exercise. Check by asking students to say their answers.

- Key**
- | | | |
|-----|-----------------|------|
| 1 a | 3 the, the, the | 5 an |
| 2 a | 4 a, the, – | |

Pronunciation

- Do **1**, ask students to listen and repeat. Note that the letters that are grouped together rhyme, or have the same 'vowel sound'.
- For **2**, have the class say the letters in chorus. For **3**, model the task by spelling your own first and family names. Do the exercise in pairs. Start **4** off with shorter words (e.g. *job*, *oil*).

Number talk**1–199**

- Do **1** and **2** with the class. Begin **3** by pointing out that *-teen* (as in *thirteen*) is long and *-ty* (as in *thirty*) is short. This is how we tell these numbers apart.
- Do **4**. Explain that for the reference and phone numbers, we say them one digit at a time (seven nine seven eight four one). For quantities, we read them as numbers (a hundred and thirty). Do **5** and **6**.

- Key**
- 4 a seven-nine-seven-eight-four-one
b four-nine-two-oh
c four-oh-three
d oh-seven-five two-eight-nine-eight six-four-three-one
e a hundred and thirty
f forty-nine
g fifteen
h fifty

Additional activity

- 1 Ask students to write down four numbers. These can be phone numbers, dates, the model number of their car, etc. They should not write any sensitive information, for example bank account numbers.
- 2 In pairs, students should read each other's list and ask questions. For example
A *What's 489-0982?*
B *It's my mobile phone number.*

* Tip

hardware – tools, parts, and equipment
spanner – a tool for gripping a nut or bolt to tighten or loosen it
wrench – an adjustable spanner

Additional activity

Do *Writing bank 1* on Student's Book p.52.

Additional activity

Students compare the information they found about employers in their country. They then work in groups to present information about employers to the class.

Listening

Conversations

- Before the listening in **1**, ask the students to say what they can see in each picture. Ask *What are they talking about?* Play the recording. Students check their answers in pairs. Then ask the students to say the correct answers.
- For **2**, play the recording again. If necessary, help with *store* (a place that keeps tools and hardware), *building* (use the building you are in or one nearby as an example), *bolt* (point to one or draw a picture), *part number* (show an example from a catalogue or on something in the classroom), and *employee number* (a number that a company gives each worker). Do **3**.

1 a 3 b 4 c 1 d 2
2 1 2, 103 3 PV3764 5 784522
 2 16 4 0725

Vocabulary

Tools and hardware

- Do **1**. Ask the students what other tools they have at home and help them name them in English. Do **2** and **3**.

Speaking

Checking

- Ask the students to say what is in the picture. Play the recording. Do **1**. Then do **2**. Student A begins the conversation by asking *What's in box 1?* Student B then says what's in the box. Student A corrects any errors.

2 Box 1
 The W987 washers are wrong. The list says W7634.
 There are only 14 bolts. The list says 40.
 The N7684 nuts are wrong. The list says N7604.
 Box 2
 The B894 bolts are wrong. The list says B984.
 There are only 14 nuts. The list says 140.
 The W8902 washers are wrong. The list says W3521.

Reading

Employers

- Tell the students to look at the picture. Ask them to say what they can see.
- Choose five students to each read part of the text (introduction, sections 1–3, conclusion) aloud. Elicit the answer to whether the situation is similar or different in your country. If possible, discuss specific examples of similarities and differences.

Project

- Assign the project as homework.

Language spot

The verb *be*

- Turn with the students to the *Grammar reference* on p.118. Students complete **1** individually, then check answers with a partner. Do **2** individually, then check answers with a partner. Do **3** in pairs.

Key

1 1 are, am /'m
2 is /'s, is /'s
3 Is, isn't

4 Are, aren't, are /'re
5 aren't, are /'re

2 1 are there
2 are there

3 Is there
4 Is there

5 Are there

3 1 How many pages are there in this book?
There are 136 pages in this book.
2 How many units are there?
There are fifteen units.
3 Is there a word list at the back?
Yes, there is.
4 Is there a contents list at the front?
Yes, there is.
5 Are there six or eight pages per unit?
There are six pages per unit.

Additional activity

Do the Unit 1 communication activity on Teacher's Resource Book p.79.

Writing

Completing a form

- Write today's date in number form on the board. Ask students to say what it means. Revise the months of the year. Have students write the two dates for **1**, then check answers by writing them on the board. Do **2** individually. Circulate and check work.

Key

1 1 04/02/20 — / 04/02/ — / 04.02.20 — / 04.02. —
2 17/11/20 — / 17/11/ — / 17.11.20 — / 17.11. —

2 First name (*Student's first name*)
Family name (*Student's family name*)
Employee no. 2178
Manager *Don Bradman*
Department *Fire and Safety*
Job title *Fire officer*
Nationality (*Student's nationality*)
Date of birth (dd/mm/yyyy) (*Student's date of birth*)
Telephone no. (*Student's telephone number*)
Email (*Student's email address*)
Signature (*Student's signature*)
Date (dd/mm/yyyy) (*Today's date*)

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

2 Upstream

Background

The industry is divided into two main sectors, **upstream** and **downstream**. The upstream sector is concerned with the **exploration** and **production** of crude oil and natural gas. The downstream section converts them to useful products at refineries and is also concerned with storage, distribution, sales, and marketing. The exploration process involves **geologists**, who understand how rocks and oil and gas deposits were formed, and **geophysicists**, who measure the different properties of these minerals and collect and analyse data to recommend whether to spend money on further investigation, drilling, and eventual production of oil or gas beneath the surface.

Crude oil is measured in **barrels** (with the abbreviation *bbl*). A barrel is about 159 litres. Gas is measured in standard cubic metres measured at normal or standard temperature and pressure (scm or m³). The earth's oil and gas proven reserves are about 1,200 thousand million (1.2 trillion) bbls of oil and 185 trillion m³ of gas. When production figures of oil and gas are given together, the barrel of oil equivalent is used; in 170 m³ of gas there is the equivalent energy of 1 bbl of oil, so world proven reserves of oil and gas together are around 2.2 trillion

barrels. Over half the reserves of oil are in the Middle East and one quarter of gas reserves are in Russia. At present production rates, it has been estimated that this oil will last another 40 years and gas another 60 years. Reserves of the other major fossil fuel, coal, are forecast to last another 120 years.

Oil and gas are recovered by drilling through impervious rock to porous rock where the oil and gas have accumulated. At first, an exploratory well is drilled and the data collected is analysed. Estimates are made and a commercial decision is taken whether to invest in production. The surface facilities to process the oil have to be designed and constructed before production begins. This can take many years, particularly where the reserves are difficult to exploit, and can involve many different specialists and support people with a variety of knowledge, skills, and experience.

Even with improved technology, oil and gas are being consumed at four times the rate that they are being discovered. There is widespread debate on when oil and gas will run out, but whatever figures are used, we need to find new sources of energy and use energy more efficiently.

* Tip

well – a deep hole in the ground

Kick off

- Ask students to say what they can about the two pictures. (The first shows workers on a drilling rig. The second shows a worker checking the pressure at a refinery). Do **1** and **2**.

- 0-π**
- 1 fuel
2 crude oil
3 produce
4 sectors
5 upstream / the upstream sector
6 downstream / the downstream sector
 - 1 Page 11, first picture
2 Page 11, first picture
3 Page 11, second picture
4 Page 10, first picture
5 Page 11, third picture
6 Page 12, second picture

*** Tip**

The hydrocarbon molecules shown in the text are methane (a gas) and benzene (one of the liquids found in crude oil).

Reading**The upstream process**

- Tell the students to look at the pictures on p.11. Ask them to say what they can see. Give them some time to do **1** individually. Check answers by asking for volunteers to read out the sentences that give the answers.
- Tell the students to find the answers for **2** in the text. Check by asking students to say their answers. Do **3** individually. They then compare answers in small groups. Ask individual students to read out answers.

- Key**
- 1**
- 1 Exploration
 - 2 Drilling
 - 3 Development
 - 4 Production
- 2**
- 1 rocks that can hold hydrocarbons
 - 2 no
 - 3 They do more tests and ask 'How much oil is there?' and 'Are there any problems?'
 - 4 to transport the oil
 - 5 a problems b transport c flow

It's my job

- Tell the students to look at the picture. Read the italicized questions aloud. If necessary, draw a simple illustration on the board to explain *How fast does the oil flow up from the well?* Explain or elicit the meaning of *be fit* (in good physical health), *be good with numbers*, *be careful*, and *use a computer*. Do **1**. Students say their ideas for the class.
-  Look at the information in **2**. Tell the students that they must listen for the missing information. Play the recording. Check by asking students to say their answers.
- Do **3** and **4**.

- Key**
- 2**
- 1 Canada
 - 2 test
 - 3 tests
 - 4 data
 - 5 12
 - 6 7 a.m. to 7 p.m.
 - 7 outside
 - 8 different places
 - 9 be fit, be good with numbers
- 3**
- a Who do you work for?
 - b What's your job?
 - c Where do you work?
 - d What do you do on a typical day?
 - e How many hours do you work (per day)?
 - f When do you start and finish?
 - g What are the good things about your job?
 - h What skills do you need for this job?

* Tip

Geotechnicians prepare rock, soil, and water samples for testing. The tests show the physical properties and chemical make-up of the samples. They use special laboratory equipment and computer programs. Some geotechnicians also keep records of drilling activity and prepare geological maps.

Additional activity

(weaker students)

Students revise vocabulary and practise writing sentences by writing eight sentences based on **1**, for example *A crane operator operates a machine for lifting and moving heavy things.*

Additional activity

(stronger students)

Students revise vocabulary from Unit 1 and practise *do* questions by writing two or three questions for their classmates, e.g. *Where do you live? Do you study in the evening? Why do you want to work in oil and gas?* Offer help as necessary with both questions and answers.

Additional activity

(all levels)

Do *Writing bank 2* on Student's Book p.53.

Vocabulary

Some upstream jobs

- Do **1**. Ask students to say where in the unit each worker is shown. If necessary, support the explanations by drawing simple illustrations on the board of, for example, a crane, a pipe, and a drill drilling into the ground.
- Do **2**.

- Answers**
- 1 e Picture on p.11, second column
 - 2 c Picture on p.13, second column
 - 3 a Picture on p.11, first column
 - 4 b
 - 5 g
 - 6 f
 - 7 h Picture on p.12, second column
 - 8 d First picture on p.10

2 Note: some of these jobs are in both sectors, e.g. maintenance technician.

- 1 crane operator – development (and offshore drilling and production)
- 2 driller – drilling
- 3 geologist – exploration
- 4 geotechnician – exploration
- 5 maintenance technician – all
- 6 pipe-fitter – development and production
- 7 production operator – production
- 8 roughneck – drilling

Language spot

do and *does*, and *Wh-* questions

- Elicit the answers to **1**. Do **2** individually. Check by asking students to say their answers.
- Do **3** in pairs. Monitor and give assistance as necessary.
- Ask volunteers to say the words in **4**. Help with pronunciation. Ask a volunteer to answer **5**. Do **6** individually. Check answers by asking pairs to read out the conversations.

- Answers**
- | | |
|---------------------------------------|----------------------------------|
| 1 1 <i>do</i> and <i>don't</i> | 2 <i>does</i> and <i>doesn't</i> |
| 2 1 Do | 4 Does |
| 2 Does | 5 Do |
| 3 Does | 6 Do |
| 3 1 No, they don't. | 4 No, he doesn't. |
| 2 Yes, he does. | 5 No, they don't. |
| 3 No, he doesn't. | 6 Yes, they do. |
| 5 h and w | |
| 6 1 Where does, works | 5 What do, study |
| 2 Who does, works | 6 Which, does, works |
| 3 How, do, work | 7 do, They like |
| 4 When do, start | 8 do, They |

* Tip

Kazakhstan has large oil and gas fields. Experts predict that by 2015, it may be one of the world's top ten oil producing countries.

The UK is eighth in the world ranking of gas producers, eighteenth in the ranking of oil producers, and thirteenth for oil and gas combined. (Source: Oil & Gas UK 2008 Economic Report, p.7.)

Additional activity

(stronger students)

Students write formulae for converting barrels to cubic metres and vice versa.

$$\text{bbl} \times 159 / 1,000 = \text{m}^3$$

$$\text{m}^3 \times 1,000 / 159 = \text{bbl}$$

Additional activity

(all levels)

Do the Unit 2 communication activity on Teacher's Resource Book p.81.

Speaking

Talking about jobs

- Tell the students they're going to learn about two upstream workers. Put them in pairs. Do **1** and **2**. Check by asking students to say their answers.

2 Possible answers

Student A

Igor Kinsky works for a Russian oil company.

He's a driller in Kazakhstan.

On a typical day, he supervises the drilling crew.

He works twelve hours a day / per day from 7 a.m. to 7 p.m.

He likes the job because the money is good.

Student B

Andrea Farrell works for a British oil company.

She's a helicopter pilot in Aberdeen, Scotland.

On a typical day, she takes men and equipment to offshore platforms.

She works twelve hours maximum per day.

She usually works from 7 a.m. to 7 p.m.

She likes flying helicopters.

Number talk

Measuring oil and gas

- Ask a student to read out each sentence in **1**. Help with pronunciation. Then ask students to say each sentence in **2** and **3**.
- For **4**, write some numbers on the board (e.g. 690; 4,575; 19,000; 609,000; 2,000,000; 8,000,000,000). Ask students to read out the number you point at. Ask more than one student to read each number, and ask each student to read a number more than once.
- Do **5** and **6** in pairs.

2 a a hundred litres

b fifty barrels

c a hundred and seventy cubic metres

d twelve litres per second

e twenty-eight cubic metres per hour

Listening

Some big numbers

- For **1**, ask students to call out their guesses. Write a range of answers on the board.
- Do **2**. Then do **3** individually. Then have them share their sentences in small groups. Circulate and listen for errors. Ask a few students to write sentences on the board.

- 0π 2**
- | | |
|------------------|------------------|
| a 85,000,000 | f 280 km x 30 km |
| b 13,000,000,000 | g 5,000,000 |
| c 560,000,000 | h 790,000 |
| d 40,000 | i 57,000,000 |
| e Saudi Arabia | |

3 Possible answers

- 1 The world uses eighty-five million barrels of oil per day.
- 2 That's about thirteen billion litres per day.
- 3 That's about five hundred and sixty million litres per hour.
- 4 There are about 40,000 oil and gas fields in the world.
- 5 The biggest field / The Ghawar field is in Saudi Arabia.
- 6 It is two hundred and eighty kilometres by thirty kilometres / 280 kilometres long and 30 kilometres wide.
- 7 The field produces five million barrels of oil per day.
- 8 That's about seven hundred and ninety thousand cubic metres per day.
- 9 The field also produces fifty-seven million cubic metres of gas per day / Gas production per day is 57,000,000 m³/d.

Additional activity*(all levels)*

Assign small groups of students countries other than their own to find information about. They then work in groups to present information to the class.

Project

- Assign the project as homework. Students can use the internet to find information in their own language, then present the information to you in English.

Writing**Spelling: e – the most common letter**

- Do **1–4** individually. Check answers for **1** and **2** by reading the word aloud and asking students to raise their hand when they think the *e* is required. Ask students to say the answers for **3** and **4**.
- Do **5**. Students should take turns finding words with *e*. Students who are giving the spelling should try to do it without reading.

- 0π 1** 1, 3, 4, 7, 8
- 2** 1, 4, 5, 8
- 3** 1 between the second *i* and the *l*
 2 between the *i* and the *s*
 3 at the end
 4 between the *m* and the *n*
 5 between the second *l* and the *r*
 6 between the *n* and the *y*
 7 at the beginning
- | | | | |
|---------------|------|------|------|
| 4 1 ea | 3 ee | 5 ee | 7 ea |
| 2 ee | 4 ee | 6 ee | 8 ea |

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

3 Downstream

Background

The downstream oil business starts when crude oil is made into useful products at a **refinery**. Refining is also used in other industries, for example in the sugar industry. However, refining crude oil is a completely different process. The crude oil refining process uses **distillation**. Distillation is also used in making alcoholic beverages to separate alcohol and water. In an oil refinery, the crude oil is heated to its boiling point at the bottom of a high steel tower to release gases and vapours. Different compounds in the crude oil condense and are collected at different levels on trays in the tower and sent by pipes through various processes and to remove contaminants. The liquids are sent to a blending plant where they are mixed and stored in large tanks for sale. Products range from gas liquefied under pressure and sold for domestic heating and cooking, to various grades of fuel for cars, trucks, and aeroplanes, heating oil, lubricating oil, and bitumen for road surfaces. Some refineries are close to chemical plants and provide feedstock for plastics, fertilizers, paint, and other chemicals. More detail on crude oil refinery processes can be found in Unit 13.

The downstream gas sector comprises the storage of **liquefied natural gas (LNG)** as described in Unit 9 and the **distribution** of gas to consumers. Distribution of gas is

either directly to consumers including individual homes, by a network of pipelines from the upstream sector, or from liquefied petroleum gas (LPG), liquefied under pressure and sold in metal cylinders.

The price of oil and gas to consumers is volatile. The price of crude oil depends on the amount of bitumen and sulphur it contains. Crude from the North Sea and Texas commands a higher price than Middle East crude. However, price fluctuations have been much higher due to global economics and political unrest in producing countries. In 1998, the crude oil price reached a low of under \$12 per barrel and peaked at over \$120 a barrel in 2008. This makes it difficult for companies to make investment decisions.

To improve security of supply, governments create strategic storage of oil. The United States has over four billion barrels of refined oil in strategic oil reserve, enough for 200 days' consumption. In addition, one-third of its supply is produced domestically.

The downstream business extends to the sale of the final products including the retail sale of motor fuel and heating oil and gas. In many countries, petrol is highly taxed since it is a necessary commodity for most people and because governments need to discourage waste and environmental pollution.

* Tip

Sometimes storage, marketing, and transport of petroleum products are called midstream processes. But midstream operations are usually included in the downstream category.

* Tip

tanker – any vehicle that carries liquid petroleum products in a tank, including road tankers, rail tankers, and tanker ships

Kick off

- Revise upstream jobs from Unit 2 by doing **1**. Elicit answers as necessary. Do **2** in groups. Check answers by asking individual students to say them.

0π 1 Possible answers

- A driller supervises a drilling crew and controls drilling equipment.
- A geologist studies rocks and looks for rocks that can hold hydrocarbons.
- A production operator checks and operates production equipment.
- A roughneck works in a drilling crew under the driller's supervision.

2 1 all

2 Possible answers

- Most plastic things e.g. combs, toothbrushes, TV cabinets, paints, ink, lubricating oils, soap, cosmetics (e.g. lipstick, shampoo, deodorant), eyeglasses, medicines (e.g. aspirin), nylon, glues, solvents, tar, candles
- 3 They're checking data.
- 4 He's unloading petrol.
- 5 He's looking for leaks.

Additional activity

Practise the Present Continuous forms by playing charades. Mime actions like driving, unloading petrol, and having lunch. Students guess what you're doing by asking, e.g. *Are you using a computer? Are you driving?* Students do this in small groups. They can activate language beyond oil and gas, for example drinking, eating, watching TV, etc.

* Tip

ethylene – the most produced carbon compound in the world. Demand and production increase every year. It is used in a wide variety of ways, the most familiar being in the form of polyethylene plastic products like bags and films used in packaging.

Language spot

Present Continuous

- Do **1** and **2** with the class. Do **3** and **4** in pairs. Do **5** with the whole class.

- 0-π**
- 1** 1 Yes, he does.
2 No, he isn't.
3 He drives a petrol tanker.
4 He's unloading petrol.
- 2** am / is / are
- 4** 1 A Where are you now?
B I'm at the refinery.
A Are you working?
B No. I'm having a break.
2 A Where is he now?
B He's outside.
A Is he repairing something?
B No. He's looking for leaks.
3 A Where are they now?
B They're at the plant.
A Are they collecting data?
B No. They're testing pipes.
4 A Where is she now?
B She's in the manager's office.
A Is she talking to the manager?
B No. She's waiting for him.

It's my job

- Do **1** with the class, brainstorming and / or eliciting answers before reading. Students then read individually and mark the places in the text that give answers.
- Do **2** in groups. Circulate and monitor. Then ask one student from each group to share their group's answers to one of the questions.

- 0-π**
- 1** 1 They produce chemicals from hydrocarbons.
2 Operators control production (using computers, radios, and telephones).
3 Plants work 24 hours a day.
- 2** 1 It produces ethylene and other chemicals. These chemicals are important because many industries use them.
2 computer skills, technical skills, communication skills
3 84

Writing

Messages

- Do **1** individually. Check answers in pairs, then with the class.
- Do **2** individually. Check answers in pairs, then with the class.

Key

1

1 **Message from Mark**
To George
Message Can you call him today? / Please call him today.

2 **Message from Dan**
To George
Message He thanks you for your message.

3 **Message from Bob**
To George
Message He's having trouble with his hand-held computer.

4 **Message from Jin**
To George
Message They need some help with their new computers.

2

1 **Message from Dan**
To Faisal
Message Please send him file A407.

2 **Message from Bob**
To Faisal
Message He's visiting the refinery today.

3 **Message from Jin**
To Faisal
Message He can't meet you today.

Speaking

Making and taking calls

- Do **1** individually. Students sit or stand back-to-back so that they do the exercise by speaking and listening only, as if they were on the phone. Check answers by having a pair of students perform the conversation.
- Do **2** in pairs. Encourage students to speak the conversation rather than simply reading it. Ask them to (a) look at the book; (b) look up and speak; (c) look at the book only when they need to remind themselves of the words.
- Do **3** in pairs.

Key

1 Hello	6 take	11 phone number
2 that	7 This	12 I'll give
3 This	8 from	13 Thank
4 speak	9 from	
5 's talking	10 about	

3

1 Student A:
To *Bill Jones*
From (*Student's name*)
Of (*company* / department) *HR*
Message *He thanks you for repairing his computer. It is working well.*
Date (*today's date*)
Time (*time now*)

2 Student B:
 To *Faisal Hamdi*
 From (*Student's name*)
 Of (*company* / department) *Technical Support*
 Message *Do you need any new equipment?*
 Date (*today's date*)
 Time (*time now*)

* Tip

In 2010, the leading petrochemical companies in the world were

- BASF (Germany)
 - Dow Chemical (USA)
 - ExxonMobil Chemical (USA)
 - LyondellBasell Industries (Netherlands)
 - INEOS (UK)
 - Saudi Basic Industries Corporation (Saudi Arabia)
 - Formosa Plastics Corporation (Taiwan)
 - Sumitomo Chemical (Japan)
 - DuPont (USA)
 - Chevron Phillips (USA)
 - Reliance Industries (India).
- (source: arabianoilandgas.com)

Reading

News

- Do **1**. Assign each student article A or article B. Students read the article individually.
- Do **2**. Make groups of two Student As and two Student Bs. The As tell the Bs about their article and vice versa. To check answers, call on some Student Bs to explain article A and some Student As to explain article B.
- Do **3** individually. Circulate and monitor. Then ask students to share their answers in small groups. Finally, call on a few students to tell the class what the other members of their group talked about.

Key 1 Possible answers

- A 1 Petrochemical production is going up in many countries in Asia and the Middle East.
 2 These countries are building new petrochemical plants because it is good for business and good for employment.
- B 1 Gas production is going up in all regions of the world.
 2 Petrochemical plants use a lot of gas, and this industry is growing. Many other industries prefer gas because oil is expensive and produces more CO₂.

Pronunciation

-  Do **1**. Do **2** with the class. Then go round the room, each student saying a word in turn. Do **3** in the same way.
- Do **4** in pairs. Circulate and monitor. Assist with correct word stress where necessary.

Key 1	1 <u>E</u> urope	7 <u>co</u> mpany	13 UAE
	2 <u>Q</u> atar	8 <u>in</u> dustry	14 CO ₂
	3 <u>b</u> usiness	9 <u>A</u> frica	15 <u>M</u> iddle <u>E</u> ast
	4 <u>b</u> ecause	10 <u>e</u> xample	16 <u>p</u> etrochemical
	5 <u>I</u> ran	11 <u>pr</u> oducer	17 <u>e</u> nvironment
	6 <u>p</u> refer	12 <u>im</u> portant	18 <u>r</u> efinery
3	1 <u>c</u> ountries	6 <u>r</u> easons	11 <u>i</u> ncreasing
	2 <u>p</u> rices	7 <u>p</u> er <u>ce</u> nt	12 <u>s</u> eparate
	3 <u>p</u> eople	8 <u>e</u> xpensive	13 <u>c</u> hemicals
	4 <u>b</u> efore	9 <u>A</u> rabia	14 <u>e</u> thylene
	5 <u>p</u> roduce	10 <u>e</u> mployment	

Additional activity

Do the Unit 3 communication activity on Teacher's Resource Book p.83.

Number talk**Calculating**

- Do **1** individually, then check answers with the class.
-  Do **2** individually. Check answers by doing **3** in pairs.
- Do **4** individually. Then check answers with the class.

0-π	1	1 +	5 =
		2 -	6 %
		3 ×	7 .
		4 ÷	8 √
2	1	54 ÷ 9 = 6	4 3,000 × 15% = 450
	2	31 + 14 + 24.5 = 69.5	5 √81 = 9
	3	380 - 45.3 = 334.7	Yes, they are all correct.
4	1	Three times twelve equals thirty-six.	
	2	Thirty thousand minus eighteen thousand five hundred equals twenty-one thousand five hundred.	
	3	Thirty-two thousand divided by eight thousand equals four thousand.	
	4	Six point two million plus ten point seven five million equals sixteen point nine five million.	

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

4 Safety first

Background

The main causes of accidents in the workplace are not dramatic fires and explosions, but very ordinary accidents that can be easily prevented by workers looking out for their own safety and the safety of others. Many of these accidents are minor, but some cause death or serious injury. The most common cause of accidents is from slips, trips, and falls, followed by lifting and carrying. Accidents involving cuts, burns, dropped objects, falling from height, and collisions are also common but often avoidable.

The main preventable measure is **safety training**. All employees in the oil and gas industry go through regular safety training courses to encourage a strong safety culture. For hazardous areas, employees will be issued with **Personal Protective Equipment (PPE)** which must be worn in signed areas. Safety boots, hard hats, overalls, gloves, and safety glasses are usually a standard issue. In addition, ear protectors and special trades' equipment such as welding shields, goggles, and gloves will be issued.

Safety signage has to be followed. Signs are classified with different shapes and colours to denote whether they are mandatory, warnings, or giving information. Most signs are independent of language and use standard symbols as ideograms. The meaning of some of these signs is not always immediately obvious and so they should be learnt. Following information signs is practised in fire drills

where workers must follow signs to safe areas. Those working offshore will attend special courses on helicopter escape, use of life jackets and survival craft, and escape through smoke. There are often opportunities for workers to volunteer as fire officers or first aiders, and special training is given.

Safety cultures are different in every country and those workers from countries with a high safety culture may not be sure how to act when they see unsafe conditions or acts where the safety culture is lower. A good guide is never to intervene unless there is imminent danger, but always to report to your supervisor or to an agreed point of contact.

When workers are assigned particular tasks, it is good practice for supervisors to give **toolbox talks**. These are talks at the working area usually at the beginning of a shift. Supervisors have the opportunity to point out particular hazards and remind workers of current safety initiatives. Most tasks will require the supervisor to carry out a generic or a specific risk assessment for a task. If special hazards are involved, a task may require a Permit to Work, where special procedures may need to be followed. A permit would be required where there is the risk of exposure to petroleum vapour and a source of ignition such as a welding operation.

* Tip

fumes – smoke or gases that smell bad or are harmful if you breathe them

Kick off

- Do **1** as a class. Students do **2** individually. Check answers by asking students to read the sentences aloud. Do **3** as a class. Ask students to call out the PPE they can see in the pictures.

- 0π 2**
- 1 head
 - 2 face
 - 3 feet
 - 4 ear protectors
 - 5 gloves
 - 6 goggles
 - 7 respirator
 - 8 safety harness
- 3**
- Page 23: hard hats
 - Page 24: hard hat, safety harness
 - Page 25: hard hats, boots
 - Page 26: hard hats

Additional activity*(stronger students)*

Teach or elicit *electrician* (a person who installs and repairs electrical systems and equipment), *plumber* (a person who repairs water pipes and heating systems), *builder* (a person who makes or repairs buildings). Ask *What are the hazards for each job?* (All: electric shock; builder: falling or being hit by falling objects; plumber: causing water damage to property.) What does each worker do before starting work? (Turn off electrical supply. Turn off water supply. Wear PPE.)

Reading**Safety signs**

- Do **1** as a class. Students do **2** individually. Check answers by asking students to read sentences aloud.
- Do **3** in class. Students do **4** in pairs. Check answers by asking students to say them.

0π 1

- 1 It's a blue and white circle.
- 2 It's a green and white square.
- 3 It's a red and white circle.
- 4 It's a black and yellow triangle.
- 5 It's a blue and white circle.
- 6 It's a black and yellow triangle.
- 7 It's a green and white square.
- 8 It's a red and white circle.

2 1 b 2 c 3 d 4 a

3

- 1 Wear goggles
- 2 This way to the emergency exit
- 3 Don't smoke here
- 4 Danger! Overhead crane
- 5 Read the instructions before using
- 6 Danger! High voltage
- 7 Life jackets are here
- 8 Do not switch off

4 Electricity can give you a dangerous shock.
Chemicals can poison you, burn your skin, or damage your eyes.
Hot things can burn you.
Natural gas can cause a fire or explosion. Some gases can poison you.
Machines can cut or injure you.
Noise can damage your ears.
Falling objects can hit you.
Slippery surfaces can cause falls. / You can easily fall on a slippery surface.

Additional activity

Ask students to note any safety signs they notice in everyday life. Do they use words or symbols? What do the signs mean (in English)? Can they find any examples that are unclear? Why are they unclear? Ask students also to notice hazards in daily life. Can they name any hazards that should be marked with signs but aren't?

Speaking**What does it mean?**

- Do **1** and **2** in pairs. Students who finish **2** first can do **3**.

0π 2 Student A	Student B
Wear a hard hat.	Do not touch.
Hot surface.	Wear ear protectors.
Do not enter.	Emergency stop button.
Emergency fire exit.	Slippery surface.

It's my job

-  Do **1** as a class. Do **2** individually. Check answers by asking a couple of students.
- Do **3** in groups. Students take turns saying the answers to the group. Check by asking students to say their answers.
- Do **4** in groups. Ask a few students to say their answers for the class.

- Key**
- 2**
- 1 the top picture
 - 2 He says safety is important to him, and he always wears a safety harness.
- 3**
- 1 He often works in high places.
 - 2 He always wears a safety harness.
 - 3 Riggers lift things and move things.
 - 4 First they estimate the weight and size of the load.
 - 5 Then they decide how they can move it.
 - 6 They put the load in the sling.
 - 7 Every day the supervisor talks about safety.
 - 8 There are a lot of hazards in his job.

* Tip

depth – the distance down from the top surface of something (e.g. *the oil well is 100 metres deep*) and also the distance from the front to the back of something (*the tunnel has a horizontal depth of one kilometre into the mountain or the shelf is 30 centimetres deep*)

Number talk

Weights and measures

- Do **1** individually. Check answers by asking students to say them.
-  Do **2** as a class. Go around the class with students taking turns saying words. If students need practice or if it's difficult, go around the room several times.
- Do **3** in groups. See which group can name the most things for each measurement.
- Do **4** in pairs. Then try to reach a consensus with the class on the answers. Do **5** as a class.

- Key**
- | | | | |
|----------|-----|------|------|
| 1 | 1 g | 4 mm | 7 km |
| | 2 k | 5 cm | |
| | 3 t | 6 m | |

3 Possible answers

We measure the...

- length of pipes, cables, bolts, and screws.
- width of roads, entrances, and vehicles.
- height of people and rigs.
- depth of wells.
- weight of loads.
- speed of vehicles.

- 5**
- 1 maximum speed twenty kph
 - 2 maximum height 3.5 metres
 - 3 maximum width 2.2 metres
 - 4 maximum weight five tonnes
 - 5 maximum length 9.2 metres

Vocabulary

Which kind of word?

- Teach or elicit the meanings of *noun* (a person, place, or thing), *verb* (an action or state), and *adjective* (a word that tells more about a noun). Do **1** as a class.
- Do **2** individually. Check answers in pairs, then as a class.
- Do **3** individually. Check answers by asking students to read sentences aloud.
- Do **4** as a class.

- 0-π 1** Nouns: operator, crane, Canada
Verbs: operates, lives
Adjectives: good, Canadian
- | | |
|-----------------|-------------|
| 2 1 wide | 4 protect |
| 2 safety | 5 calculate |
| 3 hazard | 6 driller |
| 3 1 safe | 5 hazards |
| 2 Italian | 6 deep |
| 3 calculator | 7 employer |
| 4 produce | |
- 4** 1 What does it mean?
2 How do you pronounce it?
3 Is it a noun or a verb?
4 How do you spell it?
5 Which is the stressed part?
The glossary answers all these questions.

* Tip

toolbox talk – sometimes abbreviated as TBT, a safety meeting held in the workplace to talk about hazards, safety equipment, and good working practices. Examples of toolbox talks can be found online at www.healthandsafetytips.co.uk/Toolbox_Talks.htm

Listening

A toolbox talk

- Do **1** in pairs, then check answers as a class.
-  Do **2** and **3** individually, then check answers as a class.
- Do **4** in groups, then check answers as a class.

- 0-π 1 Possible answers**
- 1 The man is standing under the load. The sling is broken, and the load is falling towards him.
 - 2 The load is swinging towards the man.
 - 3 The man's hand is between the load and the sling. This is dangerous because the crane is starting to lift the load.
 - 4 The crane is lifting a heavy load and falling over towards the man.
- 2** 1, 2, 3
- 3** 1 Don't stand / Never stand
2 You must never try
3 Be careful
4 both arms out left and right
5 One man must
- 4** 2 Look out! / Watch out! The load's swinging!
3 Let go! The load's going up!
4 Look out! / Watch out! / Get out of the way! The crane's falling!

* Tip

Modal verbs (also called *modal auxiliaries* or just plain *modals*) are used with *main verbs* for expressing possibility, permission, necessity, etc.

Additional activity

Do the Unit 4 communication activity on Teacher's Resource Book p.85.

Additional activity

The website www.transport.gov.za/library/legislation/roadtraffic/Prohibition_Signs_Detail.html has a comprehensive selection of road signs used in South Africa. Make these into flashcards and see if students can guess or say the meaning of each one. This could be done as a team game. The team that guesses the meaning of a sign correctly first gets a point. The team that gets the most points wins.

Additional activity

Do *Writing bank 4* on Student's Book p.55.

Language spot

Modal verb: can

- Do **1** as a class.
- Do **2** in pairs. Circulate and monitor, giving assistance when necessary.
- Do **3** in groups. Then check answers as a class.

- 0-π 1**
- A Can
B can't, can, can't
- 2**
- 1 No, it can't. It can hold 500 litres, but it can't hold 600 litres.
 - 2 No, it can't. It can take a 5.5-tonne truck, but it can't take a six-tonne truck.
 - 3 No, it can't. It can lift 6,500 kilos, but it can't lift 7,000 kilos.
 - 4 No, it can't. It can do 20 kph, but it can't do 30 kph.
- 3**
- 3 Can I use your phone?
 - 4 Can I take off my PPE?
 - 5 Can you help me with this pipe?
 - 6 Can you show me how to use the safety harness?

Modal verb: must

- Read the example for **4**. Do the exercise in groups. Check answers by asking students to say them.

- 0-π 4**
- 1 You must wear a hard hat in this area.
 - 2 You mustn't run here.
 - 3 You must switch the machine off when not in use / when you aren't using it.
 - 4 You mustn't smoke here.
 - 5 You must wear safety boots.
 - 6 You mustn't use ladders here.

Writing

Spelling and notices

- Do **1** and **2** individually. Then compare answers in groups. Finally check answers by asking students to say them.

- 0-π 1**
- | | | |
|--------|-----------|------------|
| 1 o | 5 e, e, e | 9 a, a |
| 2 ua | 6 i, e | 10 ea / ou |
| 3 u, a | 7 ia, e | |
| 4 a, e | 8 e, a, e | |
- 2 Possible answers**
- 1 On a wall or a board near the slippery surface:
Danger. Slippery surface
 - 2 On the machine:
Do not use this machine
 - 3 On or very near the exit:
Do not block fire exits / Keep fire exits clear
 - 4 At the entrance:
Visitors must wear hard hats

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

5 Finding oil and gas

Background

Oil companies employ geologists to identify areas where oil and gas may be recovered. By studying how the earth and oceans were millions of years ago and how they have changed, geologists can predict where there are **reservoirs** of oil and gas that can be commercially recovered. Oil company scientists and engineers use special measuring devices to **survey** these areas. The results are analysed and a decision is made whether to drill and gather more data. Most of the exploration work is carried out by company personnel to retain confidentiality. There is competition between oil companies and political sensitivity which must be considered. However, specialist drilling contractors are employed when exploratory drilling starts. The techniques used to collect this data are becoming more sophisticated as the search becomes more difficult for remaining reserves that are becoming less accessible in more challenging environments. In **seismic surveying**, sound energy generated by special vibrators or small explosives is reflected back to its source when it meets a different geological formation. Arrays of receivers, called

geophones, pick up the reflected signal. The time taken for the reflection to be recorded is measured. Computers process the signals and analyse and display the depth and the nature of the boundary. The geophone array may comprise many hundreds of geophones and will require a large team of surveyors supported by large teams using a **Global Positioning System (GPS)** over wide areas, often in desert environments. Marine surveys are carried out using vessels towing **hydrophones** fitted to cables or streamers, or by Ocean Bottom Cable in shallower water.

Large surveys must take into account the ecological disturbance they may cause, not only in mobilizing and sustaining large survey teams on land but also in generating signals at sea that can disturb and confuse marine life. Marine surveys in environmentally sensitive areas are subject to strict controls. Sakhalin Island is a breeding ground for the Western Gray Whale and Sakhalin Energy Investment Corporation, operators of platforms off the island with the Russian government, are committed to minimize any potential environmental risks in their survey work.

* Tip

geology – the study of rocks and soil, and of their development

physics – the scientific study of natural forces such as light, sound, heat, electricity, pressure, etc.

technology – the study and use of science for practical purposes in industry, etc.

two-dimensional – flat, having no depth, with only length and width

three-dimensional – having length, width, and height

Kick off

- Do **1** as a class. Elicit or explain *geology, physics, technology, two-dimensional, three-dimensional*.
- Do **2** in groups. Check answers by asking students to share their group's ideas.

- Key**
- 1** 1 Page 28 diagram 1, page 29 both diagrams
2 Page 28 diagram 3
3 Page 28 diagram 2, page 29 both diagrams, page 32
4 Page 28 diagrams 1, 2, and 3
5 Page 29 both diagrams, page 32 top diagram

2 Possible answers

- 1 a 3D image of underground rock layers
- 2 different layers of rock
- 3 3D glasses
- 4 geologists and geophysicists
- 5 rock layers that can hold hydrocarbons

Vocabulary

Some science

- Do **1** as a class, then **2** in groups. Check answers by asking students to share their group's ideas. Do **3** individually, then compare answers in pairs. Finally, check answers by asking students to say them.
- Do **4** in groups. Check answers by asking students to share their group's ideas.

- Key 1**
- A geologist studies rocks and rock layers.
 - A physicist studies things like heat, light, and sound.
 - A geophysicist uses physics to study geology.
- 2**
- 1 porous rock
 - 2 non-porous rock
 - 3 because gas is very light
 - 4 because it can't go through the non-porous rock
- 3**
- 1 sound waves
 - 2 electrical signals
- 4**
- 1 a mirror / glass / water
 - 2 electromagnetic waves, such as light waves and radio waves; mechanical waves, such as sound waves and ocean waves
 - 3 light and radio waves
 - 4 sound waves

* Tip

seismic – connected with or caused by earthquakes or other vibrations in the earth

Additional activity

(stronger students)

With the class, brainstorm words that begin with *geo*. Elicit *geology*, *geologist*, *geophone*, *geophysics*. Ask if anyone knows what *geo* means (it means *earth*). The text talks about *hydrophones*. Can anyone guess what *hydro* means? (It means *water*.) Can they guess the meaning of *hydrology* (the study of the earth's water), *hydrologist* (a person who studies water and its movement), and *hydrophysics* (the study of the physical properties of water)? Finally, elicit or teach that the suffix *logy* means *the study of*, and the suffix *phone* usually means *sound*.

Reading

Seismic exploration

- Direct students' attention to the diagram. Do **1** and **2** as a class.
- Students read the text and do **3** individually. Check by asking students to say their answers.
- Do **4** individually. Check by asking students to say their answers.
- Do **5** and **6** in pairs. Check answers by asking students to say one step of the process at a time.

- Key 1 Possible answers**
- We sometimes find oil traps below non-porous rock layers (see diagram 1 on p.28).
- In the trap, there is porous rock containing oil and gas.
- The oil and gas are there because they can't go up through the non-porous rock.
- 3**
- | | | |
|-----|-----|-----|
| 1 F | 3 T | 5 T |
| 2 F | 4 F | 6 F |
- 4**
- In paragraphs 1 and 2, *they* means oil companies.
 - In paragraph 3, *they* means seismic waves.
 - In paragraph 5, *they* means geophones.
 - In paragraph 6, *they* means crews at sea.

5 Possible answers

- 1 Vibrator trucks make seismic waves.
- 2 The waves go down through the rock layers.
- 3 The rock layers reflect the waves. The reflected waves come up to the surface.
- 4 Geophones convert the waves to electrical signals.
- 5 A machine in the recording truck records the signals.
- 6 (Not in the diagram) Computers convert the signals into maps.

6 Possible answer

An underwater gun makes seismic waves.
 The waves go down through the water and the rock layers.
 The rock layers reflect the waves.
 The reflected waves come up to the surface.
 Hydrophones on the surface convert the waves to electrical signals.
 A machine on the boat records the signals.
 Computers convert the signals into maps.

Additional activity

(stronger students)

After doing **1**, ask if any students have sat nav in their car. Does it work well? Has it ever caused them to make a wrong turn?

It's my job

-  Do **1** in groups. Play the recording to check answers.
- Do **2** and **3** individually, then check answers in pairs. Then play the recording to check answers with the class.
- Do **4** in groups. Play the recording to check answers.

- 0-π 1**
- 1 a geophone
 - 2 a GPS unit
 - 3 to find his exact position / to find the right place for the geophone
- 2**
- 1 He works in a seismic crew. He places and removes the geophones.
 - 2 He must put the geophones in the right place / read the data carefully.
 - 3 by radio
 - 4 He must walk a lot, carrying heavy things, and he often works in hot weather and difficult places.
- 3**
- 1 outside, places
 - 2 team
 - 3 money

Additional activity

(stronger students)

Write this sentence on the board: *I'm giving you the money.* First, underline the *I* and say the sentence stressing that word. Then add this sentence: *Ali isn't giving you them money, I am.* Next underline *giving*. In groups, ask students to come up with a sentence that helps explain the different meaning of stressing *I'm*, *giving*, *you*, and *money*. For *giving*, teach or eliciting *lending*.

Possible answers

giving = I'm not lending it to you.
you = I'm not giving it to your brother.
money = I'm giving you the money, not the radio.

Pronunciation

- Do **1** individually. Check by asking students to say their answers. Give several students a chance to read out each sentence with the correct stress.
- Do **2** as a class, in chorus. The stress may be somewhat exaggerated doing it this way, but that will help students understand it clearly.
- Do **3** as a class. If all of your students are native speakers of the same language, this won't take long. If you have more than one native language represented, ask students to tell the class about their own language.
- Do **4** individually.
- Do **5** as a class. Stop the recording after each sentence. Ask students to identify the stressed words. Students who underlined different words in the previous exercise should try to explain why they chose different words. Make sure they understand that different stress is not necessarily wrong: it depends on what the speaker thinks is most important for the meaning of the sentence. It also depends on speed: people sometimes speak quickly, stressing just one important word in the sentence, or they can speak with a slower rhythm, stressing two or more words, with equal time between each stress.

- 0-π 1**
- 1 That's very important.
 - 2 So we all have a GPS unit.
 - 3 The GPS tells you your exact position.
 - 4 We read the data carefully to get the position right.
- 5**
- 1 This job can be hard work.
 - 2 You're walking a lot, and carrying heavy things.
 - 3 So you must be fit.
 - 4 I like the job.
 - 5 I like it for two reasons.
 - 6 I love being outside and seeing different places.
 - 7 And I like working in a team.
 - 8 And the money's good too.
 - 9 That's three reasons, isn't it!?

* Tip

porous – allowing liquid or air to pass through slowly

Language spot

Words in sentences

- Call the class's attention to the box that explains parts of speech. Explain or elicit their meaning as necessary. It may be useful to go over the *Grammar reference* on p.120.
- Do **1** individually. Check by asking students to say their answers. Do **2** as a class. Assign each student an item (1–6) to find an example for. Then ask them to compare answers with other students who were assigned the same number. Finally, check by asking students to say their answers.
- Do **3–5** individually. Check by asking students to say their answers.

- 0-π 1**
- 1 Faisal = noun, usually = adverb, quickly = adverb
The sentence is a statement.
 - 2 He = pronoun, it = pronoun, good = adjective
The sentence is a statement.
 - 3 desert = noun, summer = noun
The sentence is a statement.
 - 4 Is = verb, new = adjective, radio = noun
The sentence is a question.

- | | |
|---|----------------------------|
| 2 1 Sentences 1, 2, and 3 | 4 Sentences 1, 2, 3, 4 |
| 2 Sentences 2, 3, and 4 | 5 Sentences 3 and 4 |
| 3 Sentence 1 | 6 Example sentence |
| 3 1 before <i>rocks</i> | 4 at the end |
| 2 after <i>mirrors</i> | 5 before <i>position</i> |
| 3 at the end | |
| 4 1 He is helping them. | 4 He has a message for us. |
| 2 They can talk to him by radio. | 5 She has the forms. |
| 3 We don't like hot weather. | |
| 5 1 The geologist is talking to him. | |
| 2 Read the seismic data carefully. | |
| 3 Can you help me? | |
| 4 I have a job at the refinery. | |
| 5 It's a good job and I like it. / I like it and it's a good job. | |

Additional activity

Do *Writing bank 5* on Student's Book p.56.

Writing

Writing sentences

- Revise the meaning of *capital letter*, *full stop*, *question mark*, and *exclamation mark*. Teach or elicit that a letter that isn't capital is *lower case*. Students do the exercise individually, then check their answers in pairs. Finally, go over the entire text with the class.

Key Sentences always begin with a capital letter. Statements always have a full stop at the end. Questions have a question mark. Imperatives have a full stop or sometimes an exclamation mark. Why is this important? It is important because it helps us to understand sentences. Some nouns always have capital letters too. The names of people and places are two examples.

* Tip

latitude – the distance of a place north or south of the equator. The equator is 0° north and 0° south latitude. The north pole is 90° north latitude and the south pole is 90° south latitude

longitude – the distance of a place east or west of the Greenwich meridian, which is 0° east and west longitude

coordinates – two numbers used to fix the position of a point on the earth, or on a map or graph

bearing – the angle, measured in a clockwise direction, of a distant point, relative to a reference direction

heading – the direction in which a vehicle is pointing, expressed in degrees from north

waypoint – a predetermined position on a route

Additional activity

Do the Unit 5 communication activity on Teacher's Resource Book p.87.

Number talk

Global positioning

- Do **1** and **2** with the class. Do **3** individually. Check by asking students to say their answers. Then practise the conversation in pairs.

Key

1 a satellite	d longitude
b signal	e latitude
c receiver	
2 N = North	
S = South	
E = East	
W = West	
322° = three hundred and twenty-two degrees	
LAT = latitude	
LON = longitude	
54.9220° = fifty-four point nine two two zero degrees	
3 1 position	4 heading
2 coordinates	5 bearing
3 waypoint	

Listening

How to use GPS

-  Do **1** individually. Check by asking students to say their answers. Do **2** in pairs.

- Key 1**
- a waypoints
 - b three
 - c coordinates
 - d waypoint
 - e the pointer to the waypoint

Speaking

Discussing specs

- Do **1** individually. Check by asking students to say their answers.
- Do **2** in pairs. Circulate and monitor.
- Do **3** in pairs. Check by asking students to say their answers.

- Key 1**
- 1** How many channels does it have?
 - What are the dimensions?
 - What's the weight? / How much does it weigh?
 - What's the colour? / What colour is it?
 - What (material) is it made of?
 - What's its maximum range?
 - What's the battery life? / How long does the battery last?
 - Is it water resistant?
 - Is it shock resistant?
 - Is it sand and dust resistant?
 - Is there / Does it have a separate clip-on microphone?
 - Is there / Does it have a display screen?
 - What controls does it have / are there?

3 Possible answer

We think the best radio for Sandro is the SP90.
 He needs a water-resistant radio, and the R40 is not water-resistant.
 The SP 90 is light – only 170 grams.
 It doesn't have a long range, but he doesn't need a long-range radio.
 The SP90 has a separate microphone, so he can use his hands while he talks.
 He needs a battery life of 36 hours, so the R40 is no good for him.

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

6 Drilling

Background

Wells are drilled using a **drill bit** – toothed wheels which turn and crush the rock. The bit is attached to a **drill string**, which also turns and is lowered from the surface. The drill string is made up of pipes each around ten metres long and screwed together. There may be around a hundred pipes in a drill string. The drill string is connected to a **kelly**, which is a square or hexagonal pipe which slides through the **rotary table**. The rotary table rotates the kelly and is turned by a powerful drive motor. The drilling **derrick** is a tall structure with a hoist of two pulleys, the crown block, fixed to the top of the derrick, and the travelling block supporting the kelly. This hoist lowers and raises the drill pipe in the well. As the well is drilled, more sections of pipe are added. Some modern rigs use a top drive to turn the pipe instead of a kelly and rotary table because it can be safer and more efficient. **Drilling mud** is pumped through the kelly and drill string to the drill bit to lubricate and cool the cutting area. It returns through the outside of the drill pipe carrying the drill cuttings and providing pressure between the drill pipe and the sides of the well. There is equipment to handle, mix, store, and pump the mud, and separate the mud and cuttings. The mud is a mixture of clay and special additives. Equipment is also used to lift and handle the pipe from the pipe rack where the pipe is stored.

A production well will then go through the **completion stage**. Casing and liners are inserted and the pipes and valves are cemented at the top of the well to connect to the flow lines at the surface. The oil-bearing rock is ‘fragmented’ or stimulated by acids or explosive caps to stimulate the flow of oil. A **blow-out preventer** is installed at the surface to control and shut off the flow in an emergency.

Although drilling equipment has become more automated, there is still a lot of hard manual labour involved, carried out by **roustabouts**, and more skilled manual work by **roughnecks**. The team is supervised by the **driller** who manages day-to-day operations and maintenance, with overall management by a **toolpusher**. The **derrickman** looks after the mud equipment and works, when required, at height on the derrick assisting pipe handling. Modern equipment may incorporate a driller’s chair which is a control station with joystick controls and a complete view of the drill floor.

Drilling operations require good teamwork and experienced workers. Working with expensive equipment requires an experienced, reliable, and punctual team used to following instructions and with a high regard for their own safety and the safety of others.

Additional activity

(stronger students)

See how much of the new drilling vocabulary students can remember. Put them in pairs or groups of three. Without looking at their books, can they recreate the diagram of the drilling rig, including all the labels? Give them five minutes to produce a labelled drawing. Put the drawings on the wall. Have the class vote on which drawing is the best.

Kick off

- Do **1** in groups. Check by asking students to say their answers.
- 🗣️ Do **2** individually. Do **3** to check answers.
- Do **4** as a class. Note a few guesses on the board. Students shouldn’t look for the answer now, but should wait to find out later in the unit. (The correct answer is in *Language spot*: 10,685 metres.)

- 🔑 **1**
- 1 the drill bit
 - 2 the drill string
 - 3 the pipe rack
 - 4 the derrick
 - 5 It rotates the drill string.
 - 6 water, clay, weighting material, and chemicals
 - 7 the mud pump
 - 8 rock cuttings
 - 9 because a long drill string is very heavy

Additional activity

Do the Unit 6 communication activity on Teacher's Resource Book p.89.

- | | |
|----------------|-----------------|
| 3 1 mud pump | 5 rock cuttings |
| 2 mud tank | 6 mud screen |
| 3 drill string | 7 mud tank |
| 4 bit | |

Reading

A drilling crew

- Do **1** and **2** individually. Check by asking students to say their answers.
- Do **3** individually. Then ask a few students to explain their choices.

- Key 1**
- roustabouts
 - the rig manager or toolpusher
 - Roustabouts and roughnecks must be strong because they move heavy equipment.
 - the derrickman
 - The driller, because he controls the drilling equipment. For example, he controls the speed of the drill, which must not be too fast or too slow.
 - The rig manager or toolpusher needs a desk for paperwork. He needs a telephone to order equipment, for example.

- | | | |
|-------|-----|-----|
| 3 1 b | 3 c | 5 c |
| 2 a | 4 a | |

* Tip

clay – a type of heavy, sticky earth that becomes hard when it is baked and is used to make things such as pots and bricks. Clay is used to make drilling mud thicker than water, which makes it good for lubricating the drilling equipment.

Listening

Problems and solutions

- Do **1** as a class. Brainstorm examples of thick and thin fluids and write them on the board.
- Do **2** as a class. Ask students to call out the answers. Write them on the board.
- Do **3–5** individually. Do **6** in pairs.

- Key 1** Some possible answers
- | | |
|-------------------------|--------------------|
| <u>Thin</u> | <u>Thick</u> |
| water | honey |
| petrol | crude oil |
| milk | yoghurt |
| cola | cooking oil |
| white spirit | liquid soap |
| 4 1 The cuttings | 6 safe |
| 2 250 | 7 mud on the floor |
| 3 mud pump | 8 clean |
| 4 thick | 9 water |
| 5 2,000 | |

Additional activity

In pairs or groups of three, ask students to make ten sentences about their classroom or school using comparatives, superlatives, and *too*. For example *The classroom is too hot in the summer. Physics is a difficult class, but English is more difficult.*

When they have finished, ask a few students to share some of the sentences their group wrote.

* Tip

H_2S – hydrogen sulphide, a colourless, toxic, flammable gas that occurs in natural gas, volcanic gases, and some well water

Language spot

Adjective forms

- Do **1** individually. Check by asking students to say their answers.
- Do **2** as a class. Ask students to read sentences a–d aloud in turn. Agree on answers to 1 and 2.
- Do **3** individually. Check by asking students to say their answers. Then put students in pairs to practise reading out the conversations. Encourage them to first read their lines silently to themselves, then to look up from the book and say the lines as realistically as possible.
- Do the first part of **4** individually. Check by asking students to say their answers. Then do the second part of **4** in groups. Check by asking students to say their answers.
- Do **5** as a class. Ask students to read the example sentences aloud in turn. Agree on answers to 1 and 2.
- Do **6** individually. Check in pairs, then check with the class by asking students to say their answers.

Key	1	1 c	6 g	11 m
		2 e	7 i	12 n
		3 b	8 d	13 l
		4 a	9 h	14 k
		5 j	10 f	

2 1 a and b mean the same; c and d mean the same.

2 We add *-er* to short adjectives but we add *more* to longer adjectives.

3 1 big enough, bigger

2 too short, longer

3 too dangerous, safer

4 hot enough, hotter

5 too narrow, wider

4 1 more difficult

2 longer

3 more important

4 colder

5 more dangerous

6 bigger

Some of the discussion questions are a matter of opinion, but the following are factual.

2 A mile is longer than a kilometre.

4 Canada is further north and so colder than the USA.

5 H_2S (hydrogen sulphide) gas is present in some wells. It can kill workers in a few seconds if they are not wearing respirators.

Comparing it with fire is a matter of opinion.

6 Russia is the biggest country in the world, although China has the biggest population.

5 1 the comparative form

2 the superlative form

6 1 most junior, dirtiest

2 oldest, most experienced

3 deepest, biggest

Pronunciation

- Do **1** and **2** individually. Check by asking students to say their answers.
- Do the first part of **3** individually. Check by asking students to say their answers. Then do the second part of **3** in pairs.

0-π **1** 1 roughneck 4 older 7 control
2 dirty 5 crew 8 heavy
3 senior 6 operate

2

/r/	tt
✓	-
-	✓
-	✓

3 1, 3, 5 (both), 6 (both), 8

* Tip

American English and British English use different spellings for some words with double consonants. In an international setting, you and your students may encounter both.

American English British English

dialing	dialling
enroll	enrol
fueling	fuelling
jewelry	jewellery
signaling	signalling
traveler	traveller
traveling	travelling

▣ Additional activity

(stronger students)

Students can search for *unsafe worker image* on the internet to find pictures of workers working unsafely. Ask students to find some images and bring them to class to talk about what workers are doing wrong and what they should do differently.

Writing

Spelling: single and double letters

- Do **1** individually. Check by asking students to say their answers.
- Do **2** as a contest. Ask students to work in pairs. Set a time limit of two minutes. The team that can find the most words wins.

0-π **1** 1 ll, l, ll 5 rr, r, rr
2 g, gg, gg 6 ss, s, s
3 n, nn, nn 7 t, tt, tt
4 p, pp, p

2 Possible answers

ff – off, difficult

tt – cuttings, better, letters

dd – add

ee – screen, between, deep, need, engineer, keep, speed, see, three

oo – cool, choose, floor, too, tool, book, look, loose, good

rr – narrow

Speaking

Giving safety advice

- Do **1** and **2** in groups. Check by asking students to say their answers.
- Do **3** in pairs. Start the exercise off by explaining that you yourself are a new member of the drilling crew and they must decide what advice to give you.

0-π **1** 1 a 2 g 3 h 4 b 5 c 6 e 7 f 8 d 9 j 10 i

2 2 The load might fall on him.

3 He might fall or knock someone down.

4 He might poison himself.

5 He might injure his hands, face, or eyes.

6 Something might fall and injure him.

7 The load might crush him against the wall.

8 He might injure his hand.

9 He might fall.

10 He might injure his back if he doesn't keep it straight.

- 3 2 You shouldn't stand under a load because the load might fall on you.
- 3 You shouldn't run up and down steps because you might fall or knock someone down.
- 4 You shouldn't eat near chemicals because you might poison yourself.
- 5 You shouldn't handle chemicals without PPE because you might injure your hands, face, or eyes.
- 6 You shouldn't walk below people working because something might fall and injure you.
- 7 You shouldn't stand between a wall and a moving load because the load might crush you against the wall.
- 8 You shouldn't use a broken tool because you might injure your hand.
- 9 You shouldn't work without a safety harness because you might fall.
- 10 You should lift correctly and keep your back straight because you might injure your back if you don't keep it straight.

* Tip

The example sentences in *Understanding instructions* are clear and direct. In a working situation, especially when team members may not all be native speakers of English and the environment may be noisy, it's important that information is transmitted as clearly as possible. If these instructions were spoken in a sharp tone of voice, they would sound harsh, but spoken in a neutral voice, they would sound appropriate to the working environment.

Vocabulary

Understanding instructions

- Do **1** individually. Check by asking students to say their answers.
- Do **2** as a class. Ask for volunteers or ask students to explain or mime each word.
- Do **3** in pairs. Circulate, monitor, and give assistance as students work.

OT	1 Clean	5 Move	9 painting
	2 Climb	6 Unload	10 Connect
	3 tighten	7 Stack	11 Pour
	4 dig	8 Guide	12 Inspect

Project

- Do **1** and **2** in groups. Circulate, monitor, and give assistance as necessary. When most of the groups have finished, ask a member of each group to share the ideas that the group talked about.

OT	Score 12–18:	Drilling is not the job for you, but there are many other good jobs in oil and gas.
	Score 19–24:	Most of your answers were <i>No</i> or <i>Maybe</i> , so a different job would be better for you.
	Score: 25–30:	You may be OK in a drilling team, but you may prefer a different job.
	Score: 31–36:	You would be good in a drilling team.

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

7 Pipes and pipelines

Background

Pipes carry the liquids and gases from the wells to platforms, under the sea, across countries, and within refineries. The pipes in refineries and on platforms are carried on large **pipe racks**, which are mainly straight. Different fittings are used to join the pipe, change the size and direction, and connect to the required process units. Pipes are joined using **flanges**. There are various types of flanges, depending on how they are attached to the pipe. Two pipes are joined by bolting the flanges together through holes in the flanges with a gasket between the faces of the flange to provide a seal. Pipe fittings for permanent fixings are **tees**, **elbows**, and **reducers**, which are attached by welding, or by screw threads for small bore pipes.

Process engineers calculate the size of pipe required and the piping scheme between the process units. Layout engineers decide exactly where the process equipment is to be located. Metallurgists check whether any special materials are required and pipe stress engineers calculate the stresses in the pipes, specify the details of the pipe required and how it will be supported. Piping designers use Computer Aided Design (CAD) to visualize the three dimensions they work in. CAD helps to generate the dimensions, select the materials, pipe, and fittings, and produce working drawings for the fabricator. A list of materials called a Material Take Off (MTO), and a three-dimensional drawing called an **isometric** are generated.

The fabricator receives the material from the MTO and makes up as much as possible into pipe spools in the workshop. The pipe spools are transported to the work site and pipefitters and welders complete the erection and construction of the isometric. Welders have to be trained, tested, and certified for the particular welding techniques they can work with.

After the pipe erection is complete, the work is inspected. Critical lines are tested. The welds may be tested for cracks and the whole line may be tested by filling it with water and looking for leaks. Finally, lines may have to be painted or insulated. Steel of different types is mainly used but plastic pipe is used for some chemicals, gas, and drainage, and copper is used for plumbing.

Pipelines carrying oil and gas long distances have to be specially designed for their surrounding environment varying from the deserts of the Middle East to the arctic environment of Alaska. Technical design has to consider such things as how the structure is supported in unstable sand or permafrost, access for maintenance and inspection, corrosion, leak detection, and cleaning. Environmental design has to allow for the protection of habitats, animal migration routes, mud slides, forest fires, and whether to build above or below ground. Marine pipelines are another specialization. Pipeline inspection gauges (sometimes called 'pigs') are used to clean and inspect the insides of pipelines. These are introduced at special stations and move through the pipeline to the next station to remove contaminants and detect and measure corrosion.

* Tip

See top of next page.

Additional activity

(stronger students)

Assign students a pipeline, or allow them to choose one, to find more information about

- where it begins and ends
- how long it is
- what country or countries it goes through
- what it carries
- the year it began service.

Ask students to present their findings to the class.

Kick off

- Do **1** individually. Check by asking students to say their answers.
- Do **2** and **3** in groups. Then ask students to share answers with the class. Write some names of pipelines on the board.

0 π	1 a	4 d	7 h
	2 b	5 e	8 f
	3 g	6 c	

Additional activity

- Put students in groups.
- Give them three minutes to make a list of things they use in everyday life that have welded parts (for example car, bicycle, bus, train, the steel parts in some buildings, etc.).
- Get them to write their lists on the board.
- Check the lists. The group with the most correct items on their list wins.

*** Tip**

A cylinder may also be called a *bottle* or a *tank* (mainly used in American English).

Additional activity

(weaker students)

Play 'safety equipment charades'.

- Write the twelve pieces of safety equipment from *Listening 5* on small pieces of paper.
- Divide the class into two teams.
- Students from alternating teams take turns choosing a piece of safety equipment and miming it. The first team to guess the mime correctly gets a point. At the end, the team with the most points wins.

It's my job

- Do **1** and **2** individually. Check by asking students to say their answers. Do **3** as a class.

- Key**
- 1** 1 pipe-fitters
2 The pipe-fitters cut and prepare them, lay them out, and put all the parts together. They also drill holes for instruments and assemble flanges, elbows, and tees.
3 the pipe-fitters
4 test them
5 electric shock, burns, smoke
- 2** 1 b 2 d 3 f 4 e 5 a 6 c

Listening**Welding hazards and precautions**

- Do **1** in groups. Check by asking students to say their answers.
- Do **2** as a class.
- Do **3–5** individually. Check by asking students to say their answers.
- Do **6** as a class.

- Key**
- 1** 1 c 2 b 3 a 4 e 5 d
2 1 e 2 a 3 d 4 c 5 b
3 1 e 2 a 3 c 4 b 5 d 6 f
4 1 e 2 a 3 c 4 b 5 d 6 f
5 1, 2, 4, 5, 7, 9, 11, 12

Language spot**Countable and uncountable nouns**

- Draw the class's attention to the explanation of countable and uncountable nouns. Teach or elicit a few examples with familiar words: *water* (uncountable), *pencil* (countable), etc. Ask students to give a few examples of each.
- Do **1–3** individually. Check by asking students to say their answers.

- Key**
- | | |
|----------------------|----------------|
| 1 1 equipment | 6 Smoke |
| 2 hazards | 7 a cart |
| 3 cylinders | 8 the material |
| 4 the spark | 9 skin |
| 5 clothes | 10 water |
| 2 1 steam – U | 6 eyes – C |
| 2 information – U | 7 welder – C |
| 3 shock – C | 8 smoke – U |
| 4 brush – C | 9 deposits – C |
| 5 oil – U | 10 Ethanol – U |
| 3 1 many | 4 many |
| 2 much | 5 much |
| 3 much | 6 many |

Number talk

Measuring pipes

- Do **1** individually. Check by asking students to say their answers.
-  Do **2** individually. Check by doing **3**. Then ask students to say their answers.
- Do **4** in pairs. Circulate and monitor, giving assistance when necessary. Check answers by doing **5**.
- Do **6** individually. Check by asking students to say their answers.

0-π	1 1 diameter	3 thickness	5 radius
	2 inside	4 length	
	3 See <i>Listening script</i> , p.128.		
	5 See <i>Listening script</i> , p.128.		
	6 1 180 cm	3 90 cm	5 296.5 cm
	2 5 cm	4 95 cm	6 1.144 m ³

* Tip

The word *isometric* comes from Greek. *Iso* means *equal* and *metric* means *measure*. In an isometric drawing, the scale along each axis of the projection is the same. All of the angles in the drawing are either 60° or 120°.

Reading

Isometrics and MTOs

- Ask students to look at the drawing. Ask *What does it show?* (Part of a pipeline system.) Do **1** individually. Check by asking students to say their answers.
- Do **2** individually. Check by asking students to say their answers.

0-π	1 1 F	3 F	5 F
	2 T	4 T	
	2 1 parts	3 valve	5 quantity
	2 elbow	4 sizes	

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

8 Working offshore

Background

Working on an offshore platform is different from a lot of other jobs. An offshore platform works continuously so it needs a team of workers to support the operations every day and night. The platform is equipped with a helideck for helicopter landings and this is how you get to work. You report for work at the heliport and check in. You will be searched and maybe breathalysed. There is no alcohol allowed on the platform. The helicopter flight is probably the most hazardous part of the job, although accidents are highly unlikely and there is a large number of safety precautions. Typically, you will work two weeks offshore for twelve hours every day, then you will have two weeks' unpaid leave. You will share a cabin, often with someone on the alternating shift. There are recreational facilities and common areas, and the food is restaurant standard. Pay is usually good and there are travel allowances and tax concessions, depending on where you are from and the location of the platform. There is a wide variety of jobs: labourers, chefs, technicians, and engineers. A crew of 150 is quite common.

The platform is supplied from an onshore base. Regular supplies are by supply boat, with the helicopter bringing urgent material where necessary. Regular communication is maintained with the onshore base and records are noted and transmitted to a support team onshore who plan maintenance, monitor throughput, order and ensure delivery of supplies and spares, and respond to any requests and emergencies. The management of the platform is by the Oil Installation Manager (OIM). Various supervisors report to the OIM.

The work is often hard and you should be fit and healthy and must have the temperament to follow instructions and be reliable, particularly with regard to safety. You will be issued with the required protective clothing and equipment and you will often have to work outside, sometimes in harsh environments. You will receive regular safety training on the job and you will be expected to work as a team. Although competition for jobs is high, once you have experience there are opportunities to work in different areas of the world. Many workers take the opportunity during their shore leave for further education and training.

Kick off

- Do **1** and **2** as a class.

- Op 1**
- 1 on the helideck
 - 2 in the accommodation block
 - 3 in the lifeboats
 - 4 the process area
 - 5 at the end of the flare boom

* Tip

Prepositions are used before a noun or pronoun to show place, position, time, or method.

Reading

A production platform

- Do **1** and **2** individually. Check by asking students to give their answers.
- Do **3** and **4** individually. Check in pairs, then with the class by asking students to give their answers.

Key	1	1 Even day visitors must have safety training.
		2 ... workers must also have a medical test ...
		3 It is as big as a football field.
		4 Drilling platforms are not as big as this ...
		5 Crude oil comes up to the well heads with gas and water in it. So it goes to the process area, which separates the oil from the other things.
		6 All the areas need electricity and other utilities. The utilities area provides these ...
2	1 training	4 accommodation
	2 course	5 well head
	3 area	6 utilities
4	1 by	4 on to
	2 as	5 of
	3 of	6 for
		7 generator
		8 ventilation
		9 distribution
		7 for
		8 above

Additional activity

Do the Unit 8 communication activity on Teacher's Resource Book p.93.

Additional activity

(stronger students)

Assign students a type of offshore platform (fixed platform, compliant towers, semi-submersible, jack-up, tension-leg, spar, drillship) to research. They can carry out the research in their native language but present their findings to the class in English. They should

- prepare a picture of the platform type
- say briefly how it works (it floats on the water, it's attached to the seabed by cables, it has legs that can be 'jacked up', etc.)
- say what depth of water it is usually used in.

When the presentations are given, elicit comparative sentences about the platforms, e.g. *A fixed platform is better in deep water than a drillship.*

Language spot

Comparative sentences

- Do **1** as a class.
-  Do **2** as a class, in chorus. The stress may be somewhat exaggerated doing it this way, but that will help students understand it clearly.
- Do **3** in groups. Circulate, monitor, and give assistance as necessary. Ask students to give their group's answers.
- Draw attention to the explanation in **4**. Then do the exercise in groups. Ask students to give their group's answers.

Key	1	A > B	2	A ≈ B	3	A < B
	3	1 Helicopters are faster than boats.				
		2 Crude oil is heavier than petrol.				
		3 Drilling rigs are not as large as production platforms.				
		4 Safety is more important than speed.				
		5 Gas is as useful as oil / more useful than oil / not as useful as oil.				
	4	1 Very cold weather is worse than / better than / (not) as bad as very hot weather.				
		2 Nice work is better than / (not) as good as good pay.				
		3 An offshore job is better than / (not) as good as an onshore job.				

*** Tip**

The pascal (symbol: Pa) is commonly used in weather reports to give atmospheric pressure, usually in the form of hectopascals (hPa; 1 hPa = 100 Pa). The kilopascal (kPa; 1 kPa = 1,000 Pa) is commonly used on bicycle tyre labels. The pascal is a measure of force per unit area, defined as one newton per square metre. The bar is a unit of pressure equal to 100 kilopascals. It is roughly equal to the atmospheric pressure on Earth at sea level. In some places, weather reports use millibars (mb; 1,000 mb = 1 bar) for atmospheric pressure. Gauges on cylinders of compressed gas often give the pressure in bars.

*** Tip**

metre – the fundamental unit of length in the metric system; it originally comes from the Greek *metron* 'measure'

meter – a device that measures and records the quantity, degree, or rate of something. It comes from Middle English *mete* + *er* 'a person who measures'. This is also the American English spelling of *metre*.

Ohm's law states that electric current is proportional to voltage (electrical force measured in volts) and inversely proportional to resistance (the opposition of a piece of electrical equipment to the flow of a direct electrical current, measure in ohms)

circuit – the complete path of wires and equipment along which an electric current flows

short circuit – a failure in an electrical circuit, when electricity travels along the wrong route because of damaged wires or a fault in the connections between wires

Number talk**Measuring and adjusting variables**

- Do **1** as a class. Do **2** individually. Check by asking students to say their answers. Then do the conversations in pairs. Do **3** as a class. Ask individual students to give answers.

- Key**
- | | | |
|----------|---|------------------------|
| 1 | 1 temperature | 3 flow |
| | 2 pressure | 4 level |
| 2 | 1 level | 3 temperature, degrees |
| | 2 flow | 4 pressure, bar |
| 3 | 1 Reduce the pressure to fifteen bar. | |
| | 2 Increase the temperature to sixty-five degrees Celsius. | |
| | 3 Reduce flow to ten cubic metres per minute. | |
| | 4 Increase the level to ninety-five per cent. | |
| | 5 Reduce the level to zero (metres). | |

It's my job

- Do **1** and **2** as a class. Then do **3** individually. Do **4** in groups.

Key **1 Possible answers**

- 1 temperature gauges, pressure gauges, electronic controls
- 2 adjust: make a small change to something to make it better
diagnose: work out what is causing a problem
inspect: look at something carefully
install: put a new thing into its place so that it is ready to use
maintain: keep something working well
repair: if something is broken, make it good again
solve: find the answer to a problem
test: use something to find out how well it is working

3 Yes, Dave does all these things.

- | | | | |
|----------|------|---------|---------------|
| 3 | a 2 | e TV | i comfortable |
| | b 2 | f gym | j good |
| | c 12 | g books | |
| | d 7 | h small | |

4 advantages: good pay, two weeks' leave every month
disadvantages: long working days, don't see friends and family for two weeks

Vocabulary**Electricity and circuits**

- Do **1** as a class. Elicit or teach that a wire, a light bulb, or anything that carries electricity is a *conductor*. Every conductor has a certain resistance to conducting electricity. Materials that conduct electricity very well have low resistance. Materials that conduct electricity less well have high resistance. In these equations, V = the potential difference measured across the resistance in units of volts, I = the current through the resistance in units of amperes, R = the resistance of the conductor in units of ohms.
- Do **2** individually. Check by asking students to say their answers. Do **3** and **4** in groups. Ask students to say their group's answers. Do **5** in pairs. Check by comparing the original drawing and the copy.

- 0-π 2**
- on-off switch, cell, lamp, wire
 - push switch, battery, buzzer, wire
 - on-off switch, battery, motor, wire
 - push switch, battery, lamp, wire
- 3**
- This circuit has an on-off switch, a cell, and a lamp. It can't work because the circuit is not complete.
 - This circuit has a push switch, a battery, and a buzzer. The circuit is complete so it should work.
 - This circuit has an on-off switch, a battery, and a motor. The circuit is complete so it should work.
 - This circuit has a push switch, a battery, and a lamp. The circuit is complete, but the lamp can't work because there is a short circuit.
- 4**
- a cell, a switch, and two lamps in series
 - a cell, a switch, and two lamps in parallel
- If one lamp fails in the series circuit, the other lamp cannot work because the circuit is broken.
- If one lamp fails in the parallel circuit, the other lamp can work because there is still a complete circuit.

Additional activity

Do *Writing bank 6* on Student's Book p.57.

Writing

A leave request form

- Do **1** and **2** individually. Check by asking students to give their answers.

0-π 1

- b
- absence
- personal leave
- (dates for next Saturday and Sunday)
- cousin's wedding

2 Employee name *Dave Bristow*
 Department *Maintenance*
 Supervisor *Martin Olsen*
 Type of absence requested (please tick one)
 Sick
 Personal Leave ✓
 Maternity / Paternity
 Other

Dates of absence
 From *(date next Saturday)* to *(date next Sunday)*
 Reasons for absence *Cousin's wedding*
 Employee's signature *Dave Bristow*
 Date *(today's date)*

Listening

Radio conversation

- Do **1** in pairs, then discuss answers. Students listen for **2** and **3**, then practise the conversation in **4**.

- 0-π 2**
- | | |
|--------|---------|
| 2 PD24 | 4 lower |
| 3 5 | 5 Dave |

* Tip

In radiotelephony, these numbers have a special pronunciation to make them as clear as possible:

3 = tree

4 = fower (like *flower* without the /)

5 = fife

9 = niner

Additional activity

Give the class a dictation quiz using the international radio alphabet. Say the words for students to write:

mike alpha india november tango echo
november alpha november charlie echo
(maintenance)

tango romeo alpha november sierra papa
oscar romeo tango (transport)

oscar foxtrot foxtrot sierra hotel oscar
romeo echo (offshore)

charlie india romeo charlie uniform india
tango (circuit)

mike uniform lima tango india mike echo
tango echo romeo (multimeter)

* Tip

Some learners try to pronounce each consonant separately and fully or insert extra sounds between consonants. As a result, *inspect*, for example, sounds like *inspecet* and *platform* sounds like *platteform*.

Learners will find it easier to pronounce these words correctly if they realise that some consonants are not pronounced fully. For example, most native speakers would find it unnatural (or impossible) to fully pronounce the C, T and R in *electrical*. Instead, the C is only half pronounced: *ele(c)trical*.

It is often the first consonant in the cluster that is weakened in this way, so:
inspe(c)t, pla(t)form, stan(d) by, ele(c)trical, equi(p)ment, depar(t)ment

Vocabulary

The international radio alphabet

- Do **1** as a class.
- Do **2** in pairs. Check by asking students to say their answers.
- Do **3** individually. Check by asking students to say their answers.
- Do **4** in pairs. Students take turns saying each item. Check by asking students to say their answers.

0-π	2	1 Charlie, Juliet, Mike, Oscar, Papa, Romeo, Victor, Yankee, Zulu	
		2 India, Lima, Quebec	9 Echo
		3 Alpha, Delta	10 X-ray
		4 Foxtrot, Tango	11 Uniform
		5 Golf	12 Whisky
		6 Hotel	13 Sierra
		7 November	14 Bravo
		8 Kilo	
3		1 Pond	3 D
		2 SF925	4 cvo.com
4		1 bravo two zero and papa two four	
		2 alpha foxtrot sierra	
		3 victor alpha zulu yankee	
		4 golf charlie alpha november delta	

Speaking

Radio conversations

- Do **1** individually. Do **2** in pairs.

Pronunciation

- Do **1** and **2** as a class. Do **3** in pairs.

0-π	1	There are no extra sounds between the red letters. ✓
		Some of the red letters sound weaker than normal. ✓

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

9 Natural gas

Background

Gas is more difficult to store than oil mainly because its volume at normal temperature and pressure is 1,000 times that of oil for the same amount of energy content. In small densely populated countries like the United Kingdom, when coal was the main source of fuel in the early twentieth century, an infrastructure was built to distribute gas from coal throughout the country using a pipeline system from the gas plants to homes in major towns and cities. When North Sea gas was discovered, the system was modified and a pipeline system was created from the onshore terminals to domestic consumers. The system stores gas by increasing the pressure in the main pipeline. Storage is also created by pumping gas back into depleted oil and gas reservoirs. As North Sea reserves of oil and gas decline and gas is imported to the UK, storage is becoming more important.

Where pipeline systems are not available, gas is distributed for domestic use in pressurized containers as propane or butane, known as **liquefied petroleum gas** (LPG). The liquefied gas is stored in cylindrical or spherical containers at refineries and terminals and can be transported by road to residential storage tanks or in

smaller exchangeable cylinders. All storage must take into account dangers of overheating in accidental fires which can cause containers to explode.

By cooling petroleum gas to -162°C , it condenses to a liquid and 1/600th of its volume. This is called **liquefied natural gas** (LNG). The method is used for bulk transport of gas and is carried out at plants usually close to the source of the gas. LNG can be transported over long distances by special **tankers** by road or sea. It is stored at the LNG plant and at its destination in special insulated **storage tanks**.

Russia has the largest reserves of natural gas in the world and transports most of its gas by pipeline. It supplies one quarter of Europe's gas requirements and 80% of this is by pipeline through Ukraine. The risk to supplies was highlighted by a dispute between Ukraine and Russia in 2009 which affected supplies to Ukraine and Europe. Russia is also using LNG from its first offshore platforms in Sakhalin Island. Natural gas is transported from the platforms to onshore terminals then by pipeline to the southern tip of the island which is ice-free during winter. Here it is processed at an LNG plant and distributed by tanker to Asia-Pacific markets.

* Tip

The natural gas we use in the processes shown in this unit is almost pure methane. However, when natural gas comes out of the ground, it usually contains ethane, propane, butanes, pentanes, sulphur, carbon dioxide, and sometimes helium and nitrogen. Natural gas requires extensive processing to be useful.

Kick off

- Do **1**. Get five students to read one sentence each. Do the matching individually. Check by asking students to say their answers.
- Do **2** and **3** in groups. Ask students to say their group's answers.

0π 1 1 d 2 a 3 c 4 b 5 e

2 5 It burns more cleanly than kerosene, producing less carbon monoxide, hydrocarbon, and nitrogen oxide emissions. It also burns more efficiently than kerosene.

3 1 CH_4
2 LNG
3 NH_3

* Tip

British English *vapour* = American English *vapor*

Additional activity

(stronger students)

Ask students to research LNG tankers.

There are five different designs for tankers (moss tanks, IHI, TGZ Mark III, GT96, and CS1). Assign individuals or groups a type of tanker to research. Students can carry out the research in their native language but present their findings to the class in English. They should bring in a picture of the tanker they are researching along with some facts about it.

Additional activity

Do the Unit 9 communication activity on Teacher's Resource Book p.95.

Vocabulary

Gas production and distribution

- Teach or elicit the meanings of *verb* (an action or state) and *noun* (a person, place, or thing). Have the students look at the glossary on p.132 for the meaning of *vapour*, *vaporize*, *liquefy*, and *consume*.
- Do 1 and 2 as a class.
- Ask students to look at the picture in 3. Do 3 and 4 individually. Check by asking students to give their answers.
- Do 5 in groups. Ask students to give their group's answers. Collect answers on the board.

Key	2	1 vapour	5 store
		2 liquid	6 transportation
		3 produce	7 pipe
		4 consumption	
	3	1 produces	6 transport
		2 vapour	7 storage
		3 liquefies	8 vaporize
		4 liquid	9 pipes
		5 store	10 consume
	4	1 Vaporization	5 Consumption
		2 Liquefaction	6 transportation
		3 production	7 pipes
		4 product	
	5 Possible answers		
		1 oil, water, milk	
		2 food, oil, almost anything which is imported into your country	
		3 oil, water, gas	
		4 all consumer goods, food	
		5 water, LNG, most liquids (depending on temperature)	

Number talk

Talking about a bar chart

- Do 1 and 2 as a class.
- Do 3 and 4 individually. Check by asking students to say their answers.

Key	1	1 nineteen seventy
		2 two thousand and two
		3 one point five trillion cubic metres
		4 two billion cubic metres
	3	1 2.5
		2 1,000,000,000,000
		3 1970
		4 1990
	4	1 500 million (0.5 trillion) cubic metres
		2 3.5 trillion cubic metres
		3 500 million (0.5 trillion) cubic metres

Language spot

Past Simple *be*

- Ask students to read the example sentences aloud in turn. Do **1** and **2** individually. Check by asking students to say their answers.
- Do **3** in pairs. Check by asking students to say their partner's answers.

- 0-π 1**
- 1 The gas was stored in tanks.
 - 2 Ahmed wasn't late.
 - 3 She was in Saudi Arabia.
 - 4 Ian and Matt weren't in the office.
 - 5 I was in the workshop.
 - 6 You weren't in Russia.
 - 7 We weren't busy.
 - 8 The gas wasn't liquid.
 - 9 Klaus was in Germany.
 - 10 She wasn't from Qatar.
- 2**
- 1 Were you a student last year?
 - 2 Were your friends at your house last week?
 - 3 Was your teacher at work last Saturday?
 - 4 Were you and your classmates at the library last night?

Listening

The past and the present

-  Do **1** and **2** individually. Check by asking students to say their answers.
- Do **3** as a class.
- Do **4** individually and then **5** in pairs. Check by asking students to say their partner's answers.

- 0-π 1**
- | | | |
|-------------|-------|-------|
| 1 yesterday | 4 are | 7 are |
| 2 was | 5 was | 8 are |
| 3 was | 6 was | 9 was |
- 3** 1 c 2 d 3 a 4 e 5 f 6 g 7 b 8 h

* Tip

Top margin

Ask students if they know which countries have the largest gas reserves. Discuss possible answers. Then look at the pie chart at the top of the page. What is their opinion about Russia having 28% of the reserves? Does this put that country in a powerful position?

Additional activity

Work in groups. Each group writes a five-question quiz about the article for the other groups. The questions shouldn't try to trick the quiz-taker, but can be about very detailed information in the text. After groups have written their quizzes, the entire class close their books. They then exchange papers with another group and try to answer the questions from memory, without looking at the text. When everyone has finished taking the test, ask groups to share the questions on the quiz they took and the answers they gave. Which group had the easiest quiz? Which had the most difficult?

Reading

The Sakhalin II Project

- Do **1** as a class. Then do **2** individually. Check by asking students to say their answers.
- Do **3-6** in groups. Ask students to say their group's answers.

- 0-π 1**
- 1 Students' own answers
 - 2 a tanker, an LPG loading facility, LPG tanks, a map
 - 3 Students' own answers
- 2**
- 1 One
 - 2 9.6 million tonnes per year
 - 3 at Prigorodnoye
 - 4 145,000 m³
 - 5 concrete and steel
 - 6 earthquake

- 3** 1 Sakhalin Island
 2 Prigorodnoye
 3 Sea of Japan, Pacific Ocean
 4 Sodegaura, near Tokyo
 5 Japan
- 4** 1 the amount of gas it can hold
 2 the number of years it is useful
 3 the amount
- 5** 1 100,000 m³
 2 30–40 years
 3 500 billion m³

Additional activity

Work in groups. Assign each group a shape. Set a time limit of five minutes. The groups should find and list as many items as possible that are their shape. If you are allowed to leave the classroom, extend the activity time and allow students to search through the entire building or beyond. If you are unable to get up and move around, or have a limited number of items in your room, students can simply think of items and use a dictionary to come up with English words for them as necessary. The winning team is the one with the most items on their list.

* Tip

Biogas is a type of biofuel. Biofuels are fuels that are derived from biomass, usually plants grown to be used as fuels or to be converted into fuels, but also waste products that come from animals. Biogas is usually produced by the breakdown of organic matter in the absence of oxygen. Scientists and governments around the world are interested in biofuels as a good alternative to petroleum-based fuels. There is a limited amount of oil available on Earth, so people need to find renewable sources of fuel.

Speaking

Describing equipment

- Do **1** and **2** as a class. Do **3** and **4** individually. Check by asking students to say their answers.
- Do **5** in pairs. Monitor and give assistance as necessary.

0-π	1 1 b	2 c	3 a		
	4 1 f			4 e	7 c
	2 b			5 h	8 g
	3 a			6 i	9 d

It's my job

- Do **1** and **2** as a class.
- Do **3** individually. Check by asking students to say their answers. Then do **4** as a class.

0-π	2 Possible answers
	The mixing tank is cuboid.
	The digester tank is underground.
	The gas holder is cylindrical. It's above-ground.
	The overflow tank is cuboid.
3	1 F 2 T 3 F 4 T 5 F

Project

- Assign this as homework. Students can carry out the research in their native language but present their findings to the class in English. Possible topics include solar energy, wind energy, bioethanol, and biodiesel.

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

10 Oil and the environment

Background

The picture many people have of the oil industry is a negative one of disasters reported in the media: **oil slicks** from tankers, birds covered in oil, oil gushing from the ground, or pillars of smoke rising from a fire. The truth is very different. The world's daily consumption of oil is around 90 million barrels, and the overall impact of its production is very low. The industry puts **environmental protection** high on its list of priorities. From planning the recovery of new resources, through design and construction and operation and eventual decommissioning and disposal of assets, all aspects of the environment are considered in order to minimize the industry's impact. Before licences are granted by governments for exploration or production of reserves on their territory, oil companies must demonstrate how the particular environment will be protected. The companies also have an obligation to consider the impact of their operations on the global environment.

Many desert and arctic areas are home to fragile, unique plant and animal species. Oil companies have their own specialists and work with other local and international experts to study the particular environment and how it should be protected. Soil protection, breeding and nesting sites, and migration routes have to be preserved from the disruption caused by exploration and production. When permanent installations are constructed, they are usually planned to operate for periods of around twenty years. Often large amounts of cooling water are used that may

change the environment. More favourable conditions may be created for invasive plants or different species that can overwhelm native species. Waste materials have to be disposed of safely.

Another perception of the industry is symbolized by the **flaring of gas**. There are international agreements to minimize flaring to decrease pollution and conserve resources, but flaring will always be required for emergencies to dispose of unwanted gas safely.

Companies also have to allow for unplanned events and emergencies. Designers must provide controls and instruments to allow for equipment failures. Plant must be designed to allow for unlikely but possible severe conditions that might only occur every twenty years, for example, extreme wave heights, extreme temperatures, or earthquakes. Technical and management systems have to be in place to ensure that the harmful effects of human error in operating procedures are minimized.

Many installations are close to residential areas, and apart from the safety implications, companies must minimize traffic, noise, and odours and generally develop good neighbourly relations. Most companies are keen to sponsor local events, educational initiatives, and opportunities to listen to local opinion and advice.

Major oil companies realize that their long-term future is in more sustainable forms of energy. Far-sighted companies have the financial motivation, resources, and the expertise to make a major contribution to the global environment.

* Tip

gasket – a flat piece of rubber placed between two metal surfaces in a pipe or an engine to prevent steam, gas, or oil from escaping

Additional activity

Get students to think about the environment they live, work, and / or study in. What are the sources of air, noise, water, and soil pollution? Do these environmental factors affect them? Are there laws that control them?

Kick off

- Do 1–3 with the class.

1	1 b	2 c	3 a	4 d
2	1 a, c, d	2 a, b, d	3 a, b, d	4 a, d
3	1 c	2 b	3 a	4 d

Additional activity

Get students to think of five events from their own past and to write a sentence about each one in the Past Simple. For example *In 2006, I moved from Hermosillo to Mexico City.* Point out the verb chart on p.116 of the Student's Book. Ask students to share their sentences in groups, then ask them to share things that other group members talked about.

Language spot

Past Simple

- Ask students to read the example sentences aloud in turn. Do **1-3** individually, checking after each exercise by asking students to give their answers.
- Do **4** in pairs.

- Key**
- | | | | |
|----------|-----------|--------|-------|
| 1 | 1 arrived | 4 had | 7 do |
| | 2 burned | 5 make | 8 see |
| | 3 went | 6 stop | |
- 2**
- 1 The crew didn't start at 6.30.
 - 2 The refinery fire didn't burn for three days.
 - 3 I didn't go to college in Abu Dhabi.
 - 4 When we opened the flow, we didn't have a lot of problems with the new pipeline.
- 3**
- 1 Did you learn about the oil industry at school?
 - 2 Why did you choose the oil industry?
 - 3 Did you use power tools at school?
 - 4 How did you learn about oil jobs?
 - 5 When did you begin English lessons?

It's my job

- Do **1** and **2** as a class.
- Do **3** and **4** individually. Check by asking students to say their answers.
- Do **5** in groups. Circulate and monitor. Then ask one student from each group to share their group's answers to one of the questions.

- Key**
- 1** 1 d 2 b 3 a 4 c
- 3** 1 d 2 b 3 a 4 c
- 4**
- 1 Kuwait Oil Company
 - 2 work safely and reduce environmental problems
 - 3 a risk assessment with the operations and maintenance team
 - 4 some construction sites
 - 5 some of the workers
 - 6 the importance of health, safety, and the environment

* Tip

hazmat suit – a garment worn for protection when handling hazardous materials (the word *hazmat* comes from the first three letters of each word). It usually is combined with breathing apparatus, and is used by workers cleaning up contaminated areas or working in toxic environments.

Vocabulary

Preventing and dealing with eco-hazards and incidents

- Ask students to read the definitions of *eco-hazard* and *incident* aloud in turn. Look at the pictures. Ask students to say the things they can see. Do **1** and **2** individually. Then do **3**. Check by asking students to say their answers.

- Key**
- 1** 1 d 2 f 3 b 4 a 5 c 6 e
- 2**
- 1 fire
 - 2 explosion
 - 3 oil spill
 - 4 gas leak
 - 5 wildlife protection programme
 - 6 safety procedures
 - 7 special drilling techniques

Additional activity

(stronger students)

Ask students to imagine that oil has been discovered directly under your classroom. Working in groups, get them to make notes about the environmental impact on the area. Help them do a simple risk assessment. Guide them with these questions:

- 1 Where can the oil company drill a well?
- 2 How will the heavy equipment get into and out of the area?
- 3 Where will the workers stay?
- 4 How will plants, animals, and people be affected?

* Tip

compressor – a machine used to supply air or other gas at increased pressure; they are used in a huge range of applications including inflating car tyres, powering pneumatic tools, pumping substances through pipes, moving coolant around refrigerators, etc. Large compressors can be very noisy.

Additional activity

Do the Unit 10 communication activity on Teacher's Resource Book p.97.

Reading

Preventing environmental damage

- Do **1** and **2** as a class. Do **3** individually. Check by asking students to give their answers.
- Do **4** in groups, as a race. The first group to find correctly all twelve verbs wins. Note which group finishes first, second, third; if the first group has any mistakes, check the second group's answers. Keep checking until you find a group with all eleven verbs correct.

Key 1 Possible answers

- noise, oil spills, bad smells, problems with air, problems with water
- 3 1 forests, trees, animals, birds, a perfect beach and seaside, a village, an oil well
 - 2 about six years
 - 3 horizontal or extended reach drilling
 - 4 ten kilometres
 - 4 discovered, were, faced, planned, studied, developed, began, put, was, couldn't see, used, started

Listening

Problems and solutions

- Do **1-4** individually. Check by asking students to share their answers.

Key 2 1 b 2 c 3 a

- 3 1 a It happened
b closed
- 2 a work
b worked
- 3 a It started
b waited

Pronunciation

- Do **1** and **2** individually. Check by asking students to share their answers.
- Do **3** in pairs. Encourage students to speak aloud rather than simply reading the conversation. Ask them to (a) look at the book; (b) look up and speak; (c) look at the book only when they need to remind themselves of the words.

Key 1

	verb+id	verb+t	verb+d
happened	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
closed	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
finished	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
worked	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
started	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
waited	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Speaking

Reporting an incident

- Do **1** individually. Check by asking students to share their answers.
- Do **2** in pairs. Monitor and give assistance as necessary.

Key 1 1 T 2 F 3 T 4 F 5 F

* Tip

double-hulled tanker – a ship that has the bottom and sides made from two complete watertight layers of hull surface. If there is damage to the outer hull, the inner hull will prevent oil leaking out, and therefore will help minimize environmental damage.

drilling mud – a mixture of water, clay, and other materials. It cleans, cools, and lubricates the drill bit during drilling as well as performing other important functions. It is usually toxic to some degree and is difficult and expensive to dispose of in an environmentally friendly manner.

Writing

An environmental incident report

- Do the exercise individually. Check by asking students to share their answers.

Key

- 1 27 March
- 2 16.30
- 3 Fazwan Area, Pipeline 32, Station 6
- 4 pipeline leak
- 5 20,000 litres
- 6 sand
- 7 no immediate risk
- 8 no damage after clean up

Project

- Assign different topics to individual students or to groups. Students can carry out the research in their native language but present their findings to the class in English. They should prepare visual materials to support their presentation and explain the methods used to protect the environment.

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

11 Workshop operations

Background

Facilities both onshore and offshore will have a workshop with basic tools and machines and a team of skilled **maintenance technicians**. Workshop specializations will include mechanical, piping, electrical, control and instruments, and computer and communications support. A lot of the work is carried out in the place where the equipment to be worked on is located. In many cases because of weather conditions, restricted space, or the need for specialized tools, the work will be brought in to the workshop. The typical workshop will have a simple lathe, milling machine and grinder, gas and arc welding equipment, electrical and instrument test equipment, and portable hand tools. Although the local team would be capable of carrying out straightforward operations, more complex work may need to be done by suppliers' specialized staff or by a maintenance contractor, particularly to preserve guarantees. However, on an offshore platform where transport to the platform could take several days in bad weather for instance, a decision has to be made whether to attempt a repair locally or wait for specialized help.

Good organization of the workshop is a key to its success. Work is requested by **job cards** and an estimate is made of the resources required, both labour and materials. Normally a stock of commonly used spares is carried in the store. If spares or materials have to be ordered, the job cannot start until they are delivered. The job cards are prioritized and scheduled. Record-keeping is important so that equipment histories can be maintained.

Constant effort has to be applied to reduce the risk of injury due to cuts, burns, trips, falls, and dropped objects. A tidy and organized working environment, clean and clear of scrap, will minimize the risk as well as organized work rosters and shift handover procedures that eliminate rushed work. **Safety procedures** as described in Unit 4 must be followed. Dust and fume extract facilities are installed in the workshop.

A good knowledge of measurement techniques is essential. A particular hazard in refinery operations is where there is a mix of metric and imperial units. English-speaking countries changed to metric measurement in the 1970s with the exception of the United States. Some older refineries including some American-built refineries in the Middle East may have a mix of imperial and metric units and care must be taken and units checked.

* Tip

If you are not familiar with tools and workshop operations yourself, don't worry. Make the most of your students who have a lot of experience with these things. Encourage them to explain tools and processes to you and to the class.

Kick off

- Do **1-4** as a class.

0π 1 1 b 2 a 3 b
 2 1 a 2 b 3 b
 3 The floor isn't tidy.
 The workbench isn't clean.
 The tools haven't been put away.
 The exit is probably blocked.
 The lights are on, but no one is working.

Listening

Workshop responsibilities

- Do **1** as a class. Then do **2** and **3** individually. Check by asking students to share their answers.
- Do **4** in pairs. Check by asking students to give their partner's answers.

Answers
1 1 c 2 d 3 b 4 a 5 f 6 e
3 1 a 2 b 3 e 4 d 5 f 6 c

* Tip

CNC – computer numerical controlled machine tools; CNC systems are used to fabricate complex machine parts by allowing a computer to control the machine tools with great precision

MIG welding – metal inert gas welding; a semi-automatic welding process in which a continuous wire electrode and a special gas called a shielding gas are fed through a gun

oxyacetylene welding – one of the oldest welding and metal cutting processes; a torch mixes the fuel gas acetylene with oxygen to create an extremely hot flame

lathe – a machine that shapes pieces of wood or metal by holding and turning them against a fixed cutting tool

grinder – a power tool fitted with an abrasive disk that can cut or shape metal and stone. An angle grinder is hand-held, and a bench grinder is mounted on a workbench

Additional activity

Brainstorm and revise basic hand tools and their functions. For example
We use a screwdriver to tighten screws.
We use a hammer to hit nails or other objects.

We use a chisel to chip away pieces of wood.
We use a vice to hold something securely in place while we work on it.

We use pliers to grip small objects.

Get students to think of tools they can name in their own language, then use a dictionary as necessary to find the English names and functions of the tools.

Reading

Managing the workshop

- Do **1** as a class. Write ideas on the board. Do **2-4** individually, checking after each exercise by asking students to share their answers.
- Do **5** individually, then do **6** in pairs. Monitor and give assistance as necessary.

Answers
1 good lighting, a shop tool with a safety zone, putting tools away, a clear workbench, cleaning the floor
3 1 productive 3 a guard
 2 a safety zone 4 a hazard
4 1 b 2 a 3 e 4 c 5 d

Vocabulary

Power tools and their functions

- Do **1** as a class. Then do **2** in pairs. Check by asking students to share their answers.
- Do **3** individually, then do **4** in pairs. Check by asking students to share their answers.
- Do **5** as a race. Which student can unscramble all three words most quickly?
- Do **6** in pairs. Monitor and give assistance as necessary.

O-π 1	1 b	2 d	3 a	4 f	5 e	6 c
2	oxyacetylene equipment, welding and cutting table saw, cutting lathe, turning and shaping bench grinder, grinding drill press, drilling CNC bench, designing welding and cutting bench, welding and cutting MIG welding equipment, welding					
3	1 table	4 grinder	7 bench			
	2 turning	5 drilling	8 welding			
	3 storing	6 designing				
5	1 grinder	2 drill	3 saw			

Additional activity

(stronger students)

In pairs or small groups, students ask each other questions beginning *Have you ... ?* Students reply *No, I haven't* or *Yes, I have*. However, they don't need to reply truthfully. After they have had a chance to ask and answer several questions, call on students to say what their classmates have and haven't done. Then have the class vote on which statements they think are true or false.

Language spot

Present Perfect

- Ask students to read the example sentences aloud in turn. Do **1** individually. Check by asking students to share their answers.
- Do **2** in pairs. Monitor and give assistance as necessary.

O-π 1	1	Have you finished welding?
	2	We've done the grinding.
	3	Have you and Ahmed painted it?
	4	We haven't painted it.
	5	Have they built the base?
	6	They haven't finished the base.
	7	Have they checked the inside?
	8	Simon has checked the inside.
	9	They haven't repaired the valve.

Speaking

Saying what's been done

- Explain or elicit *oil tank containment* (a protective structure around an oil tank). Do **1-3** in pairs. Monitor and give assistance as necessary.

O-π 1	A	Have they built the base?
	B	Yes, they've built the base.
	A	Have they assembled the containment?
	B	Yes, they've assembled the containment.
	A	Have they put the tank in the containment?
	B	No, they haven't put the tank in the containment.
	A	Have they welded the containment?
	B	No, they haven't welded the containment.
2	B	Have they done the grinding?
	A	Yes, they've done the grinding.
	B	Have they checked inside the tank?
	A	Yes, they've checked inside the tank.
	B	Have they attached the cover?
	A	No, they haven't attached the cover.
	B	Have they put the tank on the truck?
	A	No, they haven't put the tank on the truck.

*** Tip**

micron – a unit for measuring length equal to one millionth of a metre; also called a *micrometre*

micrometer – a device used for measuring very small distances or spaces; also the American English spelling of *micrometre*

*** Tip**

job card – a document that contains important details about a specific item of work, including a description of the work to be carried out, schedule, a list of materials, and so on. It will also show that a risk assessment has been carried out and a permit to work has been granted, if needed. Job cards are used as the basis for the overall schedule of work and for resource management. It also provides feedback from the assigned worker that he has understood the safety implications of the work.

Additional activity

Do the Unit 11 communication activity on Teacher's Resource Book p.99.

Number talk**Precision measurements**

- Do **1** and **2** as a class. **3** and **4** can be done in pairs.

Key	3	1 the width of a human hair	
		2 the tolerance of a CNC milling machine	
		3 the diameter of a pinhead	
		4 the length of a normal mosquito	
		5 0.001	
		6 1,000	
4	a	5 mm	c 100 μm
	b	3–8 μm	d 10 mm

Writing**A job card**

- Explain *job card* (see tip). Do **1** as a class. Do **2** individually. Check by asking students to share their answers. Do **3** as a class.

Key	1	1 a leaky discharge hose	3 three hours
		2 check the valve	
	2	1 loading area	4 12 April, 11.00 a.m.
2 leaky		5 yes	
3 12 April, 8.00 a.m		6 yes	

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

12 Repairs and maintenance

Background

Oil platforms and refineries are continuous process plants with large, valuable throughputs. Production worth millions of pounds a day can be lost by equipment failures. More important though is that production, repairs, and maintenance are carried out safely without killing or injuring anyone, or making people ill.

Planned maintenance takes several forms. There will be regular replacement of filters, oil changes, and other chemical fills. Another example of simple planned maintenance is the replacement of fluorescent lighting tubes in an inaccessible area. By knowing the statistically most likely failure rate of a tube, it makes sense to replace all tubes in the area even if none has failed and so avoid the number of times scaffolding and hazardous working needs to be employed. Pumps and other rotating equipment are often fitted with condition monitoring equipment. Sensors are placed on bearing housings and the vibration patterns are recorded so that failure can be predicted. The performance of equipment is also closely monitored and if a drop in performance is recorded, maintenance can be scheduled for a planned shutdown. Modern plant has computerized monitoring systems to record data and predict failures, but in most cases experienced maintenance crew tour areas, listening to equipment and recording data. Plant is often designed

with standby equipment. If a pump does fail, flow can be diverted to a standby or back up pump and repairs can be made without shutting down. In very critical areas, it is economical to install a whole duplicate process line or 'train'.

It is necessary periodically to schedule major equipment shutdown in refineries and offshore platforms for inspection and maintenance. In most cases, a whole refinery does not need to be shut down. These major operations are called **turnarounds**. A refinery turnaround takes place typically every four years. Detailed planning takes place months in advance. All lines and vessels have to be isolated and degassed before work can begin. Plant subjected to extreme process conditions such as crude distillation units and catalytic crackers are the focus of the planning effort. While this plant is being worked on, other plant is opened up, inspected, cleaned, repaired, and reinstated. Opportunities are taken to replace catalysts and the packing materials in towers and vessels. There may also be opportunities to make improvements or 'revamps' to process units.

Turnarounds will involve the recruitment of hundreds of skilled trades employed by specialized contractors who work together with the operator to organize and manage the work in detail to ensure that successful start up is achieved on schedule.

* Tip

vertical centrifugal pump – a type of pump commonly used to move liquids through a piping system

Kick off

- Do the exercise in pairs. Check by asking students to share their answers.

Key 1 c 2 b 3 f 4 e 5 a 6 d

Additional activity

Ask students to list things around the classroom that can split, break, get bent, corrode, jam, leak, be noisy, rust, get dented, or freeze.

Additional activity

Students write down and then discuss future changes in their city or country using *will* and *won't*. If there is an oil and gas industry in their country, they should write and talk about that.

* Tip

RIB – rigid inflatable boat; a small open boat with a fibreglass hull and inflatable rubber sides

Additional activity

Do the Unit 12 communication activity on Teacher's Resource Book p.101.

Vocabulary

Problems and solutions

- Do **1** and **2** individually. Check by asking students to share their answers. Then do **3** as a class.
- Do **4–6** individually. Check by asking students to share their answers. Then do **7** as a class.

Key

1 1 frozen
2 wasn't
3 wasn't
4 split

3 after picture 3

4 1 c 2 e 3 a 4 g 5 h 6 b 7 f 8 d
5 1 b 2 h 3 g 4 c 5 f 6 a 7 e 8 d
7 1 b 2 g 3 e 4 d 5 c 6 h 7 f 8 a

Language spot

will

- Ask pairs of students to read the example conversations aloud. Do **1** and **2** individually, checking after each exercise by asking students to share their answers.
- Do **3** in pairs. Check by asking students to give their partner's answers.

Key

1	1 'll	6 'll
	2 Will	7 'll
	3 won't	8 Will
	4 Will	9 won't
	5 won't	

2 Possible answers

1 I'll get it for you.	4 I'll write it.
2 I'll help you lift it.	5 I'll replace them.
3 I'll help you look for them.	

Pronunciation

- Do **1** individually, then **2** in pairs.
- Do **3** and **4** individually. Check by asking students to share their answers.
- Do **5** in pairs. Monitor and give assistance as necessary.

Key

1	1 b	2 b	3 a
3	1 belt	4 copier	7 repair
	2 bolt	5 cap	8 problem
	3 computer	6 broken	

*** Tip**

routine maintenance – regular checking and servicing of a machine

maintenance routine – a schedule or series of actions that are followed when doing maintenance

Reading**Routine maintenance**

- Do **1** in pairs. Check by asking students to give their partner's answers.
- Do **2–4** individually, checking after each exercise by asking students to share their answers.
- Do **5** as a class. Then do **6** individually. Check by asking students to say their answers.

- 0π** 2 1 A 2 T 3 A 4 T
- 3** 1, 3, 4
- 4** Statement 3 isn't correct.
- 5** 1 No, the generator hasn't been well maintained.
2 They haven't checked the engine oil level every day. They haven't cleaned and checked the battery every month.
- 6** 1 273
2 general inspection, checked engine oil
3 general inspection, checked engine oil
4 cleaned and checked the battery, general inspection, checked engine oil
5 general inspection, checked engine oil, changed air filter

*** Tip**

electrician – a person who installs and maintains electrical equipment

mechanic – a skilled manual worker, especially one who repairs and maintains machinery

Listening**Planning the day's work**

- Do **1** as a class.
-  Do **2–4** individually. Check by asking students to share their answers.

- 0π** 1 1 E 2 M
- 2** 1 routine maintenance on compressor
check yesterday evening's reports
2 help Carl install lights
3 at his desk
4 at his desk
5 check photocopier
6 install new lights in loading area
7 reinstall pump
8 check generator
- 3** 1 They called on the phone.
2 the manufacturer's technician
3 the welders
4 yesterday
5 yesterday

Additional activity

(stronger students)

In pairs, students work on fluency by writing a series of interview questions that Carlos Sanchez could answer based on the text, for example *What's your job? Do you work outdoors? What sort of PPE do you use?* and so on. Both students should write their own full list of the questions. After making a list of questions together, students change partners and take turns asking and answering the questions without referring to the text in the book.

Additional activity

Do *Writing bank 7* on Student's Book p.58.

It's my job

- Do **1** in pairs. Check by asking students to give their partner's answers. Do **2** and **3** as a class.

Key 2 He talks about 2, 3, and 5.

Writing

Recording repairs

- Do **1** and **2** individually, then do **3** in pairs. Check by asking students to share their answers.

Key 1

- 1 Compressor making strange noise
- 2 Checked oil level
- 3 Checked belt tension
- 4 Loose belt
- 5 Tightened belt

2

- 1 The generator won't start
- 2 Checked engine oil
- 3 Checked the spark plug
- 4 Dirty spark plug
- 5 Cleaned the spark plug

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

13 The refinery

Background

Crude oil is refined by a process called **fractionation** or **distillation**. The word **refining** means 'removing impurities or unwanted substances'. The various constituents are separated in a **fractionating column**. The process starts by heating the crude oil and then collecting the different gas and vapour fractions as they condense at different levels in the column, with the heavier fractions being taken off at the bottom. The process is improved by reflux, that is, feeding some of the light liquids back down the column, to give more efficient separation.

Crude oil is separated into around eight different fractions comprising hundreds of different molecules. The lightest fraction, petroleum gas, contains methane, ethane, propane, and butane. Propane and butane are eventually stored under pressure in small cylinders and sold for domestic heating and cooking. Petroleum gas is also used as the feedstock for plastics and fertilizers. The next fraction, naphtha, is a volatile liquid processed in the refinery to make heavier molecules which are blended with the next heaviest and most valuable fraction, petrol, also called gasoline.

Heavier fractions are used for jet fuel, diesel fuel, lubricating oil, and different grades of heating oil. The very heavy materials left are residuals which are separated as bitumen and coke. They can also be

processed to break up the molecules and to add hydrogen obtained from the lighter fractions. In this way, the value of the products is optimized to maximize production of high-grade petrol.

Refinery capacities and throughputs in the West have stayed fairly constant over the past decade, with operations concentrating on improved efficiency. However, there has been a large increase in refinery capacity in China, the Asia-Pacific region, and Africa as these producing countries have begun to build and operate their own refineries.

Refineries employ engineers, designers, technicians, and administration personnel who maintain and improve the plant. It is an exciting place to work, even though the environment is somewhat noisy and smelly. With the high temperatures and pressures, and the explosive and flammable nature of the materials, a refinery is a hazardous place and so a great deal of attention is paid to health, safety, and protecting the environment.

The main impurity separated from crude oil is **sulphur**. Sulphur is processed in the refinery and sold to the chemical industry.

After blending, products are stored in tank farms and distributed by pipelines, road tankers, and ships to oil depots and by road tankers to filling stations.

* Tip

Kerosene has many uses, and is known by different names. There are some differences between American and British usage.

- *kerosene* – in American English, this word is used for the fuel that is burned in heaters and lanterns. In British English, it is used to mean jet fuel.
- *paraffin oil* or *liquid paraffin* – in British English, this word is used for the fuel that is burned in heaters and lanterns.
- *jet fuel* – in American English, this term (or *jet-A*) is used for the fuel that is burned in jet planes.

Kick off

- Do 1–3 as a class.

- | | |
|--|---|
| <p>1 a petrol / gasoline
b fuel oil
c kerosene / jet fuel</p> | <p>d diesel / petrodiesel
e asphalt / bitumen
f liquefied petroleum gas (LPG)</p> |
| <p>2 Possible answers
Asphalt is used for roofing.
LPG is used for fuelling some cars.
Petrol is used in motorcycles, lawnmowers, chainsaws, etc.
Kerosene is used in heaters and lanterns.
Petrodiesel is used in some cars.
Fuel oil is used for heating systems for homes.</p> | |
| <p>3 1 asphalt
2 LPG
3 asphalt</p> | <p>4 petrol, kerosene, petrodiesel
5 LPG</p> |

*** Tip**

admin – short for *administration*, the activities that are done to plan, organize, and run a business or other organization

*** Tip**

earth – to connect an electrical system directly to the ground. In situations where flammable materials are handled, equipment is earthed to prevent the build-up of static electricity, which could cause a fire or explosion.

+ Additional activity

(stronger students)

Following the example of the refinery tour in *Listening*, students work in groups to write a tour of their school. They should use the passive wherever possible, for example *Classes are held in the classroom*, *Books are kept in the library*.

Listening**A refinery tour**

- Do **1** and **2** individually. Check by asking students to share their answers.
- Do **3** and **4** individually. Check by asking students to share their answers.
- Do **5** as a class. Use the questions and answers as a link to the *Language spot*.

0-π 1 i 2 h 3 c 4 d 5 g 6 f 7 e 8 a 9 b

- 3** 1 bring 6 is returned
 2 travels 7 is connected
 3 is stored 8 manage
 4 is refined 9 is hidden
 5 take
- 5** 1 in storage tanks
 2 in the main refinery's distillation tower
 3 in the salt marsh
 4 through the main gate

Language spot**The Passive**

- Point out that the questions in *Listening 5* are in the Passive. Ask students to read the example sentences aloud. Do **1-3** individually, checking after each exercise by asking students to share their answers.
- Do **4** in pairs. Check by asking students to share their answers.

0-π 1 1 hide 5 is refined
 2 is managed 6 unload
 3 leave 7 is stored
 4 is taken 8 distil

2 Passive: 2, 4, 5, 7

3 1 g 2 e 3 f 4 b 5 d 6 c 7 a 8 h

- 4** 1 is driven into the loading area
 2 is earthed
 3 master switch is switched off
 4 pipes are connected
 5 the tanker is loaded
 6 the hoses are drained
 7 the transport emergency card is checked
 8 the tanker is driven out of the loading area

Additional activity*(stronger students)*

Ask students to use the Passive to explain processes they've already learned about in this course: finding oil and gas, drilling, assembling pipelines, transporting LNG, horizontal drilling, etc.

*** Tip**

Degrees Celsius can also be called *degrees centigrade*.

The USA, Belize, Burma, and Liberia still use the Fahrenheit scale for non-scientific purposes, for example in talking about air temperature. In the Fahrenheit scale, water freezes at 32°F and boils at 212°F.

*** Tip****Top margin**

Before turning to p.92 in the Student's Book, ask students to guess the location of the world's top three refineries. Then turn to p.92. Did anyone guess correctly?

Additional activity

Do the Unit 13 communication activity on Teacher's Resource Book p.103.

Additional activity*(stronger students)*

Ask students to use the Passive to explain processes they've already learned about in this course: finding oil and gas, drilling, assembling pipelines, transporting LNG, horizontal drilling, etc.

Speaking**Explaining a process**

- Do the exercise in pairs. Check by asking students to share their answers.

Op**Student A**

- The crude oil is pumped out.
- The crude oil is pumped to the loading point.
- The tanker is moved into position.
- The tanker is loaded.
- The crude oil is taken to the refinery.

Student B

- The train is checked.
- The train is moved into position.
- The hoses are connected and the tanker is filled.
- The hoses are removed.
- The train is checked again.

Number talk**Temperature**

- Do **1-4** individually, checking after each exercise by asking students to share their answers.

Op**1** 1 a 2 c 3 e 4 b 5 d**3** 1 45°C 3 100°C

5 -40°C

2 0°C 4 37°C

It's my job

- Do **1** as a class.
- Do **2** and **3** individually. Check by asking students to share their answers.

Op**1** Ticked: 1, 4, 5**3** 1 1,000

4 a year

2 maintenance and repairs

5 petrol, kerosene

3 furnace cleaning

Reading**Fractional distillation**

- Do **1** as a class. Then do **2** and **3** individually, checking after each exercise by asking students to share their answers.
- Do **4** in pairs.

Op**2** 1 crude oil

3 distillation tower

5 asphalt

2 furnace

4 petroleum gas

3 1 petrodiesel

2 petrol

3 asphalt

4 lorry, rail tanker, boat

5 noise, odour, air pollution, water pollution

6 the safety and environment officer

Additional activity

Do *Writing bank 8* on Student's Book p.59.

Writing**Explaining a process**

- Do **1** individually. As students work, monitor and give assistance as necessary.
- Do **2** in pairs. Then ask a few students to read their answers.

Key 1 Possible answers**Student A**

First, the crude oil is pumped out of the well. Then it's pumped to the loading point. Next, the tanker is moved into position. After that, the tanker is loaded. Finally, the crude is taken to the refinery.

Student B

First, the train is checked by safety and security staff. Then it's moved into position. Next, the hoses are connected and the tankers are filled. After that, the hoses are removed. Finally, safety and security staff check the train again.

Project

- Assign **1** and **2** as homework. Ask students to present their findings to the class.

Key 2 Possible answers

petroleum gas = 5.7 litres

petrol = about 73.3 litres

kerosene = about 15.5 litres

petrodiesel = about 39.7 litres

fuel oil = about 6.4 litres

asphalt = about 4.9 litres

other products = about 14 litres

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

14 Emergencies

Background

Because of the hazardous processes in all stages of the production, storage, and distribution of oil and gas, there must be emergency response procedures in place in case of **incidents** or **accidents**. Because accidents do not happen often but can have severe consequences, workers have to be trained and continually tested so that they instinctively follow these procedures. Lessons are learned from both real events and practices and then procedures are improved and updated.

Whether full-time emergency response resources are provided depends on the size of the installation. Large refineries will have staffed medical rooms, ambulances, and fire engines and will coordinate their operations closely with their local community services. All manned platforms and refineries rely on trained volunteers. Volunteers are taught that a fire needs three elements, a heat source, fuel, and oxygen, and they are taught how different fire extinguishers work to remove these elements. They practise using the hoses and extinguishers available in their workplace and how to carry out emergency evacuations and practice drills.

First aiders are taught how to deal with minor injuries,

cuts, burns, dirt in the eyes, etc. and are equipped with the necessary supplies and equipment. In some cases they will be trained to use defibrillators in the event of a cardiac arrest. Trained **fire marshals** and first aiders know their limits of competence and know when to call for more experienced help. For example, no attempt should be made to extinguish a fire that is out of control.

Reporting accidents and emergencies is normally to the next level of supervision. An alternative on a platform or refinery would be directly to the control room. The control room will ensure that the correct procedure for isolating the fuel for the fire is followed by making sure isolating valves are closed for example, and that the right people are quickly informed. They will ensure the correct operation of automatic fire fighting equipment and alarms.

All incidents must be reported, normally in a local logbook. This will be followed up by safety professionals who will produce a full report to include an investigation into the root cause and lessons learnt to avoid future occurrences. Depending on the severity of an incident, reports may have to be circulated to high-level management and in severe cases to the Health and Safety Executive or similar government agencies.

* Tip

emergency services – the public organizations that deal with emergencies: the police, fire, ambulance, and coastguard services

Kick off

- Do **1** as a class. Then do **2** and **3** individually, checking after each exercise by asking students to share their answers. Explain new vocabulary as necessary by pointing it out in the pictures.

0-π 2 1 e 2 b 3 a 4 d 5 c
3 a 4 b 3 c 2 d 5 e 1

*** Tip**

first aid – simple medical treatment that is given to somebody before a doctor comes or before the person can be taken to a hospital

*** Tip**

medic – a person involved with medicine, especially emergency medicine. The term can be applied to paramedics, nurses, and in the oil industry and some other situations, to doctors

Additional activity

Do *Writing bank 9* on Student's Book p.60.

Reading**Dealing with accidents and emergencies**

- Do **1** as a class, then do **2** as a class by asking students to read sections of the text out loud. Call attention to it when any answers that students gave in **1** are mentioned.
- Do **3** and **4** individually, checking after each exercise by asking students to share their answers. Explain new vocabulary as necessary by pointing it out in the pictures.
- Do **5** and **6** as a class.

Open 1 Possible answers

call for help; give first aid

3 1 assess 2 calmly 3 protect

4 a 3 b 1 c 4 d 2

5 1 Remove 3 Activate 5 Try

2 Ensure 4 Call

6 REACT

It's my job

-  Do **1** as a class. Then do **2** and **3** individually. Check by asking students to share their answers.

Open 2 1 take care

3 give

5 get

2 arrange

4 follow

6 deal with

Language spot**if / when / in case**

- Ask students to read the example sentences aloud. Do **1–3** individually, checking after each exercise by asking students to share their answers.

Open 1 1 When

3 If

5 in case

2 in case

4 When

6 If

2 Possible answers

1 go to the doctor's

2 study a lot

3 leave the building

4 I need to repair my car

5 go to the swimming pool

6 I need to phone someone

3 Possible answers

b If there's a fire, use this fire blanket.

c If there's a fire, don't use the lift. Use the stairs.

d When you evacuate, assemble here.

e Push this button if there's a fire.

f We have a first aid station in case someone gets hurt.

Additional activity

Ask students to locate and identify all of the emergency equipment in their place of study. Is all of the equipment in good working order? Do they know how to use it? Is there any emergency equipment that they think should be there that is not?

Vocabulary**Emergency vehicles and equipment**

- Do **1** as a class. Do **2** individually. Check by asking students to share their answers.
- Do **3** and **4** in pairs or groups. After each exercise, ask students to give their group's answers.

Key 2 1 h 2 a 3 d 4 f 5 e 6 c 7 g 8 b 9 i

3 Possible answers

- a when someone has a cut
- b when someone has a heart problem
- c when someone has a breathing problem
- d when someone needs to go to hospital
- e when we need to move an injured person
- f when there's a fire
- g when someone has chemicals on them
- h when there's a fire
- i when there's a lot of smoke

4 Possible answers

- 2 I'll get the first aid kit. I'll help him clean it.
- 3 I'll make the area safe by turning off the power. I'll call for help.
- 4 I'll pour cold water on it. I'll take him to the medic.
- 5 I'll try to put out the fire. I'll call for help. I'll assess the workshop manager. I'll give him oxygen.

Additional activity

(stronger students)

Working in pairs (situations 1 and 2) or groups of three (situation 3), give students a few minutes to try to memorize the conversations and perform them from memory. To avoid making it too stressful, prompt them if they get stuck.

Listening**Understanding what's wrong**

-  Do **1-3** individually. Check by asking students to share their answers.

Key 1 1 F 2 F 3 T 4 T 5 T 6 T 7 F 8 T 9 F

- 2 1 in the workshop
- 2 They were welding.
- 3 They'll go to the clinic.
- 4 tools
- 5 No, he can't.
- 6 in the tank area, on tank 27
- 7 his arms
- 8 in the bulk tanker loading area
- 9 clean up the mess

*** Tip****Top margin**

Before turning to p.98 in the Student's Book, ask the students if they can guess which parts of the body are most commonly injured in the oil and gas injury. Then turn to p.98. Did anyone guess correctly?

*** Tip**

vent – to provide an outlet for air

veal – meat from a young cow

viper – a small poisonous snake

wiper – windscreen wiper: a blade with a rubber edge that moves across the windscreen of a car or truck to make it clear of rain, snow, etc.

Additional activity

Working in pairs or small groups, ask students to write a role-play in which they discover and deal with an emergency situation. They should model their work on situations presented in the unit, but should change details and create original scenarios.

Language spot**Past Continuous**

- Ask students to read the example sentences aloud. Do **1** individually. Check by asking students to share their answers.
- Do **2** in pairs. Check by asking students to give their partner's answers.

- Key**
- 1 I was working in Dubai last year.
 - 2 We weren't welding yesterday when the fire started.
 - 3 Were they going to the airport when the car broke down?
 - 4 He was cleaning the spark plugs.
 - 5 You weren't using the hand guard.
 - 6 Was she using her mobile phone when she was driving?
 - 7 It was making a strange noise so we turned it off.
 - 8 I wasn't driving the truck.

Pronunciation

- Do **1-3** individually, checking after each exercise by asking students to share their answers.
- Do **4** in pairs.

- Key**
- 1 w 2 v 3 v 4 v 5 v 6 w 7 w 8 v 9 w
 - 3 1 went 2 wheel 3 wiper

Speaking**Explaining an accident**

- Do **1** and **2** as a class.
- Do **3** and **4** in pairs. As students work, monitor and give assistance as necessary.

- Key**
- 1 e 2 c 3 d 4 a 5 b
 - 2 1 on the roof of the admin block
2 Rolf Jordan fell into the roof space (and broke his leg).
3 Bill Becks, John Green
4 a broken leg
5 10.00 a.m., 8 July

Writing

An accident report

- Do **1** as individuals, then do **2** in pairs. As students work, monitor and give assistance as necessary.

1 Student A

Injury type: *Back injury*

Work activity: *Preparing to install pipeline*

Location: *Near main refinery*

Date and time of incident: *8.30 a.m. 12 August*

Description of incident: *Pascal Larue was walking to the work area. He didn't notice Dirk Boyd's vehicle. The vehicle hit Larue. He fell to the ground. His back was injured. Luke Inman came to help.*

Student B

Injury type: *Broken arm*

Work activity: *Replacing a valve*

Location: *The pipe field*

Date and time of incident: *19 June, 4.00 p.m.*

Description of incident: *Piet van Espen was working alone in the pipe field. He fell over and broke his arm.*

Additional activity

Do the Unit 14 communication activity on Teacher's Resource Book p.105.

Number talk

Vital signs

- Do **1** and **2** individually. Check by asking students to share their partner's answers.

1 1 temperature
2 heart
3 breathing

4 blood
5 Pain

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

15 Petrochemicals

Background

Petrochemicals are chemicals derived from petroleum, that is, oil and gas formed from the decayed remains of marine plants and animals millions of years ago. Coal was formed from land-based organisms and is a hard, brittle rock composed mainly of carbon, whereas oil is a liquid. Coal, oil, and gas are known as **fossil fuels**. Oil and gas contain mainly carbon and hydrogen, and so they are called **hydrocarbons**. Carbon is twelve times heavier than hydrogen and one carbon atom combines with up to four atoms of hydrogen. As more carbon atoms combine together and with hydrogen, the resulting compounds become heavier. The lightest, simplest hydrocarbon is methane, which has the chemical formula CH_4 . Heavier gases are ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). The next compound in the series, pentane (C_5H_{12}), is a volatile liquid at room temperature.

The carbon atoms in these compounds join together by single bonds. Carbon atoms can also combine with double bonds. As more carbon atoms combine, as well as forming straight chains, they form branches, loops, and rings. The heavy product from the oil refining process, bitumen, is so complex and variable that it has no definable chemical formula. After lighter and heavier compounds are separated out from crude oil by distillation, their structure can be changed at the refinery to provide various fuels. But there are many other useful chemical compounds made from crude oil.

A simple chemical with a double carbon bond is the gas ethylene (C_2H_4) which is produced by steam cracking in the refinery. It is used in chemical plants to make **polyethylene** (polythene) by joining the ethylene molecules together under pressure in the presence of a catalyst. It is the most widely used **plastic**, mainly produced in sheets for packaging. The names of many other useful **polymers** begin with the prefix 'poly'. Polyester, polystyrene, polyamide (nylon), polycarbonate, and polyvinyl chloride (PVC) are examples. Many of these polymers can be extruded to produce pipes and fibres. The fibres can be made into fabrics. Plastics can be moulded into complex shapes or made with air bubbles to produce foam. Certain polymers combined with **carbon black** are a substitute for natural rubber and are used to make car tyres.

Synthetic resins are petrochemical liquids that are capable of hardening. They are used for paints, adhesives, and varnishes. Epoxy resin is used with a hardener in conjunction with a strong fibre such as glass or carbon. Such materials are stiff, strong, and light. They are replacing aluminium as a structural material in aircraft. The properties of petrochemicals are superior and more consistent than natural materials. They are also cheap to produce and relatively expensive to recycle so they create problems in disposal and pollution.

Additional activity

Look around the classroom. What materials are things made of? How many objects can you find that are made from wood? From metal? From plastic?

Kick off

- Do **1-3** as a class.

0 π 2 1 h 2 f 3 c 4 g 5 a 6 b 7 e 8 i 9 d

3 Possible answers

- 1 Carpets can be made from wool.
- 2 Cosmetics can be made from plants and minerals.
- 3 Paints can be made from minerals and natural oils.
- 4 Clothes can be made from wool and cotton.
- 5 Rubber can be obtained from rubber trees.
- 6 Fertilizer can be made from animal waste.
- 7 Containers can be made from glass.
- 8 Adhesives can be made from animal products.
- 9 Medicines can be made from plants.

* Tip

crayon – a coloured pencil or stick of soft coloured chalk or wax, used for drawing. It shouldn't be confused with the French word *crayon*, which means *pencil*.

Additional activity

(stronger students)

Many plastic products are stamped with a *resin code* or *international universal recycling code*. There are seven codes. As homework, get the students to research the seven codes and report back to the class on what materials they are used for, along with examples of products made from those materials.

	PET(E) Polyethylene terephthalate Polyester fibres, soft drink bottles
	PEHD or HDPE High-density polyethylene Plastic bottles, plastic bags, trash cans, imitation wood
	PVC Polyvinyl chloride Window frames, bottles for chemicals, flooring
	PELD or LDPE Low-density polyethylene Plastic bags, buckets, soap dispenser bottles, plastic tubes
	PP Polypropylene Bumpers, car interior trim, industrial fibres
	PS Polystyrene Toys, flowerpots, video cassettes, ashtrays, trunks
	O(ther) All other plastics

(Source: en.wikipedia.org/wiki/International_Universal_Recycling_Codes)

Additional activity

(weaker students)

Students practise *and*, *but*, *because* by writing six true sentences about themselves (two sentences for each word). Students share their sentences in groups. Ask a few students to share a partner's sentence with the class.

Reading

The history of petrochemicals

- Do **1** and **2** individually, checking after each exercise by asking students to share their answers.
- Do **3** as a class. Do **4** by asking students to take turns reading the sentences of the text. Then do **5** as a class.

Key 1 1 b 2 a 3 b 4 a 5 b 6 a 7 b 8 a 9 a

2 1 cotton, wool, leather
2 carbon black
3 There were a lot of oil refineries. Companies wanted to use the by-products.
4 from the 1920s to the 1940s
5 nylon
6 They do not rot or break up. They pollute oceans and kill wildlife.

3 Possible answers
clothing, plastic containers, medicines

4 1 F 2 F 3 T

5 Possible answers
Polystyrene: packaging, cups
PVC: pipes, window frames
Nylon: clothing, camping equipment

Language spot

and, *but*, *because*

- Ask students to read the example sentences aloud. Do **1** individually. Check by asking students to share their answers. Do **2** in pairs or groups. Check by asking students to share their answers.

Key 1 1 because 3 and 5 and
2 but 4 but 6 because

2 1 a I cut my finger, and Juan injured his hand.
b I cut my finger, but it wasn't serious.
c We called the medic because Juan injured his hand.
2 a We replaced the gasket, and we cleaned the spark plug.
b It's running much better, but it's making a funny noise. / We replaced the gasket, but it's making a funny noise.
c It's running much better because we cleaned the spark plug.
3 a We're using this tank, and it isn't damaged.
b We're using this tank, but it's damaged. / We aren't using this tank, but it isn't damaged.
c We're using this tank because it isn't damaged. / We aren't using this tank because it's damaged.

*** Tip**

Give students practice with fluency by having them read the *Listening script* aloud. Encourage them to look at the script and read silently, then look up and say the words as naturally as they can.

Additional activity

(stronger students)

As homework, students do research about a local manufacturing company. They give short presentations in English about the location, operations, and products of the company.

*** Tip**

tensile – (only before a noun) used to describe the extent to which something can stretch without breaking

Listening**Factory and product description**

- Do 1–6 individually, checking after each exercise by asking students to share their answers.

- Key**
- 1 Chisso Petrochemical Corporation
2 Goi Factory
3 near Tokyo
4 polyethylene and polypropylene
 - 3 Ticked: 2, 3, 5, 6, 8, 9, 11
 - 5 1 manufactures
2 uses
3 produced
 - 4 specializes
5 is used

Speaking**Describing a petrochemical product**

- Do the exercise in pairs. As students work, monitor and give assistance as necessary.

- Key**
- Student A**
Arg-Nyl's San Lorenzo Plant is near Buenos Aires, Argentina. It manufactures nylon fabric. Its product is used to make clothing, shoes, and camping tents.
- Student B**
Ming Hing Carbon Company's MH Guanzhou Works is in Guangzhou, China. It manufactures carbon fibre. Its product is used to make composite fabrics used in cars and airplanes.

It's my job

- Do 1 and 2 individually, checking after each exercise by asking students to share their answers. Do 3 as a class.

- Key**
- 1 Specialist Plastics Limited
2 the test department
3 most of the test equipment
4 larger plastics manufactures and other industries such as aerospace, oil and gas, and domestic appliance companies
5 chemistry
6 the aerospace industry
 - 1 impact test
2 tensile test
3 bend test
 - 3 Because it will be used in an airplane. Many people could die if there is a problem.

*** Tip**

requisition – a formal, official written request or demand for something

Additional activity

Do *Writing bank 10* on Student's Book p.61.

Additional activity

Do the Unit 15 communication activity on Teacher's Resource Book p.107.

Writing**Materials requisition**

- Do **1** as a class, then do **2** individually. Check by asking students to share their answers.

1	1 polycarbonate pellets
	2 500 kg
	3 (20 kg) bags
	4 Plasco, Hitrust (Sizhou), Yugao Dayu
2	1 polycarbonate pellets
	2 PC 180
	3 500 kg
	4 20 kg bags
	5 9 April
	6 Teesside lab
	7 Plasco, Hitrust (Suzhou), Yugao Dayu
	8 George Harvey
	9 3578

Project

- Assign the project as homework. Ask students to present their findings to the class.

Checklist, Key words

- Go through the checklist with students. Get them to tell you which activities in the unit helped them practise each point. Ask students to tick the points they feel they can perform. Ask the class if they need more practice in any of the areas. Go through the list of words to check students' understanding.

Instructions for communication activities

General instructions for information gap activities (2, 3, 4, 5)

- 1 Students work in pairs.
- 2 Give each pair a Student A worksheet and a Student B worksheet. Do not let them look at each other's worksheets. If possible, seat the students so that they are back-to-back and must complete the activity through speaking only.
- 3 Students do the tasks on the worksheet.
- 4 When they have completed the task, they look at each other's worksheets and check their answers.

Unit 1

This activity will give students practice with saying and listening to personal details, especially letters and numbers.

- 1 Give each student a copy of the worksheet.
- 2 Elicit the questions they will need to ask to find out the information. Write them on the board.
What's your first name?
What's your family name?
What's your nationality?
What's your phone number?
What's your email address?
What's your date of birth?
- 3 Ask the students to stand up and circulate. Each student will need to ask four other students for the information and will need to give their information four times.
- 4 Circulate and give help as necessary.
- 5 When everyone has finished, go around the room and indicate each student. Ask other students to call out the information they learned about that student.

Unit 2

This activity gives students practice with saying and listening to large numbers and units of measurement. Follow the general instructions for information gap activities.

Unit 3

This activity gives students further practice with phone messages. It also gives them practice with saying calculations. Follow the general instructions for information gap activities.

Unit 4

This activity gives students further practice with asking and answering questions about weights and measures. Follow the general instructions for information gap activities.

Unit 5

This activity gives students further practice with asking and answering questions about locations using global positioning technology. Pre-teach *meeting place* (the place on the map where Student A and Student B are going to meet). Follow the general instructions for information gap activities. Do **1** individually. Do **2** and **3** in pairs.

Unit 6

This activity gives students further practice with some drilling jobs and equipment.

- 1 Divide the class into pairs or groups of three.
- 2 Give each pair or group a sheet. Students cut the sheet into cards.
- 3 Students shuffle the cards and place them face down so that no card is lying on another card.
- 4 They play *pelmanism*:
 - The first player turns over two cards.
 - If the cards form a pair (the image matches the text), the student keeps the pair and turns over two more. If they match, the student keeps the pair and continues. If they don't match, the cards are turned over again and the next player takes a turn.
 - As the game continues, students will see more and more cards. They should try to remember where they are so when their turn comes, they can make pairs.
 - When all of the cards have been taken, the student with the most pairs wins.

Unit 7

This activity revises the vocabulary of welding safety equipment and *Have you got ... ?* Before you begin, review the names of the seven pieces of welding safety equipment on the cards (*jacket, helmet, gloves, safety harness, overalls, safety glasses, respirator*). Write *Have you got ... ?* on the board, along with *No, I haven't* and *Yes, here you are*.

- 1 Divide students into pairs or groups of three.
- 2 Give each pair or group a set of cards to cut out and mix up.
- 3 Each group chooses a dealer. The dealer gives each player five cards. The remaining cards should be placed in a pile face down. This is the *draw pile*.
- 4 The aim of the game is to get sets of four matching cards. A turn consists of taking one card, either from another player or from the pile, and putting down one card face up, next to the draw pile.
- 5 The player to the dealer's left starts. He asks the other player(s) for an item that he already has a card for, for example *Have you got (a jacket)?* If the player has that card, he must say *Yes, here you are* and hand it over. If not, he says *No, I haven't* and the player asking the question must draw a card from the draw pile.

- 6 As soon as one player collects four cards with the same picture, these must be put down face up. The game continues until all of the cards have been played. The winner is the person with the most sets.

Unit 8

This activity gives more practice with comparatives and superlatives.

- 1 Start by introducing the Troll A Offshore Gas Platform. Tell students to raise their hand every time they hear you use a superlative adjective. Say *The Troll A Offshore Gas Platform is the heaviest man-made mobile object in the world. It is the tallest construction to be moved from one place to another. It is one of the largest and most complex engineering projects in history. In 2006, singer Katie Melua gave the world's deepest underwater concert at the platform, 303 metres below sea level.* If students don't get all of them, say the text again.
- 2 Divide students into groups of three.
- 3 Give each group a set of cards to cut up. Students shouldn't look at one another's cards, but should share information about the platform they've been given. For example, *My platform weighs 656,000 tonnes. How much does yours weigh?*
- 4 After they have finished comparing information, they write comparative and superlative sentences, for example *The Troll A Offshore Gas Platform is the oldest. It was finished in 1996. The Troll A Platform is almost the same height as the Tombua-Landana Oil Platform.*
- 5 Ask each group to write five sentences on the board. Check with the class.

Unit 9

This activity gives students further practice with talking about bar charts. It also gives them practice with saying calculations. Follow the general instructions for information gap activities. Point out that each bar chart shows consumption with black bars and production with grey bars.

Unit 10

This activity gives students further practice with the Past Simple. Pre-teach *case study* (a process of research into a situation to help understand what went well and what could have been improved) and *cloudy* (when referring to water – i.e. not clear, in this case probably full of sand). Follow the general instructions for information gap activities. Complete **1** and **2** in pairs.

Unit 11

This activity gives students further practice with the Present Perfect and some basic workshop terminology. Follow the general instructions for information gap activities. Complete **1** and **2** in pairs.

Unit 12

This activity gives students further practice with talking about basic machine parts and damage. Follow the general instructions for information gap activities. Complete the activity in pairs.

Unit 13

This activity gives students further practice with the Passive and some basic refinery vocabulary. Pre-teach *capacity* (the number or amount of things or people that a container or space can hold). Follow the general instructions for information gap activities. Complete **1** and **2** in pairs.

Unit 14

This activity gives students further practice with *if / when / in case* and also encourages them to think about what they might do in an emergency situation. Students do the activity in groups of three or four.

There is no single correct answer. Allow students to make their own arguments for why they think certain items might be useful. Survival experts say that, especially in the desert, it is important to stay with the plane. This will increase your chances of being found. Walking in the desert would soon make you exhausted. The desert will probably be very cold at night. It would be very important to make a shelter, so the rope, plastic sheet, and blanket would be very useful. The sunglasses could protect your eyes from the sun and sand. The least useful items may be the matches (probably no fuel for a fire in the desert) and the pistol (probably nothing to shoot).

Unit 15

This activity gives students practice with talking about a petrochemical production process. Teach or elicit *epoxy* (a type of strong glue), *flammability* (ability to burn), *density* (thickness of something measured by its mass per unit of volume), and *porosity* (the amount of air or water that can pass through a substance).

- 1 Make one copy of the worksheet for every three students in your class.
- 2 Give one worksheet to groups of three students. Ask them to cut out the cards.
- 3 Write on the board *How do you turn crude oil into a coffee cup?* In their groups, students answer the question by putting the text and illustrations into the correct order.

Key illustrations: C, H, D, E, I, F, G, A, B
text: c, e, d, f, g, b, i, h, a

1 Language test

1 Complete the sentences with *a, an, the*, or nothing.

- 1 BP is _____ British company.
- 2 I like working _____ outside.
- 3 Ian is from _____ Canada.
- 4 I work in _____ UAE.
- 5 There's _____ screwdriver in my toolbox.
- 6 Exxon is _____ American company.
- 7 Do you have _____ electric drill at home?
- 8 Khaled is _____ manager of the workshop.
- 9 Do you work in _____ Saudi Arabia?
- 10 There's _____ technician in the control room.
- 11 I like working in _____ small team.
- 12 Do you speak _____ English?

2 Match the halves of the sentences.

- | | |
|-------------------|---|
| 1 I'm from | a you from? |
| 2 Where are | b from the US? |
| 3 What is | c aren't Spanish. They're Italian. |
| 4 He's | d Shell an American oil company? |
| 5 Is | e isn't American. It's British. |
| 6 BP | f Braschem and Petrobras Brazilian companies? |
| 7 Are | g Egypt. We're from Libya. |
| 8 Leo and Arno | h German. His name is Otto. |
| 9 Are you | i her name? |
| 10 We aren't from | j Bahrain. |

3 Underline the correct words.

- 1 *Are there / There are* a lot of oil and gas jobs in your country?
- 2 *There is / are* two wrenches in my toolbox.
- 3 *Is there / There is* a spanner in your toolbox?
- 4 *There are / There's* a big oil and gas industry in Brazil.
- 5 *Is there / Is* a big oil industry in your country?
- 6 *There are / There's* some bolts on the table.
- 7 *Are there / There's* a foreign company drilling in my country.
- 8 How many technicians *there / are there* in your team?
- 9 *There are / They are* a lot of offshore wells in the UK.
- 10 How many offshore wells *is / are there* in your country?

1 Communication

Get to know four classmates. Ask them for the information. Write it down.

First name: _____

Family name: _____

Nationality: _____

Phone number: _____

Email address: _____

Date of birth: _____

First name: _____

Family name: _____

Nationality: _____

Phone number: _____

Email address: _____

Date of birth: _____

First name: _____

Family name: _____

Nationality: _____

Phone number: _____

Email address: _____

Date of birth: _____

First name: _____

Family name: _____

Nationality: _____

Phone number: _____

Email address: _____

Date of birth: _____

Useful language

What's that number again?

How do you spell that?

Could you say that again, please?

Sorry?

What's that again?

2 Language test

1 Complete the conversations with *do*, *does*, *don't*, or *doesn't*.

A _____¹ you work in Indonesia?

B Yes, I _____².

A _____³ you live in Jakarta?

B No, I _____⁴.

A _____⁵ Stanley work in an office?

B Yes, he _____⁶. But he _____⁷ like it! He likes working outside.

A _____⁸ João and Sylvie live in Brasilia?

B No, they _____⁹.

A Where _____¹⁰ they live?

B They live in São Paulo.

A _____¹¹ we start at seven o'clock?

B No, we _____¹². We start at seven thirty.

2 Complete the questions. Use the words in the list.

How What Where When Which Who Why

1 _____ does Tom live?

2 _____ do roughnecks do?

3 _____ country does Anatoli work in?

4 _____ many days per week do you work?

5 _____ does Wayan work for?

6 _____ do we start work in the morning?

7 _____ does a well test operator need to be good with numbers?

3 Complete the table.

307	three hundred and seven
490	a
b	five thousand
6,344	c
d	ten thousand
13,450	e
f	three hundred thousand
465,000	g
h	seven million
75,000,000	i
j	nine billion

2 Communication

Student A

1 Look at this information. Answer Student B's questions.

Tupi oilfield

Location: in Brazil, offshore, 250 kilometres from the city of Rio de Janeiro

Oil production (bbl/d): 100,000

Oil production (m³/d): 16,000

Gas production (m³/d): 4,000,000

2 Student B has information about an oilfield. Ask these questions. Write the answers.

- 1 What's the name of the oilfield?
- 2 Where is it?
- 3 How many barrels of oil does it produce per day?
- 4 How many cubic metres is that?
- 5 How much gas does it produce?

Useful language

What's that number again?
 Could you say that again, please?
 How do you spell that?
 What's that again?
 Sorry?

Student B

1 Student A has information about an oilfield. Ask these questions. Write the answers.

- 1 What's the name of the oilfield?
- 2 Where is it?
- 3 How many barrels of oil does it produce per day?
- 4 How many cubic metres is that?
- 5 How much gas does it produce?

Useful language

What's that number again?
 Could you say that again, please?
 How do you spell that?
 What's that again?
 Sorry?

2 Look at this information. Answer Student A's questions.

Burgan oilfield

Location: in Kuwait, onshore, 45 kilometres south of Kuwait City

Oil production (bbl/d): 1,200,000

Oil production (m³/d): 190,800

Gas production (m³/d): 15,574,260

3 Language test

1 Write sentences using the Present Continuous.

EXAMPLE

I'm not working (not work) today. I'm having (have) a day off.

- 1 You _____ (work) in the office today. You _____ (not work) outside.
- 2 They _____ (not collect) data. They _____ (test) pipes.
- 3 We _____ (have) problems with the new computer. The screen _____ (not work).
- 4 I _____ (not drive) now. I _____ (have) lunch.
- 5 He _____ (not measure) a pipe. He _____ (check) for leaks.
- 6 The drill _____ (make) a funny noise. It _____ (not work) properly.

2 Complete the conversations. Use the Present Simple or the Present Continuous of the words in brackets.

A What _____¹ geologists _____² (do)?

B They _____³ (study) rocks.

A What _____⁴ you _____⁵ (do) today?

B I _____⁶ (work) in the Riyadh office.

A _____⁷ you _____⁸ (have) a lot of problems with your hand-held computer today?

B Yes! I _____⁹ (go) to the technical support desk right now!

A How _____¹⁰ it _____¹¹ (go)?

B OK, thanks. I _____¹² (have) a lot of work to do!

3 Complete the table.

2 + 2	two plus two
7 × 3	a
b	twelve divided by four
√4	c the _____ of _____
d	fifteen per cent
8 - 7	e
f	ten times three equals thirty
7.25	g
h	three over four

4 Language test

1 Put the words in the correct order to make questions.

EXAMPLE lift / the / 25 tonnes / crane / can ?
Can the crane lift 25 tonnes?

1 come / can / I / in ?

2 me / you / can / pass / hammer / that ?

3 can / use / phone / your / I ?

4 this / you / me / help / carry / can / pipe ?

5 harness / can / you / me / show / this / to / how / use / safety ?

6 hard / take / my / off / I / can / hat ?

2 Explain the signs. Use *You must* or *You mustn't*.

1 **No mobile phones**

2 **Watch for trucks**

3 **Do not switch off this machine**

4 **Wear a hard hat**

5 **Danger. Sparks. Wear goggles**

6 **High voltage wires. Do not touch**

3 Answer the questions with *Yes, it can* or *No, it can't*.

1 Can it lift 450 kg? _____

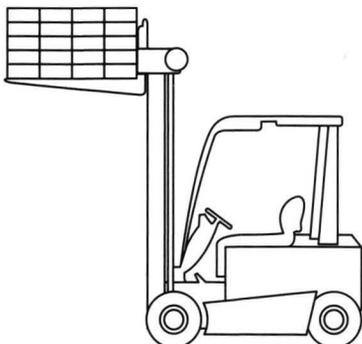
2 Can the tank hold 20 l? _____

3 Can it do 30 kph? _____

4 Can the tank hold 30 l? _____

5 Can it do 20 kph? _____

6 Can it lift 550 kg? _____



Lift: 500 kg
 Speed: 25 kph
 Tank: 25 l

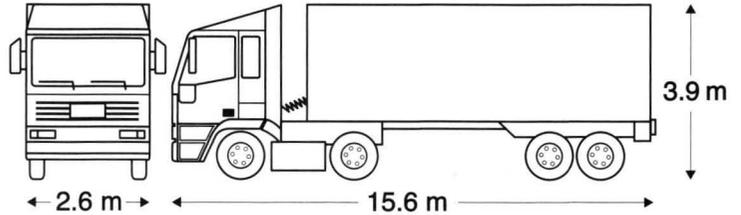
4 Communication

Student A

1 Ask questions to find out about Student B's lorry.

length: _____
 height: _____
 weight: _____
 speed: _____

2 Answer Student B's questions about this lorry.



Model D-156
 32 tonnes, 60 kph

Useful language

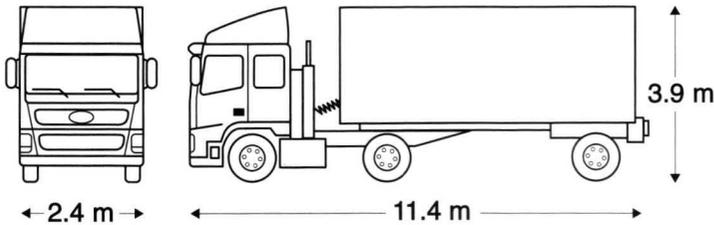
How _____ is it?
 (long, high, heavy, fast)

3 Can the lorries go on a road with each sign? Tick (✓) the correct box.

| D-156 | yes <input type="checkbox"/> no <input type="checkbox"/> |
|-------|--|--|--|--|--|
| D-114 | yes <input type="checkbox"/> no <input type="checkbox"/> |

Student B

1 Answer Student A's questions about this lorry.



Model D-114
 27 tonnes, 70 kph

2 Ask questions to find out about Student A's lorry.

length: _____
 height: _____
 weight: _____
 speed: _____

Useful language

How _____ is it?
 (long, high, heavy, fast)

3 Can the lorries go on a road with each sign? Tick (✓) the correct box.

| D-156 | yes <input type="checkbox"/> no <input type="checkbox"/> |
|-------|--|--|--|--|--|
| D-114 | yes <input type="checkbox"/> no <input type="checkbox"/> |

5 Language test

- 1** What kind of word is each underlined word? Write V (verb), N (noun), P (pronoun), Adj (adjective), or Adv (adverb).

João¹ is² a geologist³. He lives⁴ and works⁵ in Brazil. He⁶ often⁷ works⁸ away from home⁹. João uses¹⁰ GPS every day. He says, 'GPS is a wonderful¹¹ tool. It helps¹² me do my work quickly¹³. It tells me exactly¹⁴ where I am¹⁵'. João likes his job because it's interesting¹⁶. 'Every day¹⁷ is different¹⁸', he says.

- | | | |
|---------|----------|----------|
| 1 _____ | 7 _____ | 13 _____ |
| 2 _____ | 8 _____ | 14 _____ |
| 3 _____ | 9 _____ | 15 _____ |
| 4 _____ | 10 _____ | 16 _____ |
| 5 _____ | 11 _____ | 17 _____ |
| 6 _____ | 12 _____ | 18 _____ |

- 2** What kind of sentence is each sentence? Write I (imperative), Q (question), or S (statement).

- 1 _____ Meet me at eight o'clock.
- 2 _____ My bearing is 220 degrees.
- 3 _____ What's your position?
- 4 _____ Don't forget your GPS.
- 5 _____ Can you help me?
- 6 _____ My radio is in the car.

- 3** Put the words in the correct order to make sentences.

- 1 companies / oil / Oil / search / possible / for / traps

- 2 3D / produce / help / Geophones / maps

- 3 seismic / trucks / Vibrator / make / waves

- 4 the / of / reflects / waves / Each / some / layer / rock

- 4** Complete the sentences. Use the words in the list.

he her him she them they us we

Mr Wong is talking to Mr Spencer.
= _____¹ is talking to _____².

Pete and Fawaz are helping the woman.
= _____³ are helping _____⁴.

Mrs Makita works with George and me.
= _____⁵ works with _____⁶.

Rudy and I know Mr Aziz and Mr Hastings.
= _____⁷ know _____⁸.

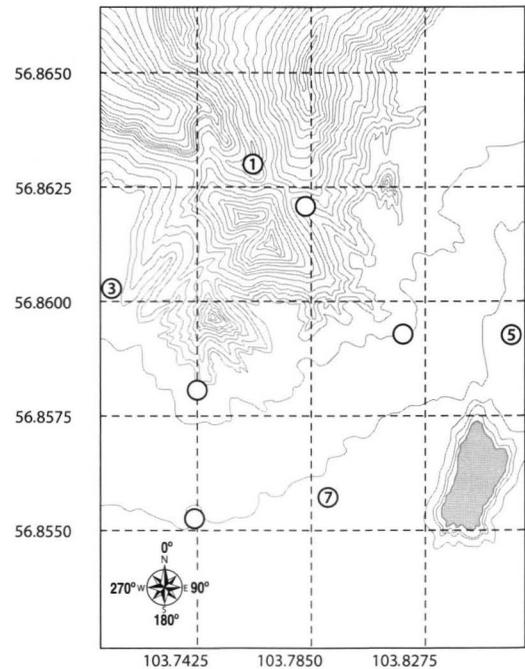
5 Communication

Student A

- Write the numbers from the map.
 - _____ Your position: 56.8560, 103.7912
 - _____ Your next waypoint: 56.8605, 103.7104
 - _____ The position of the survey crew: 56.8632, 103.7635
 - _____ Base camp: 56.8595, 103.8595
- Answer Student B's questions.
- Ask Student B questions. Mark these places on the map.
 - 2 = Student B's position
 - 4 = Student B's next waypoint
 - 8 = The position of the seismic team
 - 6 = Your meeting place with Student B
 What is Student B's heading?

Useful language

What's your position right now?
 My coordinates are _____ degrees by _____ degrees.
 What's your heading?
 _____ degrees.

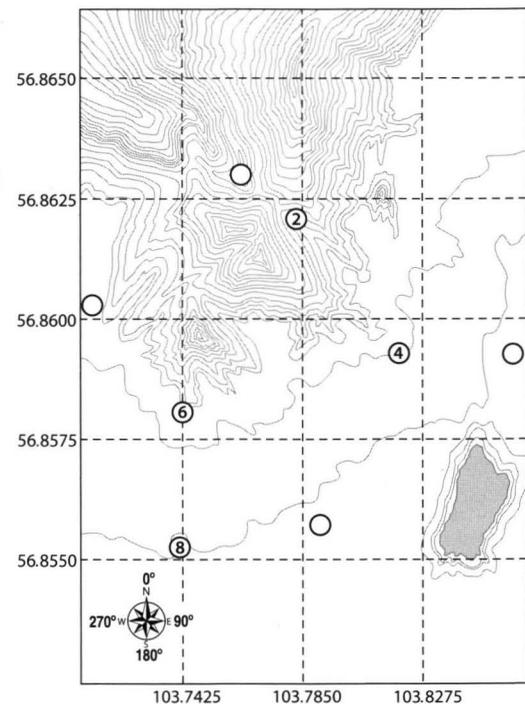


Student B

- Write the numbers from the map.
 - _____ Your position: 56.8622, 103.7845
 - _____ Your next waypoint: 56.8595, 103.8190
 - _____ Your meeting place with Student A: 56.8583, 103.7425
 - _____ The seismic team: 56.8555, 103.7420
- Ask Student A questions. Mark these places on the map.
 - 9 = Student A's position
 - 3 = Student A's next waypoint
 - 1 = The position of the survey crew
 - 5 = Student A's base camp
 What is Student A's heading?

Useful language

What's your position right now?
 My coordinates are _____ degrees by _____ degrees.
 What's your heading?
 _____ degrees.



6 Language test

1 Choose the correct word to complete each sentence.

- 1 Drilling mud is usually *thicker* / *thinner* than water.
- 2 There's a problem with that pump. It's *too noisy* / *the noisiest*.
- 3 This water isn't hot enough. It should be *colder* / *hotter*.
- 4 Roughnecks must be strong because the drilling equipment is very *light* / *heavy*.
- 5 These chemicals can be *dangerous* / *difficult*, so we use PPE.
- 6 Roustabouts are the *least* / *most* junior people on the crew.
- 7 The rig manager is probably the *oldest* / *heaviest* worker on a rig.
- 8 This rope is *too short* / *shorter*. We need a longer one.
- 9 Safety is more *exact* / *important* than speed.
- 10 A mile is *longer* / *weaker* than a kilometre.

2 Use the letters to complete the words.

l ll r rr p pp d dd t tt

- 1 Who gui___es the top part of the drill pipe?
- 2 The too___pusher is the most senior person on the drilling crew.
- 3 The mud screen separates the cu___ings from the mud.
- 4 The opposite of deep is sha___ow.
- 5 The mud is too viscous. A___ some water.
- 6 Drillers cont___ol the drill with a joystick.
- 7 Sto___ the drill! There's a problem!
- 8 The de___ick must be strong to support the heavy drill string.
- 9 The mud lubrica___es the drill.
- 10 The measurements don't need to be exact. They can be a___roximate.

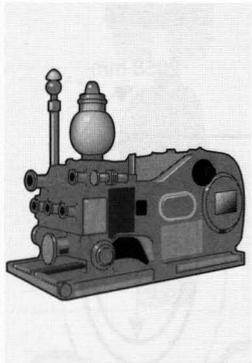
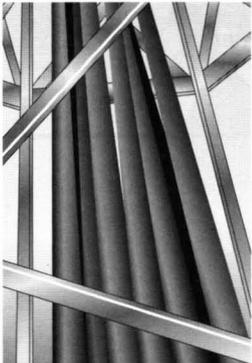
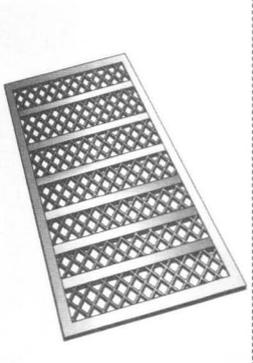
3 Match the sentence halves.

- 1 Connect
- 2 Paint
- 3 Inspect
- 4 Clean
- 5 Dig
- 6 Unload
- 7 Stack
- 8 Tighten
- 9 Move
- 10 Climb

- a the bit for damage.
- b the mud off the rotary table.
- c up to the top of the derrick.
- d the tank red.
- e those pipes away from the door. They're blocking it.
- f the pipes neatly on the pipe rack.
- g the boxes from the truck and put them in the warehouse.
- h the hose to the pump.
- i that bolt. It's loose.
- j a hole here.

6 Communication



<p>Roustabout</p> 	<p>Roughneck</p> 	<p>Derrickman</p> 	<p>Driller</p> 	<p>Rig manager</p> 
<ul style="list-style-type: none"> ● is like a roustabout, but more skilled ● works on the drilling floor ● connects and disconnects drill pipes 	<ul style="list-style-type: none"> ● works high up on the monkey board ● guides the top part of the drill pipe ● checks the mud and maintains the pump 	<ul style="list-style-type: none"> ● is the youngest in a drilling crew ● cleans, maintains, and moves equipment ● helps the other workers 	<ul style="list-style-type: none"> ● is the most senior person in the drilling crew ● is usually the oldest and most experienced ● makes sure the crew has the right equipment ● is responsible for safety and paperwork 	<ul style="list-style-type: none"> ● supervises and trains the drilling crew ● controls the drilling equipment ● on very modern rigs, sits in a special chair
<p>Mud pump</p> 	<p>Pipe rack</p> 	<p>Derrick</p> 	<p>Mud screen</p> 	<p>Monkey board</p> 
<ul style="list-style-type: none"> ● supports the lifting equipment and the drill string 	<ul style="list-style-type: none"> ● sends mud down to the bit 	<ul style="list-style-type: none"> ● holds the pipes before they go into the hole 	<ul style="list-style-type: none"> ● is where the derrickman works 	<ul style="list-style-type: none"> ● separates the cuttings from the mud

7 Language test

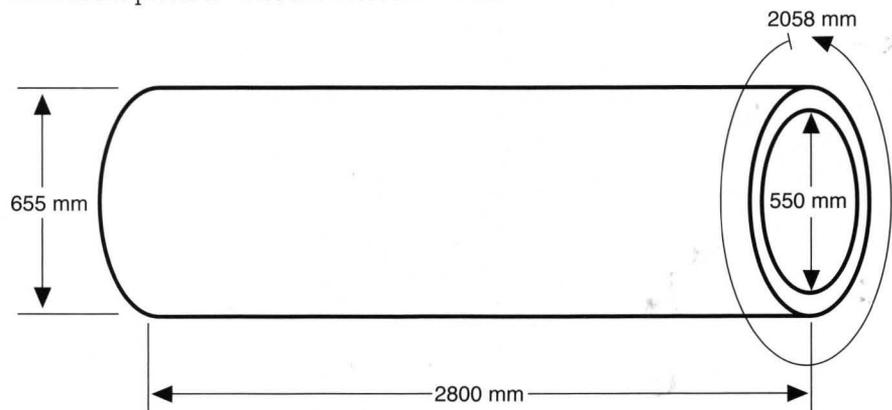
1 Complete the sentences with *a*, *an*, or nothing.

- 1 Don't stand in _____ water.
- 2 Never look directly at _____ arc.
- 3 Wear _____ leather shoes.
- 4 Switch off _____ equipment when you aren't using it.
- 5 Always secure _____ gas cylinders and always move them safely.
- 6 Use _____ cart to move the cylinder.
- 7 Always wear _____ safety glasses when you're working.
- 8 Cover _____ skin and eyes.
- 9 Wear _____ safety harness when you work up high.
- 10 Always use _____ welder's helmet and gloves.

2 Complete the sentences with *much* or *many*.

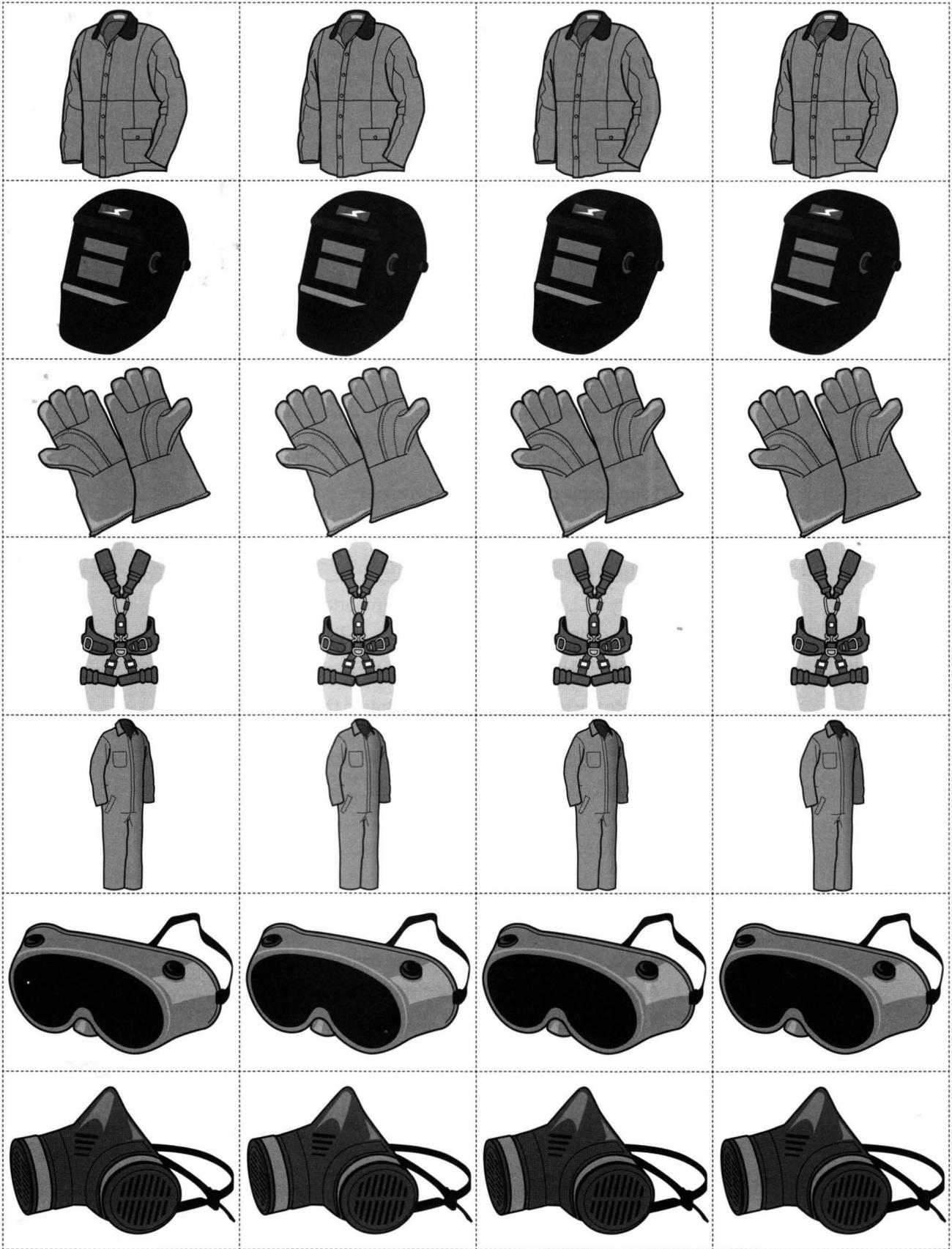
- 1 How _____ brushes are on the pipeline inspection gauge?
- 2 There isn't _____ ethanol in the tank.
- 3 Are there _____ deposits in the pipeline?
- 4 How _____ gas cylinders are there?
- 5 Is there _____ smoke in the workshop?
- 6 Do you get _____ shocks when you use the arc welder?
- 7 I don't have _____ information about the new project.
- 8 How _____ oil can that pipe hold?
- 9 How _____ welders work on your crew?
- 10 Have we got _____ petrol?

3 Look at the picture. Write the measurements.



- 1 length = _____
- 2 outside diameter = _____
- 3 pipe wall thickness = _____
- 4 outside circumference = _____
- 5 inside diameter (bore) = _____
- 6 inside radius = _____
- 7 volume = $\pi r^2 \times l =$ _____ \times _____ \times _____
 _____ \times _____ = 0.66510675 m³

7 Communication



8 Language test

1 Match the words with the symbols.

- 1 Reduce the pressure to ten bar.
- 2 A is as big as C.
- 3 The resistance is ten ohms.
- 4 A is not as big as C.
- 5 The voltage is ten volts.
- 6 Increase the pressure to ten bar.
- 7 Reduce the flow to ten cubic metres per minute.
- 8 A is bigger than C.
- 9 The current is ten amps.

- a $A < C$
- b $14 \text{ m}^3/\text{min} \rightarrow 10 \text{ m}^3/\text{min}$
- c $A \approx C$
- d $R = 10\Omega$
- e $V = 10\text{V}$
- f $5 \text{ bar} \rightarrow 10 \text{ bar}$
- g $A > C$
- h $15 \text{ bar} \rightarrow 10 \text{ bar}$
- i $I = 10\text{A}$

2 Write the correct form of the word in brackets.

- 1 Fuel oil is _____ (heavy) than petrol.
- 2 For me, working offshore is the _____ (good) place.
- 3 The weather in the Atlantic Ocean is usually _____ (bad) than in the Gulf of Mexico.
- 4 I don't mind my onshore job because the pay is _____ (good).
- 5 For me, a job working in very hot weather would be the _____ (bad).
- 6 Drilling rigs are not as _____ (large) as production platforms.
- 7 Safety is _____ (important) than speed.
- 8 Crude oil isn't _____ (light) as kerosene.
- 9 The storms in the North Sea can be very _____ (bad).

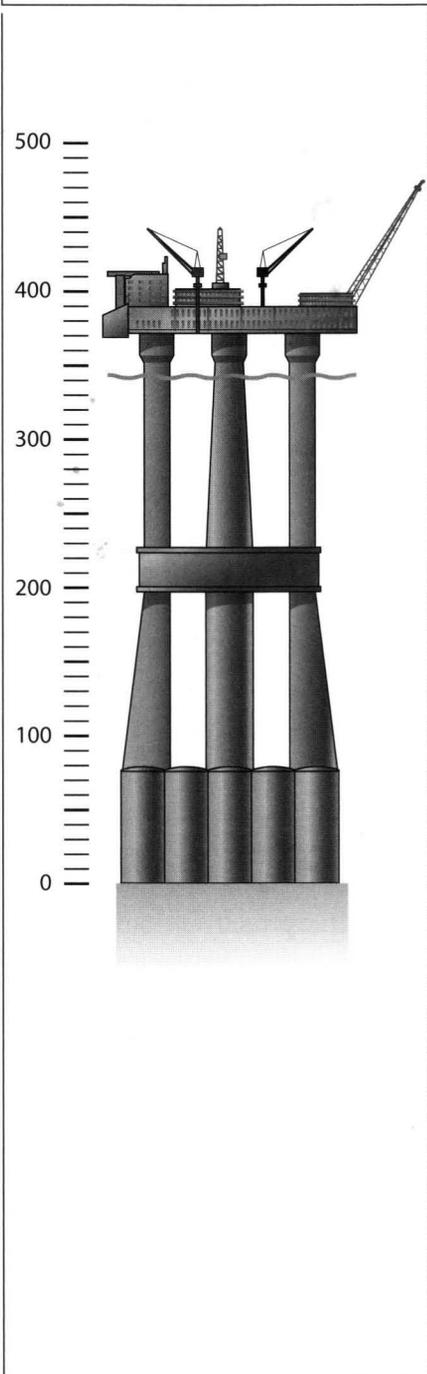
3 Complete the sentences using the words in the list.

circuit component equation gauge
level multimeter pressure short circuit temperature

- 1 Kilopascal is a unit of _____.
- 2 Degrees Celsius are units of _____.
- 3 Per cent or metres are used to express _____.
- 4 A _____ is an instrument for measuring the amount of something, for example flow, temperature, or pressure.
- 5 You can measure variables with a _____.
- 6 A _____ must be complete to work.
- 7 A buzzer is an example of an electrical _____.
- 8 $V=IR$ is a very useful _____.
- 9 A circuit won't work properly if there is a _____.

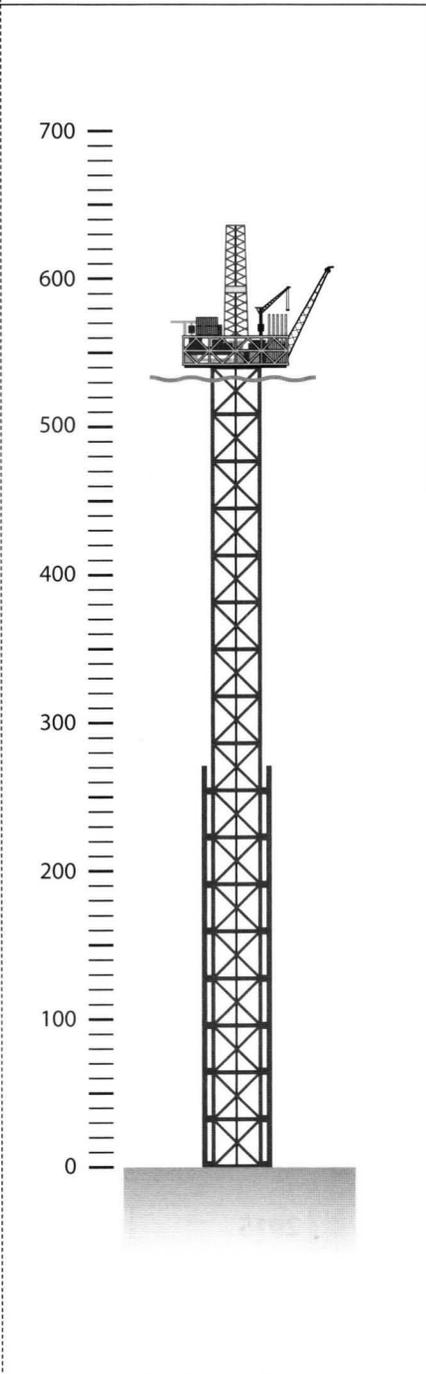
8 Communication

Student A



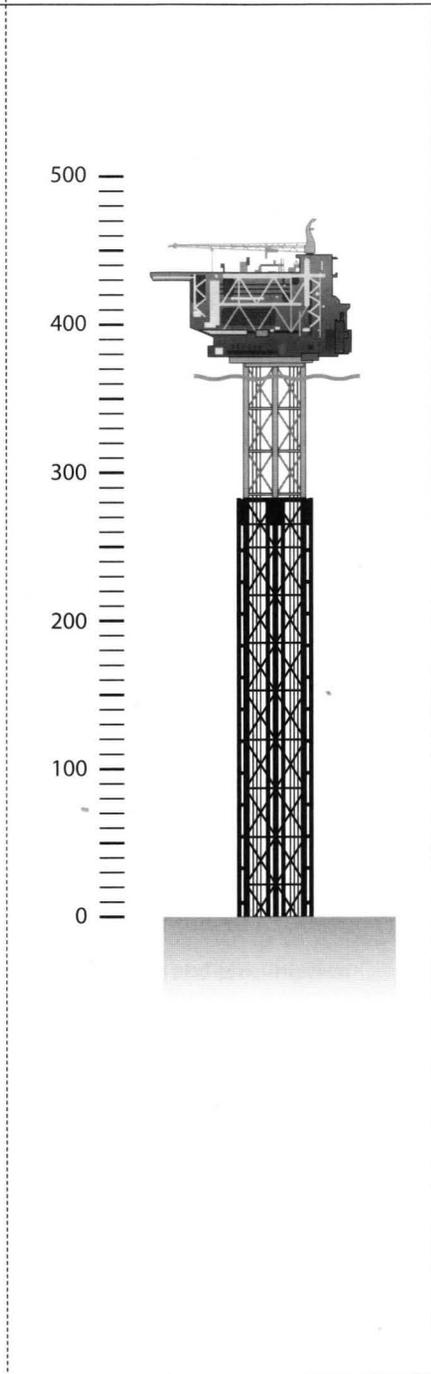
The Troll A Offshore Gas Platform
 Location: North Sea
 Year construction finished: 1996
 Weight: 656,000 tonnes
 Height: 472 m
 Production: 100,000,000 m³ of natural gas per day

Student B



The Petronius Oil Platform
 Location: Gulf of Mexico
 Year construction finished: 2000
 Weight: 43,000 tonnes
 Height: 640 m
 Production: 8,000 m³ of oil and 2,000,000 m³ of natural gas per day

Student C



The Tombua-Landana Oil Platform
 Location: Atlantic Ocean, near West Africa
 Year construction finished: 2009
 Weight: 32,000 tonnes
 Height: 474 m
 Production: 16,000 m³ of oil per day



9 Language test

1 Choose the correct word to complete each sentence.

- 1 Russia *products* / *produces* a lot of gas.
- 2 Gas comes out of the ground as a *vapour* / *vaporization*.
- 3 The liquefaction facility *liquefies* / *liquids* the gas.
- 4 Special tankers *transportation* / *transport* LNG.
- 5 The gas goes from the tanker into tanks for *store* / *storage*.
- 6 *Vaporizers* / *Vaporization* turn the liquid gas into vapour.
- 7 The pipeline system *pipes* / *pipelines* the gas to consumers.
- 8 Homes, businesses, power stations, and so on *consume* / *consumption* the gas.

2 Write the sentences in the Past Simple.

- 1 The tanker is at the terminal.

- 2 Victor isn't in the office.

- 3 I'm in the control room.

- 4 João and Veejay aren't here today.

- 5 Mr Glenwood is at lunch.

- 6 Are you busy?

- 7 You're not late.

- 8 We're in China.

3 Look at the timeline. Read the sentences. Write T (true) or F (false).

Today is 3 May, 2015. It's 1.00 p.m.

Mario's life 2008–2015

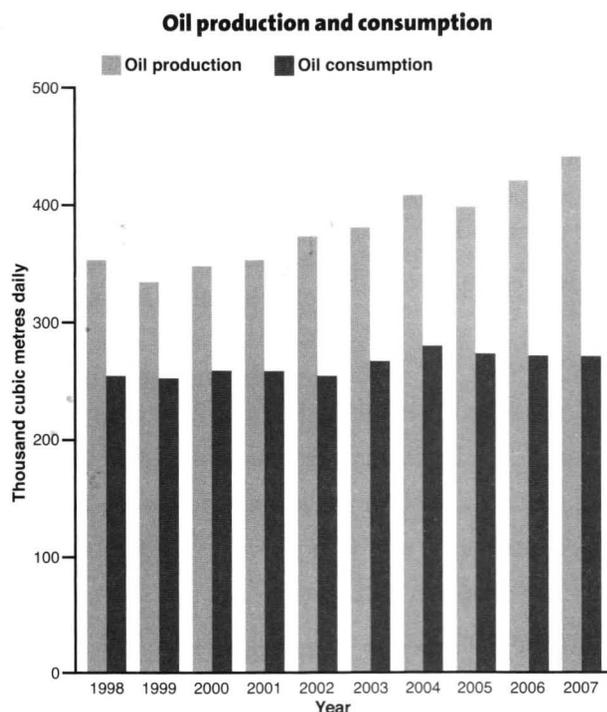
2008	2014		2015			
January	March	April	January	April	2 May	3 May
Start job in Qatar	Leave job in Qatar	Start job in Brazil	Business trip to Argentina	Business trip to Mexico	Meeting with Petrobras	Today 10.00 – meeting with Braschem

- 1 Mario was in Qatar from 2008 to 2015. _____
- 2 He was in Qatar and in Brazil last year. _____
- 3 He was in Argentina last month. _____
- 4 Yesterday was 1 May. _____
- 5 The meeting with Petrobras was last week. _____
- 6 The meeting with Braschem was this morning. _____

9 Communication

Student A

1 Look at the bar chart. Answer Student B's questions.



2 Ask Student B these questions. Write the answers.

- 1 What was gas production in 2004?

- 2 Was consumption higher in 2000 or 2001?

- 3 What was gas consumption in 1998?

- 4 Was gas production higher in 2002 or 2003?

- 5 What was gas production in 2007?

- 6 What year was gas consumption the lowest?

- 7 What year was gas production the highest?

- 8 On average, what is the difference between gas production and gas consumption?

Student B

1 Ask Student A these questions. Write the answers.

- 1 What was oil production in 2004?

- 2 Was consumption higher in 2003 or 2004?

- 3 What was oil consumption in 1998?

- 4 Was oil production higher in 2004 or 2005?

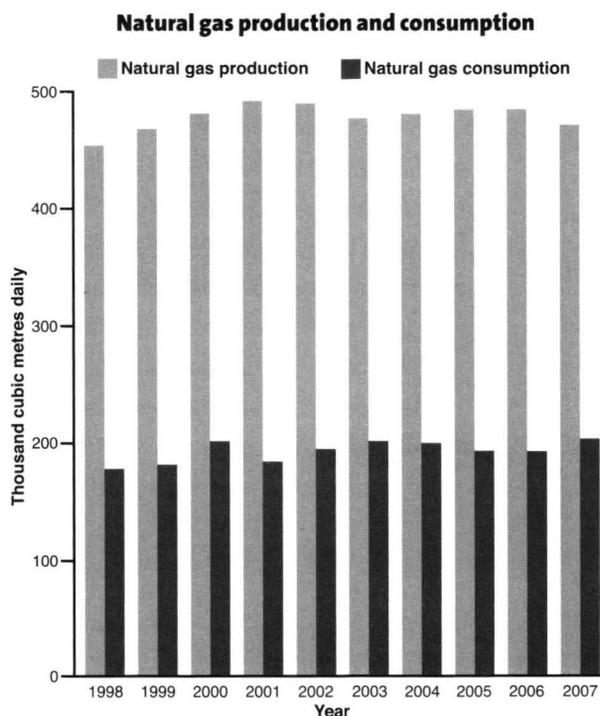
- 5 What was oil production in 2007?

- 6 What year was oil production the lowest?

- 7 What year was oil production the highest?

- 8 On average, what is the difference between oil production and oil consumption?

2 Look at the bar chart. Answer Student A's questions.



10 Language test

1 Complete the conversation. Use the words in the list.

did do finish finished repair repaired start started

A What time did you _____¹ work?

B We _____² at seven o'clock.

A Did you _____³ the compressor?

B Yes, we _____⁴. And we _____⁵ the pump, too.

A Good work. What time did you _____⁶?

B We _____⁷ at 4.00 this afternoon. Now I have to _____⁸ the paperwork.

2 Put the words in brackets in the Past Simple.

Wood River Refinery

Standard Oil _____¹ (finish) building the Wood River Refinery in 1907. The company _____² (begin) production there in 1908. In 1956, Standard Oil _____³ (change) its name to Amoco. The company _____⁴ (refine) oil at Wood River for 25 more years, until they _____⁵ (close) it in 1981. They _____⁶ (start) cleaning up the area right away, but it _____⁷ (be) a long and difficult job. But in 2001, the new owners, British Petroleum, _____⁸ (open) a nature reserve on the site.

3 Match the words with the definitions.

- 1 a safety procedure
- 2 a risk assessment
- 3 a protection programme
- 4 a technique
- 5 an injury
- 6 a nature reserve
- 7 an eco-hazard
- 8 an incident

- a something that can harm the environment
- b harm done to a person's or animal's body
- c something that happens, an event: a fire, a gas leak, an oil spill, a collision, an accident
- d a way of doing things to prevent accidents
- e a plan to work in a way that keeps animals and the environment safe
- f an area where plants and animals are protected
- g a report about possible dangers
- h a particular way of doing something, especially one in which you have to learn special skills

10 Communication

Student A

- 1** Read part 1 of the case study.
Answer Student B's questions.
- 2** Ask Student B these questions.
Write the answers.
 - 1 What did the risk assessment find?

 - 2 Why couldn't the divers work safely?

 - 3 What did BP decide to do?

 - 4 What did they develop?

 - 5 How did they make maps of the sites?

 - 6 How much material did they remove from each site?

Case study part 1

In 2005, there was a large storm in the Gulf of Mexico. The storm was called Hurricane Katrina. Katrina damaged some of BP's natural gas platforms in the Gulf. BP decided to end production at some of the very badly damaged platforms. They needed to take the platforms apart. Usually specially trained divers do this job. They work very carefully underwater using special tools and machines. BP did a risk assessment at the damaged platforms.

Student B

- 1** Ask Student A these questions.
Write the answers.
 - 1 Who or what was Katrina?

 - 2 What did Katrina do?

 - 3 What did BP decide?

 - 4 What job do specially trained divers do?

 - 5 How do the divers usually do the job?

 - 6 What did BP do at the damaged platforms?

- 2** Read part 2 of the case study.
Answer Student A's questions.

Case study part 2

The risk assessment found that it was very difficult to see in the water. The water was very cloudy. The divers couldn't see, so they couldn't work safely. BP decided to find a new way to do the job. What did they do? They developed robots that could control the tools and machinery. The robots used acoustic devices to scan the underwater structures. They made 3D maps of the sites. This way, they could 'see' where they were working. They safely moved about 100 tonnes of material from each site. They protected the environment and made the job safer for divers.

11 Language test

1 How many syllables does each word have? Tick (✓) the correct box.

	1	2	3
1 floor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 workshop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 workbench	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 repairing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7 maintaining	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8 schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 designing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 lathe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2 Write sentences using the Present Perfect.

1 you finish welding the containment?

2 we replace the bearings, but we not put in the gasket.

3 he ever use a MIG welder?

4 they not build the base.

5 you work in the UAE?

6 I never use an oxyacetylene welder.

7 it rain this week?

8 we not paint the tank, but we weld it.

3 Complete the sentences. Use the words in the list.

clean clear cluttered dirty disorganized organized safe unsafe

1 We keep our workshop _____ so we can always find our tools.

2 Keep the floor very _____. A spill, for example oil, can be very dangerous.

3 You must keep the exit _____ in case there's a fire.

4 We use good equipment that keeps our workers _____.

5 The workbench is really _____ with tools. Please put the tools away.

6 If a tool gets _____ when you're using it, clean it before you put it away.

7 The toolbox is _____. Nothing is in the correct place.

8 Turn off the saw! That cable is damaged. It's _____.

11 Communication

Student A

1 Ask Student B if these jobs have been done. Use the Present Perfect.

Have you put the spanners away?

put spanners away

repair broken switch on table grinder

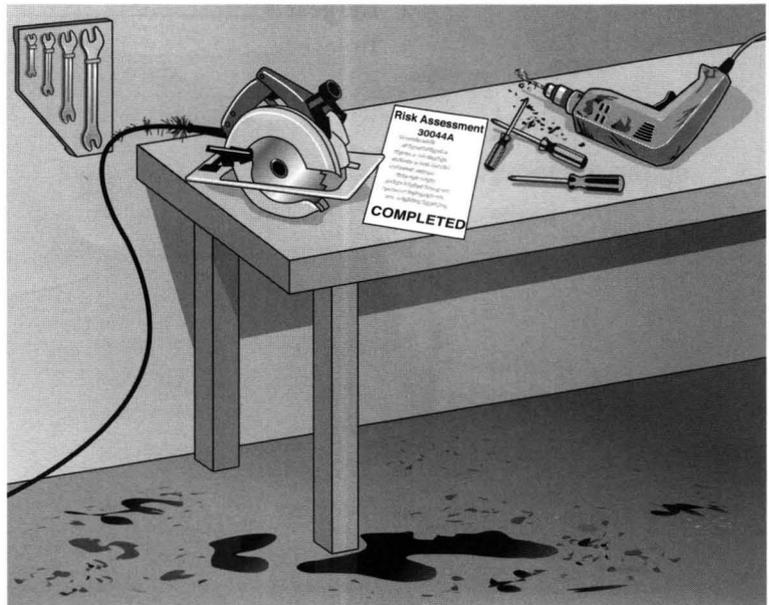
clean the floor

finish job card 5506B

organize the screwdrivers

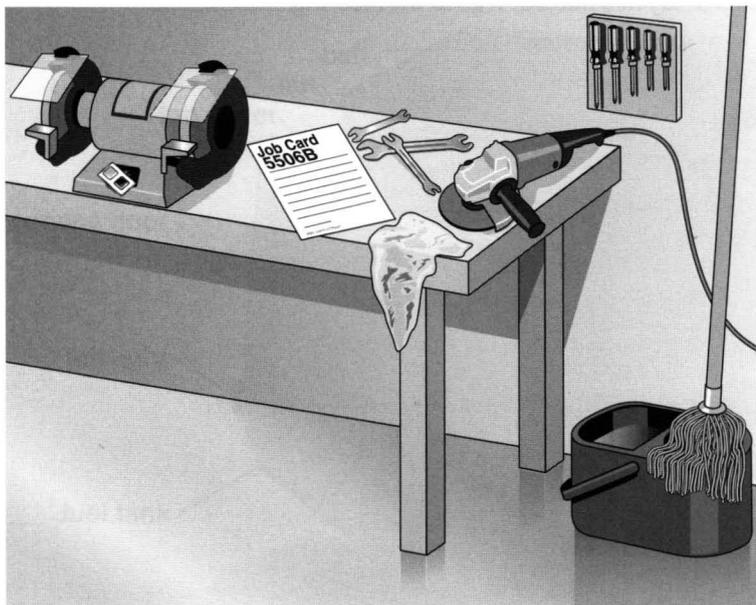
clean the angle grinder

2 Look at the picture. Answer Student B's questions. Say *Yes, I have* or *No, I haven't*.



Student B

1 Look at the picture. Answer Student A's questions. Say *Yes, I have* or *No, I haven't*.



2 Ask Student A if these jobs have been done. Use the Present Perfect.

Have you put the screwdrivers away?

put screwdrivers away

repair cable on circular saw

clean the floor

finish risk assessment for job 30044A

organize the spanners

clean the drill

12 Language test

1 Complete the sentences. Use the words in the list.

corroded dented frozen jammed leaking loose rusted worn

- 1 The belt on the compressor is _____, so it's noisy. We need to tighten it.
- 2 The gear is _____. It's almost smooth. We need to replace it.
- 3 The cap is _____. There's oil dripping out of it.
- 4 The copier is _____. The paper is really stuck inside.
- 5 This bolt is _____. I can't loosen it at all.
- 6 My computer is _____. The system is down.
- 7 The tank is _____. Someone bumped into it with a fork-lift.
- 8 The wires are _____ where they connect to the battery. We need to clean them.

2 Match the sentence halves.

- 1 Routine maintenance
- 2 Heat and dust can
- 3 The generator should be
- 4 The hose was split so we
- 5 We removed the pump after it
- 6 We replaced the compressor because we couldn't
- 7 The gasket was
- 8 It's very important to

- a damaged.
- b inspected every day.
- c replaced it.
- d follow the maintenance schedule.
- e repair it.
- f stopped working.
- g damage a machine.
- h reduces accidents and injuries.

3 For each sentence, write D (deciding what to do) or F (talking about the future).

- 1 I'll be in Paris next week, so we can meet. _____
- 2 Your phone's ringing. I'll answer it. _____
- 3 Ben just phoned to say he's late, so I'll go to the meeting. _____
- 4 Viktor won't be at work tomorrow. _____
- 5 I'll start my new job next month. _____
- 6 Is that heavy? Here, I'll help you! _____
- 7 We'll arrive in Tripoli in two hours. _____
- 8 Wait here, and I'll get some coffee. _____

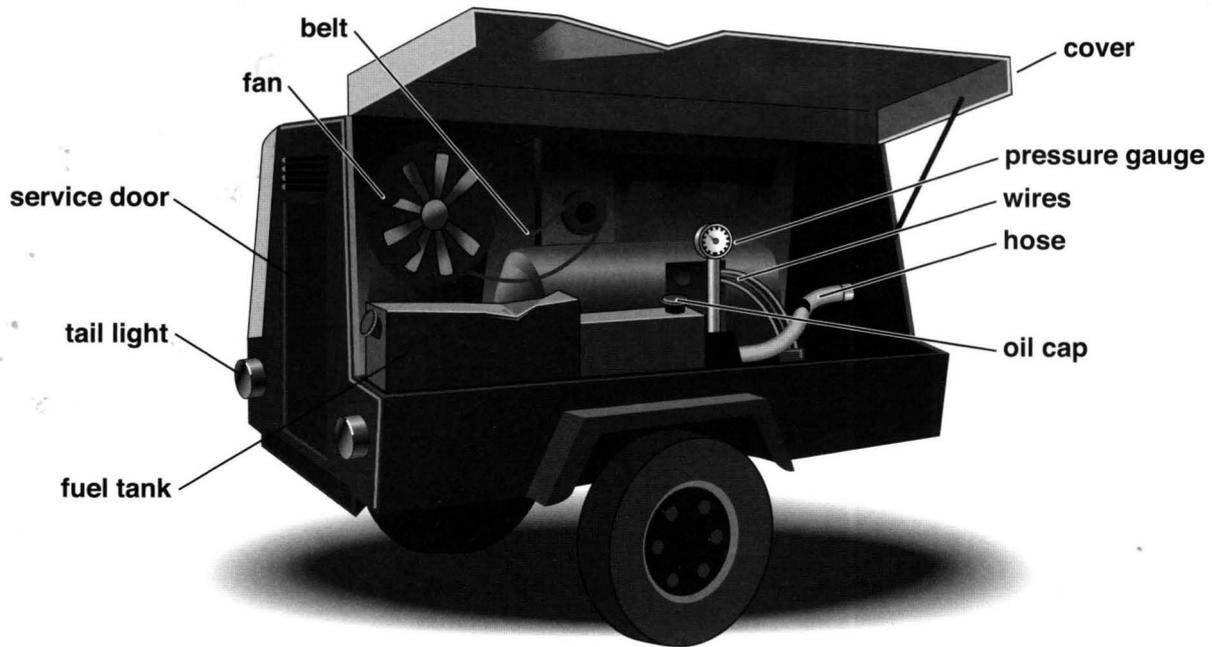
12 Communication

Student A

Don't look at Student B's picture and don't show Student B your picture.

Describe your picture to Student B. Listen to Student B's description.

Ask and answer questions. Find ten differences between the two pictures.

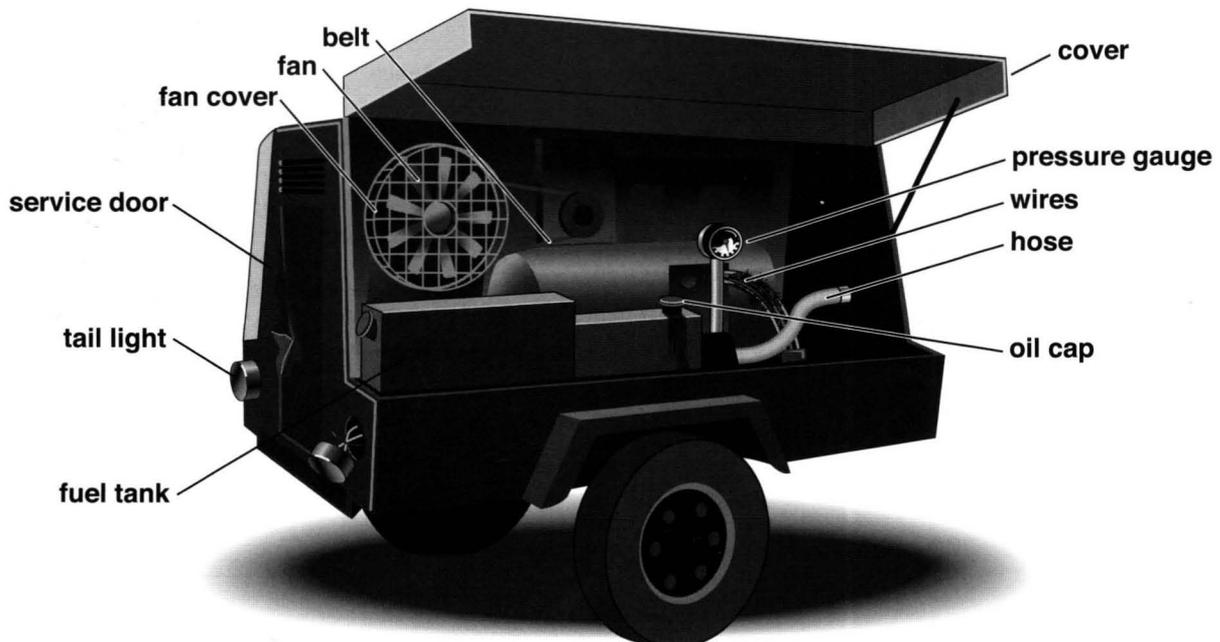


Student B

Don't look at Student A's picture and don't show Student A your picture.

Describe your picture to Student A. Listen to Student A's description.

Ask and answer questions. Find ten differences between the two pictures.



13 Language test

1 Write the sentences in the Passive.

1 The distillation towers separate the oil into fractions.

2 A pipeline takes the oil to the jetty.

3 Workers attach the hoses to the tankers.

4 The tanks store the oil.

5 Tanker trucks take the oil through the west gate.

6 A pipeline returns the clean water to the river.

7 The safety officer checks our work every day.

8 The trees hide the drilling rig.

2 Complete the text. Use the words in the list.

asphalt boiling oil crude oil distillation
fractions furnace pipes tanks

The _____¹ is pumped into the _____², where it's boiled. Next, the _____³ is put into the _____⁴ tower. Boiling separates the crude oil into _____⁵. The petroleum gas rises to the top, because it is the lightest. _____⁶ is heavy, so it sinks to the bottom. The separated products leave the still in _____⁷ and are stored in _____⁸ until they are taken out of the refinery.

3 Choose the correct word to complete each sentence.

1 Kerosene is *heavier* / *lighter* than fuel oil.

2 Ice *melts* / *boils* at 0 °C.

3 Asphalt is a *liquid* / *solid*.

4 39 °C is *higher* / *lower* than normal body temperature.

5 LPG / Kerosene burns as a gas.

6 In a refinery, crude oil is *heated* / *refined* to about 600 °C.

7 Each refinery product boils at a different *temperature* / *weight*.

8 The *freezing point* / *boiling point* of petrol is about 200 °C.

13 Communication

Student A

1 Read about the refinery. Answer Student B's questions.

Hovensa Refinery

Location: US Virgin Islands

Built: 1966

Crude oil delivery: by tanker

Crude oil storage capacity: 32 million barrels

Crude oil processing capacity: 500,000 bpd

Main products: petrol, diesel, home heating oil, kerosene and jet fuel, and fuel oil

Number of employees: 2,500

2 Student B has information about a refinery. Ask questions and write the answers.

- 1 What's the name of the refinery?

- 2 Where is it located?

- 3 When was it built?

- 4 How are products taken out of the refinery?

- 5 How many tankers can be unloaded at one time?

- 6 How much crude oil can be processed there?

- 7 What is produced there?

- 8 How much money is spent in the local community every year?

Student B

1 Student A has information about a refinery. Ask questions and write the answers.

- 1 What's the name of the refinery?

- 2 Where is it located?

- 3 When was it built?

- 4 How are products delivered to the refinery?

- 5 How much crude oil can be stored there?

- 6 How much crude oil can be processed there?

- 7 What is produced there?

- 8 How many people are employed there?

2 Read about the refinery. Answer Student A's questions.

Fawley Refinery

Location: Southampton, UK

Built: 1921

Products taken out: mostly by pipeline, some by sea, road, and rail

Sea terminal capacity: up to nine tankers

Crude oil processing capacity: sixteen million tonnes per year

Main products: petrol, diesel, kerosene and jet fuel, fuel oil, LPG

Money spent in the local community every year: £65 million

14 Language test

1 Choose the correct words.

- 1 *In case / If* a machine breaks, we try to repair it as quickly as possible.
- 2 We always have a first aid kit in the truck *in case / if* there's an accident.
- 3 *When / In case* there's a computer problem, we call IT support.
- 4 *In case / When* we do electrical work, we turn off the power.
- 5 *If / In case* we want to go on holiday, we have to complete some paperwork.
- 6 I always carry water in my truck *in case / if* I have a breakdown in the desert.
- 7 We have a fire extinguisher *when / in case* there's a fire.
- 8 *When / In case* we get new tools or equipment, we are trained to use them properly.

2 Write sentences with the Past Continuous and the Past Simple.

EXAMPLE

I was learning (learn) to weld when I burned (burn) my hand.

- 1 When I _____ (fall), I _____ (climb) a ladder.
- 2 Bob _____ (answer) the phone while I _____ (drive) the car.
- 3 They _____ (weld) when the fire _____ (start).
- 4 The truck _____ (not work) when they _____ (decide) to buy a new one.
- 5 _____ (you use) the computer when the power _____ (go off)?
- 6 She _____ (not use) the handrail when she _____ (slip).
- 7 He _____ (not use) the safety guard when he _____ (cut) his finger.
- 8 When we _____ (eat) lunch, the oxygen bottle _____ (explode).

3 Complete the sentences. Use the words in the list.

beats breathing breaths fever high
low mild rate scale temperature

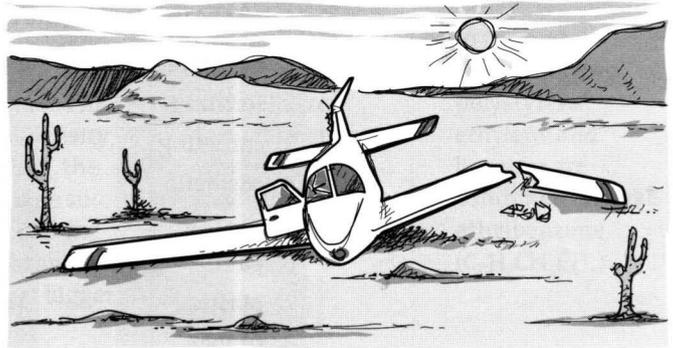
- A _____¹ is a body _____² above 38.5 °C.
 A normal resting heart _____³ is 60–100 _____⁴ per minute.
 A normal resting _____⁵ rate is 12–20 _____⁶ per minute.
 85/55 is a _____⁷ blood pressure. 150/100 is _____⁸.
 Pain is measured on a _____⁹ of 1–10. 1 is very _____¹⁰ and 10 is the worst possible.

14 Communication

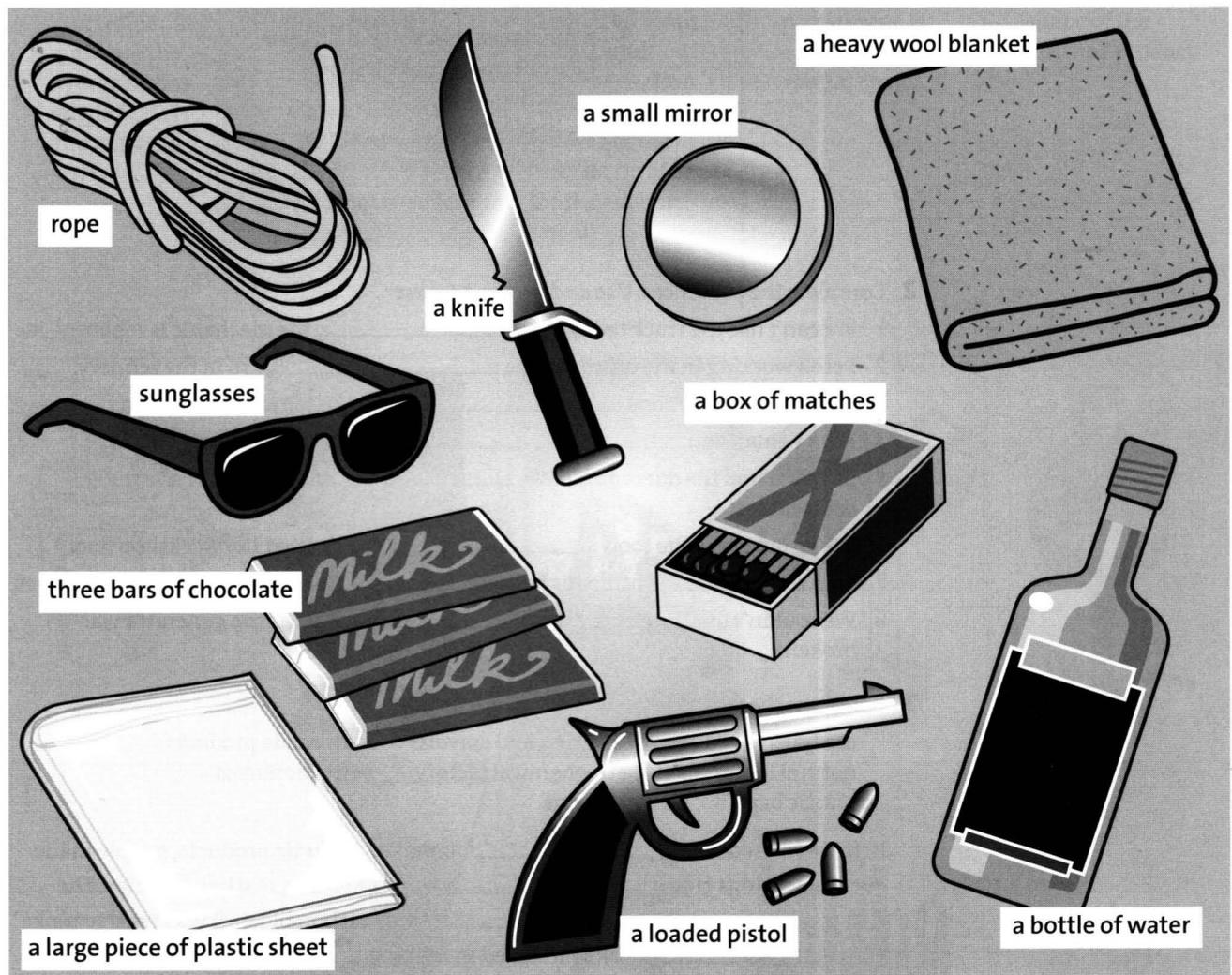
Read the scenario. Do the exercise.

Scenario

You are with a group of workers flying in a small plane to an oil well deep in the desert. The plane crashes. One passenger has a broken leg. One has a broken arm. Everyone has cuts and bruises.



You have these things. As a group, choose the five most important things. Number them 1-5 (1 = the most important).



Useful language

We should keep the plastic sheet in case it rains.
 If we want to make a fire, we'll need the matches.
 When we need to signal another airplane, we can use the mirror.

15 Language test

1 Match the words with the definitions.

- 1 adhesive
- 2 fertilizer
- 3 carpeting
- 4 cosmetic
- 5 medication
- 6 paint
- 7 plastic
- 8 rubber

- a a light, strong material that is produced by chemical processes and can be formed into shapes when heated
- b a drug or another form of medicine
- c a substance you use to make things stick together
- d a substance added to soil to make plants grow well
- e a strong substance that can be stretched and does not allow liquids to pass through it
- f a substance that you put on your face or body to make it more attractive
- g a liquid that is put on surfaces to give them a particular colour
- h a thick material used for covering floors

2 Complete the sentences. Use *and*, *but*, or *because*.

- 1 We can't use the truck today _____ the mechanic is repairing it.
- 2 Pete's working in the office today _____ I'm in the refinery.
- 3 I have the instructions _____ I don't understand them.
- 4 I can't email you _____ I don't have my computer today.
- 5 I need to find the damaged valve, _____ I don't have the coordinates.
- 6 We've put away the tools _____ cleaned the workshop floor.
- 7 Tom remembered to bring his helmet, _____ he forgot his gloves.
- 8 We couldn't use the electric tools _____ the generator was broken.

3 Complete the text. Use the words in the list.

- | | | |
|-------------------|-------------------------|-------------------|
| car tyres | ink, paint, and crayons | man-made products |
| natural materials | petrochemical factory | petrochemicals |
| plastic bags | problems | |

Before we used _____¹ to make synthetic products, people made everyday things from _____² like cotton, leather, and clay. The first product from a _____³ was carbon black. It was used to make _____⁴. Now it's used in making _____⁵. From the 1920s to the 1940s, familiar _____⁶ like nylon and PVC were developed. Today, petrochemical products are everywhere. They are useful, but they also cause _____⁷. For example, _____⁸ pollute the oceans and kill wildlife.

15 Communication



<p>a) The moulded, coated polystyrene is tested for strength, flammability, and density. It is also tested for porosity.</p>	<p>b) In the first step of making a polystyrene product, the polystyrene beads are heated in a machine called a pre-expander. This makes the polystyrene the right density for moulding. After pre-expanding, the beads are transferred to the storage silo. Here, the beads cool for about 24 hours. The beads are fed into the mould and heated with steam. The beads get bigger and stick together.</p>	<p>c) Crude oil is taken from the ground and delivered to oil refineries, where it is made into many different products.</p>	<p>d) In the first step of making polystyrene, ethylene and benzene are combined to make ethylbenzene ($C_6H_5CH_2CH_3$).</p>	
<p>e) Two products that refineries make are the hydrocarbons ethylene (C_2H_4) and benzene (C_6H_6).</p>	<p>f) The ethylbenzene is heated to $650\text{ }^\circ\text{C}$. This removes some of the hydrogen and creates the monomer styrene (C_8H_8).</p>	<p>g) The styrene is heated to about $100\text{ }^\circ\text{C}$ and polymerization is started. This results in the formation of beads of polystyrene.</p>	<p>h) The moulded polystyrene is coated with a special epoxy.</p>	<p>i) They form the shape of the finished product.</p>



<p>A</p>	<p>B</p>	<p>C</p>	<p>D</p>	<p>E</p>
<p>F</p> <p>steam heated polystyrene</p> <p>mould</p> <p>moulding machine</p>	<p>G</p>	<p>H</p>	<p>I</p>	

Language tests key

Unit 1

- 1**
- 1 a
 - 2 nothing
 - 3 nothing
 - 4 the
 - 5 a
 - 6 an
 - 7 an
 - 8 the
 - 9 nothing
 - 10 a
 - 11 a
 - 12 nothing
- 2**
- | | | | | |
|-----|-----|-----|-----|------|
| 1 j | 3 i | 5 d | 7 f | 9 b |
| 2 a | 4 h | 6 e | 8 c | 10 g |
- 3**
- 1 Are there
 - 2 are
 - 3 Is there
 - 4 There's
 - 5 Is there
 - 6 There are
 - 7 There's
 - 8 are there
 - 9 There are
 - 10 are there

Unit 2

- 1**
- 1 Do
 - 2 do
 - 3 Do
 - 4 don't
 - 5 Does
 - 6 does
 - 7 doesn't
 - 8 Do
 - 9 don't
 - 10 do
 - 11 Do
 - 12 don't
- 2**
- 1 Where
 - 2 What
 - 3 Which
 - 4 How
 - 5 Who
 - 6 When
 - 7 Why
- 3**
- a four hundred and ninety
 - b 5,000
 - c six thousand three hundred and forty-four
 - d 10,000
 - e thirteen thousand four hundred and fifty
 - f 300,000
 - g four hundred and sixty-five thousand
 - h 7,000,000
 - i seventy-five million
 - j 9,000,000,000

Unit 3

- 1**
- 1 You're working in the office today. You aren't working outside.
 - 2 They aren't collecting data. They're testing pipes.
 - 3 We're having problems with the new computer. The screen isn't working.
 - 4 I'm not driving. I'm having lunch.
 - 5 He isn't measuring a pipe. He's checking for leaks.
 - 6 The drill is making a funny noise. It isn't working properly.

- 2**
- 1 do
 - 2 do
 - 3 study
 - 4 are
 - 5 doing
 - 6 'm working
 - 7 Are
 - 8 having
 - 9 'm going
 - 10 's
 - 11 going
 - 12 have

- 3**
- a seven times three
 - b $12 \div 4$
 - c the square root of four
 - d 15%
 - e eight minus seven
 - f $10 \times 3 = 30$
 - g seven point two five
 - h $3/4$

Unit 4

- 1**
- 1 Can I come in?
 - 2 Can you pass me that hammer?
 - 3 Can I use your phone?
 - 4 Can you help me carry this pipe?
 - 5 Can you show me how to use this safety harness?
 - 6 Can I take off my hard hat?

- 2**
- 1 You mustn't use mobile phones.
 - 2 You must watch for trucks.
 - 3 You mustn't switch off this machine.
 - 4 You must wear a hard hat.
 - 5 You must wear goggles.
 - 6 You mustn't touch the wires.

- 3**
- 1 Yes, it can.
 - 2 Yes, it can.
 - 3 No, it can't.
 - 4 No, it can't.
 - 5 Yes, it can.
 - 6 No, it can't.

Unit 5

- 1**
- 1 N
 - 2 V
 - 3 N
 - 4 V
 - 5 V
 - 6 P
 - 7 Adv
 - 8 V
 - 9 N
 - 10 V
 - 11 Adj
 - 12 V
 - 13 Adv
 - 14 Adv
 - 15 V
 - 16 Adj
 - 17 N
 - 18 Adj

- 2**
- | | | |
|-----|-----|-----|
| 1 I | 3 Q | 5 Q |
| 2 S | 4 I | 6 S |

- 3**
- 1 Oil companies search for possible oil traps.
 - 2 Geophones help produce 3D maps.
 - 3 Vibrator trucks make seismic waves.
 - 4 Each rock layer reflects some of the waves. / Each layer of the rock reflects some waves.

- 4**
- 1 He
 - 2 him
 - 3 They
 - 4 her
 - 5 She
 - 6 us
 - 7 We
 - 8 them

Unit 6

- 1** 1 thicker
2 too noisy
3 hotter
4 heavy
5 dangerous
6 most
7 oldest
8 too short
9 important
10 longer

- 2** 1 guides
2 toolpusher
3 cuttings
4 shallow
5 Add
6 control
7 Stop
8 derrick
9 lubricates
10 approximate

- 3** 1 h 3 a 5 j 7 f 9 e
2 d 4 b 6 g 8 i 10 c

Unit 7

- 1** 1 nothing
2 an
3 nothing
4 nothing
5 nothing
6 a
7 nothing
8 nothing
9 a
10 a

- 2** 1 many
2 much
3 many
4 many
5 much
6 many
7 much
8 much
9 many
10 much

- 3** 1 2,800 mm
2 655 mm
3 105 mm
4 2,058 mm
5 550 mm
6 275 mm
7 3.141, 0.275, 0.275, 2.8

Unit 8

- 1** 1 h 3 d 5 e 7 b 9 i
2 c 4 a 6 f 8 g

- 2** 1 heavier
2 best
3 worse
4 good
5 worst
6 large
7 more important
8 as light
9 bad

- 3** 1 pressure
2 temperature
3 level
4 gauge
5 multimeter
6 circuit
7 component
8 equation
9 short circuit

Unit 9

- 1** 1 produces
2 vapour
3 liquefies
4 transport
5 storage
6 Vaporizers
7 pipes
8 consume
- 2** 1 The tanker was at the terminal.
2 Victor wasn't in the office.
3 I was in the control room.
4 João and Veejay weren't here today.
5 Mr Glenwood was at lunch.
6 Were you busy?
7 You weren't late.
8 We were in China.
- 3** 1 F 3 F 5 F
2 T 4 F 6 T

Unit 10

- 1** 1 start
2 started
3 repair
4 did
5 repaired
6 finish
7 finished
8 do
- 2** 1 finished
2 began
3 changed
4 refined
5 closed
6 started
7 was
8 opened
- 3** 1 d 3 e 5 b 7 a
2 g 4 h 6 f 8 c

Unit 11

- 1** 1 1
2 2
3 2
4 1
5 3
6 3
7 3
8 2
9 3
10 1
- 2** 1 Have you finished welding the containment?
2 We've replaced the bearings, but we haven't put in the gasket.
3 Has he ever used a MIG welder?
4 They haven't built the base.
5 Have you worked in the UAE?
6 I've never used an oxyacetylene welder.
7 Has it rained this week?
8 We haven't painted the tank, but we've welded it.
- 3** 1 organized
2 clean
3 clear
4 safe
5 cluttered
6 dirty
7 disorganized
8 unsafe

Unit 12

- 1** 1 loose
2 worn
3 leaking
4 jammed
5 rusted
6 frozen
7 dented
8 corroded
- 2** 1 h 3 b 5 f 7 a
2 g 4 c 6 e 8 d
- 3** 1 F 3 D 5 F 7 F
2 D 4 F 6 D 8 D

Unit 13

- 1**
- 1 The oil is separated into fractions (by the distillation towers).
 - 2 The oil is taken to the jetty by a pipeline.
 - 3 The hoses are attached to the tankers (by workers).
 - 4 The oil is stored in the tanks.
 - 5 The oil is taken through the west gate (by tanker trucks).
 - 6 The clean water is returned to the river (by a pipeline).
 - 7 Our work is checked every day (by the safety officer).
 - 8 The drilling rig is hidden by the trees.

- 2**
- 1 crude oil
 - 2 furnace
 - 3 boiling oil
 - 4 distillation
 - 5 fractions
 - 6 Asphalt
 - 7 pipes
 - 8 tanks

- 3**
- 1 lighter
 - 2 melts
 - 3 solid
 - 4 higher
 - 5 LPG
 - 6 heated
 - 7 temperature
 - 8 boiling point

Unit 14

- 1**
- 1 If
 - 2 in case
 - 3 When
 - 4 When
 - 5 If
 - 6 in case
 - 7 in case
 - 8 When

- 2**
- 1 When I fell, I was climbing a ladder.
 - 2 Bob answered the phone while I was driving the car.
 - 3 They were welding when the fire started.
 - 4 The truck wasn't working when they decided to buy a new one.
 - 5 Were you using the computer when the power went off?
 - 6 She wasn't using the handrail when she slipped.
 - 7 He wasn't using the safety guard when he cut his finger.
 - 8 When we were eating lunch, the oxygen bottle exploded.

- 3**
- 1 fever
 - 2 temperature
 - 3 rate
 - 4 beats
 - 5 breathing
 - 6 breaths
 - 7 low
 - 8 high
 - 9 scale
 - 10 mild

Unit 15

- 1**
- | | | | |
|-----|-----|-----|-----|
| 1 c | 3 h | 5 b | 7 a |
| 2 d | 4 f | 6 g | 8 e |

- 2**
- 1 because
 - 2 and
 - 3 but
 - 4 because
 - 5 but
 - 6 and
 - 7 but
 - 8 because

- 3**
- 1 petrochemicals
 - 2 natural materials
 - 3 petrochemical factory
 - 4 ink, paint, and crayons
 - 5 car tyres
 - 6 man-made products
 - 7 problems
 - 8 plastic bags

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