# UNIT 1 Technology in use

- Describing technical functions and applications
- Explaining how technology works
- Emphasising technical advantages
- Simplifying and illustrating technical explanations

## Describing technical functions and applications

**1 a In pairs, think about two or three products you use regularly and discuss the following questions.**

- What are the main functions of the products? (What do they do?)
- What are their different applications? (What are they used for?)

**b What do you know about Global Positioning System (GPS) devices? In pairs, describe their main function, and give some examples of different applications of GPS devices.**

**2 a ▶1.1 Paula, a design engineer for a GPS manufacturer, is discussing product development with José, a senior manager new to the company. Listen to the conversation and complete the following notes.**

- the primary application of GPS — (1) _____
- associated applications — Tracking systems for (2) _____
  Tracking systems for (3) _____
- more creative features — (4) _____ alarms
  (5) _____ buttons
- not technical innovations — (6) _____ the technology

**b Complete the following extracts from the discussion with words that come from *use*.**

1 *Then you've got associated applications, _____ that are related to navigating ...*
2 *... tracking systems you can _____ for monitoring delivery vehicles ...*
3 *... from the end-_____ point of view, accuracy is no longer the main selling point. Most devices are accurate enough. The key is to make them more _____ .*

**3 a** **Match the GPS applications (1–6) to the descriptions (a–f).**

| | | | |
|---|---|---|---|
| 1 | topographical surveying | a | navigation and safety at sea |
| 2 | geological exploration | b | setting out positions and levels of new structures |
| 3 | civil engineering | c | mapping surface features |
| 4 | avionics equipment | d | applications in mining and the oil industry |
| 5 | maritime applications | e | highway navigation and vehicle tracking |
| 6 | GPS in cars and trucks | f | air traffic control, navigation and autopilot systems |

**b** **In pairs, practise explaining the applications of GPS in Exercise 3a to a colleague who has limited knowledge of the devices using the following phrases.**

used for -ing  used to  useful for  another / a similar use

**4 a** **Complete the following extracts from the conversation by underlining the correct words.**

1 *... there's a setting on the GPS that* ***allows/prevents*** *it to detect the movement ...*
2 *... an alarm sounds to warn you, and* ***allows/prevents*** *the boat from drifting unnoticed.*
3 *... and* ***enables/ensures*** *that you don't lose track of where you were, which then* ***enables/ensures*** *you to turn round and come back to the same point ...*

**b** **Match the words in Exercise 4a to the synonyms.**

1 _____ = makes sure  2 _____ / _____ = permits  3 _____ = stops

**c** **Complete the following extract from the user's manual of a GPS device using the verbs in Exercise 4a. Sometimes, more than one answer is possible.**

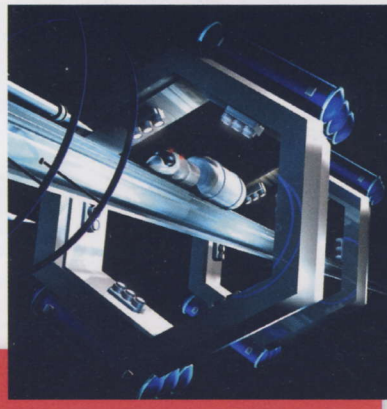
INTRODUCTION

The core function of your GPS receiver is to (1) _____ you to locate your precise geographical position. To (2) _____ the device to function, it receives at least three signals simultaneously from the GPS constellation – 30 dedicated satellites which (3) _____ receivers can function anywhere on earth. To (4) _____ extremely precise positioning and (5) _____ errors from occurring due to external factors, this device is designed to receive four separate signals (see enhanced system accuracy on page 18).

**5** **In pairs, explain the main functions and applications of a product made by your company or a product you know about. Student A, you are an engineering manager; Student B, you are a new employee. Use the language from this section and the phrases in the box. Swap roles and practise again.**

I see. So ...  OK. In other words ...  So you mean ...

# Explaining how technology works



**6 a** **In pairs, look at the picture and discuss the following questions.**

- How do you think a space elevator would work?
- What could it be used for?
- What technical challenges would it face?
- How seriously do you think the concept of space elevators is being taken at present?

**b** **Read the following article and compare it to your answers in Exercise 6a.**

## Space elevators: preparing for takeoff

IN his 1979 novel, *The Fountains of Paradise*, Arthur C Clarke wrote about an elevator **connecting** the earth's surface to space. Three decades later, this science-fiction concept is preparing to take off in the real world. NASA has launched the Space Elevator Challenge, a competition with a generous prize fund, and several teams and companies are working on serious research projects aimed at winning it.

As its name suggests, a space elevator is designed to **raise** things into space. Satellites, components for space ships, supplies for astronauts in space stations, and even astronauts themselves are examples of payloads that could be **transported** into orbit without the need for explosive and environmentally unfriendly rockets. However, the altitude of orbital space – a colossal 35,790 km above the earth – is a measure of the challenge facing engineers. How could such a height be reached?

The answer is by using an incredibly strong and lightweight cable, strong enough to **support** its own weight and a heavy load. The design of such a cable is still largely theoretical. This would be **attached** to a base station on earth at one end and a satellite in geostationary orbit (fixed above a point on the equator) at the other. Lift vehicles would then **ascend** and **descend** the cable, **powered** by electromagnetic force and **controlled** remotely.

**c** **Match the verbs (1–9) from the text in Exercise 6b to the definitions (a–i).**

| | | | |
|---|---|---|---|
| 1 | connecting | a | carried (objects, over a distance) |
| 2 | raise | b | hold something firmly / bear its weight |
| 3 | transported | c | climb down |
| 4 | support | d | provided with energy / moved by a force |
| 5 | attached | e | joining |
| 6 | ascend | f | driven / have movement directed |
| 7 | descend | g | fixed |
| 8 | powered | h | climb up |
| 9 | controlled | i | lift / make something go up |

**7 a** **James, an engineer, is giving a talk on space elevators. Complete his notes using the correct form of the verbs (1–7) in Exercise 6c.**

*Space Elevators*

- *Challenge of (1)* connecting *a satellite to earth by cable is significant.*
- *To (2)* _____ *its own weight, and be securely (3)* _____ *at each end, cable would need phenomenal strength-to-weight ratio.*
- *How could vehicles be (4)* _____ *into space, up cable?*
- *Self-contained energy source problematic, due to weight (heavy fuel or batteries required to (5)* _____ *vehicle).*
- *Two possible ways round problem:*

  *1 Transmit electricity wirelessly. But technique only at research stage.*

  *2 Solar power. But would only allow vehicle to (6)* _____ *slowly. Not necessarily a problem, as car could be controlled remotely, allowing it to (7)* _____ *payloads unmanned.*

**b** ▶1.2 **Listen to part of James' talk and check your answers in Exercise 7a.**

**c** **What kinds of word are missing from the notes? In pairs, compare the audioscript on page 86 with the notes in Exercise 7a.**

**8** **a** **Some space elevator designs propose an offshore base station. In pairs, discuss how such a system might work using words in Exercise 6c. What advantages might an offshore base have compared with a land base?**

**b** ▶1.3 **James goes on to discuss offshore base stations. Listen to the talk and answer the following questions.**

1 How would an offshore base station be supported?
2 What would the function of its anchors be?
3 How would payloads reach the base station?
4 What problem would a mobile base station help to prevent?
5 What would the procedure be if there was an alert?

**9** **a** **You are members of a space elevator research team designing a concept for offshore base stations. In pairs, analyse the notes below, which were made during a briefing given by your manager. Imagine you are giving a presentation. Begin by reading out the abbreviated notes in full.**

OFFSHORE BASE STATION - ANCHORING & PROPULSION ISSUES

Anchoring system

Wind loads on cable will be huge. What implications for anchoring system? Base will need to be moved continually, sometimes urgently. What temp system could be used to hold base in position?

Base in shallow water near coast, or deep water further offshore? Choice will have impact on design of anchor system.

Propulsion system

Will weight of cable allow base to be moved by own propellers? Or more powerful system for propulsion and control nec.? E.g. extern. power source?

**b** **In pairs, discuss the questions raised in the notes and think of some suitable solutions for the anchoring system and the propulsion system. At this stage, these should be overall concepts, not detailed designs. Remember to make notes.**

**c** **In small groups, take turns to give a short talk using your notes to explain how the systems work, in general terms. Imagine you are speaking to a small group of colleagues, including your manager.**

**d** **Write two or three paragraphs to summarise your talk. These will be included in your manager's longer report on offshore base stations.**

# Emphasising technical advantages

**10** In pairs, discuss the term *technical advantage*. Give some examples of technology you are familiar with.

**11 a** Read the first paragraph of some promotional literature from Otis, a leading elevator company. What is the Gen2™ system?

**b** Match the words (1–6) from the text in Exercise 11a to the synonyms (a–f).

| | | | |
|---|---|---|---|
| 1 | conventional | a | decreases |
| 2 | eliminates | b | better / the best |
| 3 | superior | c | improved |
| 4 | energy-efficient | d | standard, usual |
| 5 | enhanced | e | gets rid of |
| 6 | reduces | f | has low energy consumption |

**c** Complete the following text using the correct form of the words (1–6) in Exercise 11b. You will need to use some words more than once.

## OTIS Unique Flat Belt

### *The key to Otis's patented drive technology*

At the heart of the Gen2™ elevator system is a flat belt (developed by and unique to Otis). It is just 3mm thick. Yet it is stronger than **conventional** steel cables. It lasts up to three times longer. And it has enabled Otis to completely re-invent the elevator. The flat, coated-steel belt totally **eliminates** the metal-to-metal effect of conventional systems. Coupled with a smooth-surface crowned machine sheave, the result is exceptionally quiet operation and **superior** ride comfort. Furthermore, the flexible flat belt enables a more compact, **energy-efficient** machine, which can be contained in the hoistway. This **enhanced** technology **reduces** building and system operating costs, and frees up valuable space.

### *Protecting the environment*

Neither the belt nor the gearless machine, with its permanently sealed bearings, requires any lubrication so the Gen2™ system is cleaner for the environment. The highly (1) energy-efficient gearless machine, with its permanent-magnet synchronous motor, (2) _____ power consumption by as much as 50 percent over (3) _____ geared machines and 15 percent over other machines with permanent-magnet motors of axial construction.

### *Reliable by design*

Long-lasting flat belts, smooth, crowned sheaves and minimal moving parts in the gearless machine dramatically (4) _____ wear and increase durability and efficiency. To further (5) _____ reliability and safety, Otis developed the Pulse™ system, which continually monitors the status of the belts' steel cords. Unlike visual inspections of (6) _____ steel ropes, the Pulse™ system automatically detects and reports belt faults to maintenance personnel for rapid response, providing owners with greater peace of mind. With flat belt technology, Otis has created a (7) _____ system that (8) _____ the need for a machine room, is quiet, clean, reliable and economical, and easy to install and maintain.

**d** In pairs, summarise the advantages of the flat belt system. Discuss durability, wear, noise, space, cleanliness, efficiency, automation, maintenance and cost.

**12 a** **Complete the following tips on emphasising technical advantages using the words in the box.**

| conventional | eliminated | enhanced | reduced | superior |
|---|---|---|---|---|

When describing technical advantages, it's useful to emphasise ...

a (1) _____ performance, compared with the older model of the same product.
b negative issues that have been (2) _____ , or completely (3) _____ .
c special features that differentiate the technology from (4) _____ systems.
d performance levels that make the technology (5) _____ to the competition.

**b** ▶1.4 **Stefan, an engineer, is briefing some sales colleagues on the advantages of a new pump design. Listen to the briefing and match the tips (a–d) in Exercise 12a to the extracts (1–4).**

Extract 1 _____ Extract 2 _____ Extract 3 _____ Extract 4 _____

**c** **Complete the following sentences from the briefing by underlining the correct emphasising word.**

1 *We've come up with a* ***completely/significantly*** *unique profile.*
2 *It* ***completely/dramatically*** *reduces vibration.*
3 *Machines like these can never be* ***entirely/highly*** *free from vibration.*
4 *The new design runs* ***dramatically/extremely*** *smoothly.*
5 *Another advantage of the new profile is that it's* ***considerably/entirely*** *lighter.*
6 *So compared with our previous range, it's* ***highly/totally*** *efficient.*
7 *Trials so far suggest the design is* ***completely/exceptionally*** *durable.*
8 *We expect it to be* ***entirely/significantly*** *more reliable than rival units.*

**d** **Match the words in Exercise 12c to the synonyms.**

| considerably | dramatically | entirely | exceptionally | highly | totally |
|---|---|---|---|---|---|

1 _____ / _____ = completely
2 _____ / _____ = significantly
3 _____ / _____ = extremely

**13** **You are Otis engineers back in the 1850s, when elevators were new. In pairs, prepare a short talk to brief your sales colleagues on the advantages of elevators for lifting people and goods. Emphasise the points below, using the phrases and techniques from this section. Remember that people at this time are sceptical about the technology.**

Elevators are ...

- safe – a reliable braking system eliminates the danger of a car falling if a cable fails
- simple – they're controlled from the car and are very easy to operate
- convenient – they're easier on the legs than the conventional alternative (stairs)
- valuable – they enhance the value of land by allowing taller buildings on smaller areas

# Simplifying and illustrating technical explanations

**14 a** ▶1.5 **Richard, a structural engineer, often takes clients on guided tours of their new buildings during construction. He is talking about explaining technical concepts to non-specialists. Listen and answer the following questions.**

1 What does Richard say about explaining technical concepts?
2 What does he mean by *dull* explanations?
3 What is *being patronising*?

**b In pairs, think of some tips on how to solve the following problems.**

1 not being understood
2 being patronising
3 explaining difficult concepts
4 sounding dull

**c** ▶1.6 **Richard is giving some advice about the problems in Exercise 14b. Listen and summarise his ideas. Compare his tips with your suggestions.**

**15 a Richard has made notes for a guided tour of a site. The project is a skyscraper in the early stages of construction. During the tour he explains the technical terms to the non-specialist group. In pairs, discuss the following terms and try to interpret them using everyday language to rephrase them.**

*SUBSTRUCTURE*

- *Pile foundations (in general)*
- *Bored in situ concrete piles*
- *Pre-cast driven concrete piles*
- *Pile driver*
- *Pile auger*
- *Bentonite*

**b** ▶1.7 **Richard is giving a tour of a construction site. Listen and make notes of his explanations of the following technical terms. Compare your ideas with his.**

1 the substructure *the part of the structure below ground*
2 a pile foundation .....
3 to bore (a pile) .....
4 in situ concrete .....
5 pre-cast piles .....
6 to drive in (a pile) .....
7 a pile driver .....
8 a pile auger .....
9 bentonite .....

**c** **Listen again and compare Richard's explanations with the tips in Exercise 14c. Which techniques did he use? Were they successful?**

**d** **Complete the following table using the words in the box.**

basically (x2) call effectively essentially imagine other picture refer ~~simple~~ simply

| Function | | Words / Phrases |
|---|---|---|
| 1 | Simplifying the language | in simple terms / put _____ / in _____ words / _____ |
| 2 | Simplifying the concept | _____ / _____ / _____ |
| 3 | Focusing on technical terms | what we _____ / what we _____ to as |
| 4 | Illustrating with images | if you _____ / if you _____ |

**e** **In pairs, practise explaining the technical terms in Exercise 15a using the simplified words and phrases in Exercise 15d.**

**16** **Read the textbook description of two types of pile foundation. Use the words and phrases in Exercise 15d and the following notes to rephrase it.**

From a structural perspective, pile foundations can be divided into two categories: end-bearing piles and friction piles.

Imagine water and the seabed

End-bearing piles are driven or bored through soft ground in order to attain firm substrata below. The pile then transmits load vertically to firm subsoil or bedrock. The soft ground surrounding the sides of the pile is structurally redundant.

Like standing on stilts in water

Friction piles counteract downward loads from the structure through frictional resistance between the sides of the pile and the surrounding ground, and do not therefore rely on firm substrata. In some cases, the diameter of the concrete at the pile's base is widened by compaction, allowing the increased area to give the friction pile a certain degree of end-bearing resistance.

Like a nail in wood

Imagine a leg and a foot

**17** **You are showing a non-specialist visitor around your company and explaining technical concepts using simplified language. In pairs, practise explaining a product or type of technology that you are familiar with.**

# UNIT 2 Materials technology

- Describing specific materials
- Categorising materials
- Specifying and describing properties
- Discussing quality issues

## Describing specific materials

1 **In pairs, discuss the benefits and problems of recycling. Use the following examples and your own ideas.**

breaking up ships  demolishing buildings  recycling electronics  scrapping cars

2 a **Read the following web page and complete the missing headings using the words in the box.**

Aluminium  Copper  Glass  Plastic  Rubber  ~~Steel~~  Timber

### RECYCLABLE MATERIALS

1 Steel Scrap can be sorted easily using magnetism. If the metal is galvanised (coated with zinc) the zinc is fully recyclable. If it is stainless steel, other metals mixed with the iron, such as chromium and nickel, can also be recovered and recycled. More ...

2 _____ Sorting is critical, as there are key differences between the clear and coloured material used in bottles and jars, and the high-grade material used in engineering applications, which contains traces of metals. More ...

3 _____ Scarcity makes recycling especially desirable, and justifies the cost of removing insulation from electric wires, which are a major source of scrap. Pure metal can also be recovered from alloys derived from it, notably brass (which also contains quantities of zinc, and often lead) and bronze (which contains tin). More ...

4 _____ The cost of melting down existing metal is significantly cheaper than the energy-intensive process of electrolysis, which is required to extract new metal from ore. More ...

5 _____ Hardwood and softwood can be reused. However, the frequent need to remove ironmongery and saw or plane off damaged edges, can make the process costly. More ...

6 _____ Tyres are the primary source of recyclable material. These can be reused whole in certain applications. They can also be ground into crumbs which have varied uses. More ...

7 _____ An obstacle to recycling is the need to sort waste carefully. While some types can be melted down for reuse, many cannot, or result in low-grade material. More ...

**b** **Match the materials from the web page (1–8) in Exercise 2 to the definitions (a–h).**

| | | | |
|---|---|---|---|
| 1 | stainless steel | a | a metal used to make brass, and in galvanised coatings on steel |
| 2 | zinc | b | the predominant metal in steel |
| 3 | iron | c | a type of steel not needing a protective coating, as it doesn't rust |
| 4 | bronze | d | a dense, poisonous metal |
| 5 | lead | e | rocks from which metals can be extracted |
| 6 | hardwood | f | an alloy made from copper and tin |
| 7 | ore | g | timber from pine trees |
| 8 | softwood | h | timber from deciduous trees |

**c** **Complete the following sentences using *from*, *with* or *of*.**

1 Bronze contains significant amounts of copper.
2 Galvanised steel is steel coated _____ zinc.
3 Steel is an alloy derived _____ iron.
4 Pure metals can usually be recovered _____ alloys.
5 To produce stainless steel, iron is mixed _____ other metals.
6 Stainless steel contains quantities _____ chromium and nickel.
7 Glass tableware contains traces _____ metals, such as lead.
8 When new metal is extracted _____ ore, the costs can be high.

**d** **In pairs, ask and answer questions about different materials using the following phrases.**

Can ... be recycled? What's ... made from? Where does ... come from?

## 3

**a** **Irina, an ecological adviser, is talking to a group of engineers on a training course about environmentally friendly design. In pairs, discuss the ideas from her slide and give some examples.**

**Environmental audit**

**Product phases:**

- Pre-use
- In use
- Post-use

**b** ▶2.1 **Listen to an extract from the talk and compare your ideas with what Irina says. What example does she use to illustrate her main point?**

**c** ▶2.2 **Irina asks the engineers to do a simplified environmental audit. Their task is to compare steel and aluminium car bodywork from an ecological perspective. Listen to Sophia and Pete, two of the engineers, discussing the topic and make notes of their ideas.**

**d** **In pairs, do an environmental audit for the following applications and materials. Use the words and phrases in the box.**

| | Application | Materials |
|---|---|---|
| 1 | electrical wires in vehicles | copper and aluminium |
| 2 | external walls in houses | bricks and softwood |

as far as I know ... I think so / I'd say so I'm (not) sure
that's an important consideration that needs to be researched
coated derived mixed recovered recycled

# Categorising materials

**4** **What do you know about braking systems? In pairs, discuss the following questions.**

1 Generally speaking, what do brakes do and how do they work?
2 What kinds of material are used in brake pads and brake discs in different vehicles?

**5 a** **Read the article on braking systems. In the title of the article, what do the colours green and red refer to?**

**b** **In pairs, answer the following questions.**

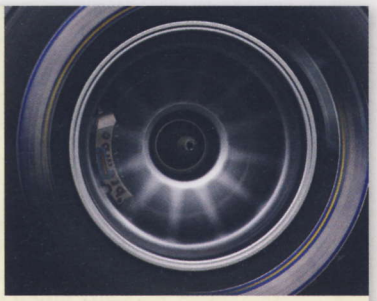
1 Why do most braking systems waste energy?
2 What are regenerative braking systems, and how do they save energy?
3 What characteristics are required of materials used for the brakes on racing cars?
4 What is meant by *heat soak*, and why is it a problem in racing cars?

## GREEN BRAKES
### – A RED HOT TOPIC IN MOTOR RACING

As motor racing goes green, Formula 1 is aiming to lead automotive research in finding hi-tech efficiency gains. One of the keys to this ecological drive is regenerative braking (also known as kinetic energy recovery), which recovers energy generated during deceleration, and stores it as a source of power for subsequent acceleration.

Regenerative brakes limit the energy loss inherent in traditional braking systems. In most vehicles, conventional brakes comprise pads previously made from asbestos-based composites, but now consisting of **compounds*** of **exotic**, non-hazardous materials, and discs made of **ferrous** metal. The resulting friction generates heat, which is wasted. In performance cars, this phenomenon is taken to extremes, and due to the high temperatures generated, brake discs are often made out of **ceramics**.

The carbon discs and pads used on Formula 1 cars generate so much heat that they glow red hot. High temperatures are, in fact, necessary for the effective operation of carbon brakes. But there's still plenty of potential for recovering the kinetic energy, rather than merely dissipating it in the form of heat.



The potential for recovering energy also extends to the heat generated by engines and exhaust systems. This area has also been discussed as a possible area for future exploitation in motor racing. Heat recovery might offer the added benefit of reducing heat soak (thermal absorption by the chassis) as delicate **alloy** parts and sensitive **non-metallic** materials, such as **polymers**, are susceptible to heat damage.

**c** **Match the materials from the text (1–7) to the descriptions (a–g).**

| | | | |
|---|---|---|---|
| 1 | compounds | a | materials that are not metal |
| 2 | exotic | b | iron and steel |
| 3 | ferrous | c | combinations of materials |
| 4 | ceramics | d | mixture of metals |
| 5 | alloy | e | plastic materials |
| 6 | non-metallic | f | minerals transformed by heat |
| 7 | polymers | g | rare or complex |

**d** **In pairs, take turns to describe an object using the words from Exercise 5c and the phrases in the box. Ask your partner to guess what it is.**

| comprise | consist of | made from | made of | made out of |
|---|---|---|---|---|

**6** **a** **You are going to give a talk on composites technology at a construction materials trade fair. In part of the talk, you focus on reinforced concrete as a well-known example of a composite material. Prepare your talk using words and phrases from this section and the following notes.**

*Composite materials*

*Common example: reinforced concrete (very widely used composite)*

*Cement (derived from lime)*

*Aggregate – fine aggregate (sand) + coarse aggregate (gravel or crushed stone)*

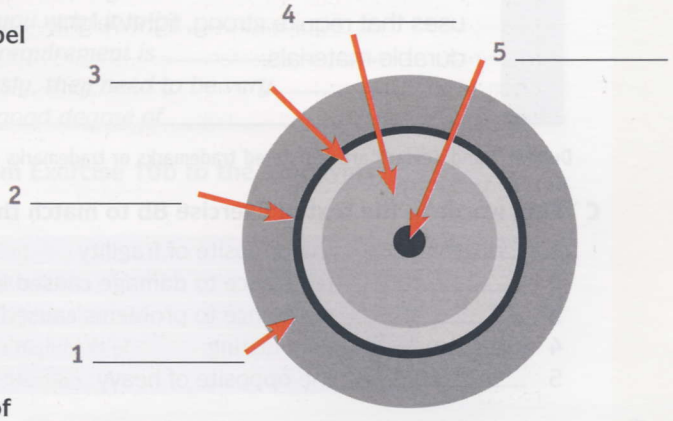
*Water + chemical additives (e.g. plasticiser to improve workability)*

*Reinforcement (steel bars, fixed together with steel tie wire)*

**b** **In small groups, take turns to give your talk.**

**c** **Margit, a sales engineer, is describing a high-voltage cable. Before you listen, label the cross-section with the parts (a–e).**

a insulation
b waterproof membrane
c outer jacket
d armoured protection
e conductor




**d** ▶2.3 **Listen to the description and check your answers in Exercise 6c.**

**e** **Match the parts of the cable (a–e) in Exercise 6c to the following categories of materials (1–5). You will need to use some parts more than once.**

1 non-metallic a _____ _____
2 metallic _____ _____
3 ferrous metal _____
4 non-ferrous metal _____
5 polymer-based _____ _____ _____

**7** **Imagine you are presenting a product or appliance you know well to a potential client. Describe the categories of material used to make the different parts.**

## Specifying and describing properties

**8 a** **In pairs, discuss what you know about the properties of Kevlar® and how it is used.**

**b** **Read the following extract from DuPont™'s technical guide to Kevlar®. Compare the information with your ideas from Exercise 8a.**

### WHAT IS KEVLAR®?

DuPont™ KEVLAR® is an organic fiber in the aromatic polyamide family. The unique properties and distinct chemical composition of KEVLAR® distinguish it from other commercial, man-made fibers.

KEVLAR® has a unique combination of high modulus, toughness, abrasion resistance and thermal stability. It was developed for demanding industrial and advanced-technology applications. Currently, many types of KEVLAR® are produced to meet a broad range of end uses that require strong, lightweight, durable materials.




**c** **Find words in the text in Exercise 8b to match the following definitions.**

1 toughness = the opposite of fragility
2 _____ = resistance to damage caused by friction
3 _____ = resistance to problems caused by temperature change
4 _____ = long-lasting
5 _____ = the opposite of heavy

**9 a** **Match the automotive parts (1–5) to the descriptions (a–e).**

| | | | |
|---|---|---|---|
| 1 | drive belts | a | sheets inserted between parts to prevent gas or fluid leakage |
| 2 | brake pads | b | pneumatic envelopes in contact with the road surface |
| 3 | tyres | c | flexible bands used in transmission systems |
| 4 | sealing gaskets | d | protective barriers capable of resisting gunshots |
| 5 | bullet-resistant armour | e | pads pressed against discs to induce deceleration |

**b** **Read the information from DuPont™ on the following page explaining some of the automotive applications of Kevlar®. Complete the text using the automotive parts in Exercise 9a.**

Car and truck (1) _____ have incorporated Kevlar® into their construction because it offers superb puncture, abrasion and tear resistance.

The high modulus and abrasion resistance of Kevlar® help (2) _____ retain their original shape and tension over the millions of revolutions they go through over the lifespan of a vehicle.

The frictional forces that (3) _____ are designed to endure take less of a toll on those made with Kevlar® pulp. The enhanced thermal stability and inherent abrasion resistance of Kevlar® allow them to last long and stop the vehicle safely and quietly.

Kevlar® provides an effective, lightweight (4) _____ solution for vehicles that require protection against ballistic attack, allowing cars and light trucks to retain most of their original handling characteristics.

Chemical stability and thermal stability help make (5) _____ reinforced with Kevlar® pulp strong and durable. The galvanic corrosion resistance of Kevlar® also contributes to improved long-term engine performance.

**c** **In pairs, discuss why the properties of Kevlar® are especially important for each application described in the text.**

**a** ▶2.4 **Listen to a conversation about the properties of materials used in a specific type of tool and answer the following questions.**

1 Where does the conversation take place?
2 What tool is being discussed?
3 Which materials can be used for its different parts?

**b** **Complete the following extracts from the conversation using the properties in Exercise 8c. Listen again and check your answers.**

1 The handle mustn't be heavy. *Ideally, you want it to be* _____.
2 Resisting friction is essential. *The key requirement is* _____ _____.
3 The bur has to be built to last. *Obviously, they need to be very* _____.
4 Heat builds up in the bur. *You need a good degree of* _____ _____.

**c** **Match the words and phrases (1–5) from Exercise 10b to the synonyms (a–e).**

| | | | |
|---|---|---|---|
| 1 | ideally | a | it's clear that |
| 2 | obviously | b | for the best results |
| 3 | the last thing you want | c | the most important factor |
| 4 | the key requirement | d | a lot of / a high level of |
| 5 | a good degree of | e | the worst situation |

**a** **You work for a manufacturer of hand tools and have been asked to investigate using alternative materials in your products. In pairs, read the notes and discuss the main properties required of the materials used to make the tools.**

Hammers a) Joiners' hammers (for nails)
b) Lump hammers (for masonry chisels)
Consider the hammer head and the hammer shaft.

Saws a) Wood saws (for cutting wood)
b) Hacksaws (for cutting metal)
Consider the saw blade and the saw handle or frame.

**b** **Think of a product you know well. In pairs, discuss the materials used in it and what properties make the materials suitable. Discuss whether alternative materials could be used.**

## Discussing quality issues

**12** **In pairs, answer the following questions.**

1 In advertising, what hi-tech, high-performance situations are often used to promote watches?
2 What messages are they intended to send about the quality of products?
3 What quality issues differentiate higher-quality watches from lower-quality ones?
4 What is the difference between describing something as water-resistant and waterproof?

**13** **a** ▶2.5 **Louisa, a marketing executive for a watch manufacturer, is discussing material selection with Tom, one of her engineering colleagues. Listen to the discussion and complete the four quality issues that are mentioned in the meeting.**

1 _____ resistance
2 _____ resistance
3 _____ resistance
4 _____ resistance

**b** **In pairs, discuss what is meant by each of the quality issues in Exercise 13a.**

**14** **a** ▶2.5 **Listen again and answer the following questions.**

1 What point does Tom make about the reasons for selecting materials?
2 What does he say about submarine-grade steel to exemplify the above point?
3 What problem does he describe with regard to the marketability of many materials?
4 What hard commercial fact does Louisa give?

**b** **In pairs, mark the following statements True (T) or False (F) according to the views expressed in the conversation. Read the audioscript on page 87 and check your answers.**

1 Often, exotic-sounding materials are not that suitable, technically.
2 People think that a submarine steel watch must be tremendously water-resistant.
3 The corrosion resistance of submarine steel is exceptionally good.
4 Submarine-grade steel looks fairly good.
5 Tom thinks submarine steel is particularly suitable for watches.
6 The firm has often used materials that are not adequately durable.
7 Often, the compositions of good watch materials are relatively complex.
8 Materials with complicated names are pretty good for marketing.

**c** ▶2.6 **Listen to the following phrases from the conversation and underline the stressed syllable. Practise saying the phrases.**

1 not particularly suitable
2 exceptionally resistant
3 not at all suitable
4 tremendously marketable
5 relatively complex
6 not all that good

**d** **Complete the following table using the words in the box.**

~~exceptionally~~ fairly insufficiently not adequately not (all) that
not particularly pretty relatively tremendously

| extremely | quite | not very | not enough | definitely not |
|---|---|---|---|---|
| exceptionally | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | |
| | _____ | | | |

**15** **In pairs, discuss the key properties and different types and grades of the following materials. Give examples of the properties that make each material good or bad for watch-making, from a quality perspective.**

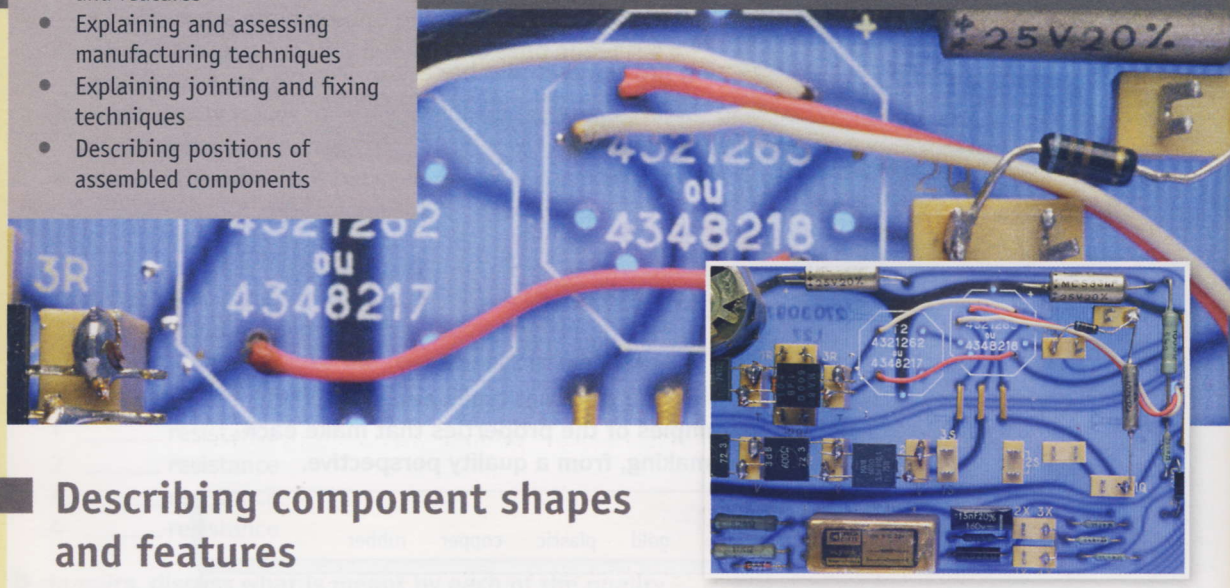
Materials
steel glass aluminium titanium gold plastic copper rubber

Properties
water-resistant abrasion-resistant corrosion-resistant shock-resistant tough
brittle elastic durable heavy lightweight thermally stable

**16** **In small groups, choose a well-known consumer product or appliance and discuss it from a quality perspective. How suitable are the materials used? How good is the product, compared with others sold by competitors?**

# UNIT 3 Components and assemblies

- Describing component shapes and features
- Explaining and assessing manufacturing techniques
- Explaining jointing and fixing techniques
- Describing positions of assembled components




## Describing component shapes and features

1 What do you know about the electrical plugs and sockets used in different countries? In pairs, describe some specific designs.

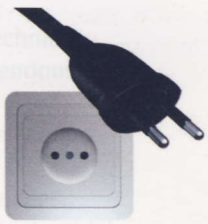
2 a ▶3.1 Jan, a project manager for a firm that manufactures electrical plugs and sockets, is briefing some of his engineering colleagues. Listen to the briefing and summarise the aim of the project.

b In pairs, discuss what is meant by *profile of the pins* and *standard configuration*.

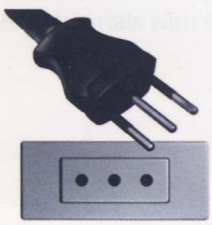
c ▶3.2 Erin, an engineer with the same company, is describing different electrical plug and socket formats during the briefing. Listen and match the descriptions (1–6) to the pictures (a–f).

a _____

b _____



c _____



d _____

e _____

f _____

**d** **Complete the following phrases from the descriptions using adjectives based on the words in brackets.**

1 *... there are* circular *pins for live and neutral.* (circle)
2 *... the earth slot's got a flat base with one side* _____ *over to form a semi-circle.* (round)
3 *This one has* _____ *blades for live, neutral and earth ...* (rectangle)
4 *... it has a* _____ *slot to receive the earth pin.* (cylinder)
5 *... the pins are arranged in* _____ *configuration.* (line)
6 *... they're laid out in* _____ *configuration.* (triangle)

**e** ▶3.3 **Listen and underline the stressed syllable in each of the following words.**

| | | | |
|---|---|---|---|
| rectangle | rectangular | triangle | triangular |
| cylinder | cylindrical | line | linear |

**3 a** ▶3.4 **Listen to a longer description from the meeting. Which picture (a–f) in Exercise 2c does Erin describe?**

**b** **Complete the following extracts from the description using the correct form of the words in the box.**

| flush with | groove | ~~hole~~ | pin | recess | ridge | set back |
|---|---|---|---|---|---|---|

1 *... there's a circular slot at the top. It's obviously a blind* hole *, it doesn't go right through.*
2 *... there are two plastic* _____ *, one on either side of the plug casing, and they slot into corresponding* _____ *at each side of the socket. In addition, the centre of the socket is* _____ *. So rather than being* _____ *the front of the socket, on the same face, the circular area that receives the plug is* _____ *from the surrounding casing ...*
3 *These covers only open when pressure is applied to both by the two* _____ *of the plug simultaneously.*

**c** **In pairs, describe the different plug and socket formats in the pictures in Exercise 2c.**

**4 a** ▶3.5 **Andy and Karin, two electrical engineers, are evaluating a plug and socket format in Exercise 2c. Listen to the conversation and make notes of the advantages and disadvantages of the following features.**

1 Plug slots into a recess in the socket:
Advantages _____
Disadvantages _____
2 Covers protect live and neutral slots:
Advantages _____
Disadvantages _____

**b** **In pairs, discuss the advantages and disadvantages of the plug and socket formats in Exercise 2c. Use the following phrases from the conversation.**

| |
|---|
| an advantage/disadvantage of this format is ... another advantage/disadvantage is ... |
| the problem with this system is ... this (shape/format/feature) stops ... from ... -ing |
| this (shape/format/feature) allows it to / helps it to / makes it easy to / makes it difficult to ... |

# Explaining and assessing manufacturing techniques

5 **In pairs, think of some examples of machining operations that are often used in manufacturing involving metalworking.**

6 a ▶3.6 **Evan, a sales engineer with a metal fabrication company, is showing Mr Barrett, a new customer, around their plant. Listen to the conversation and mark the statements True (T) or False (F).**

1 The company specialises in sheet metal working.
2 The company does a lot of metal casting.
3 Metal bashing is a precise technical term for hammering.
4 Drills and milling machines are always noisy.
5 Grinding is a process that uses abrasives.
6 The press is used for shearing metal.

b **Complete the following training material for graduate engineers using the words in the box.**

Drilling Flame-cutting Milling Sawing Shearing

## MANUFACTURING TECHNIQUE EVALUATION: CUTTING OPERATIONS

Key factors in determining the most appropriate cutting technique are: material characteristics (notably hardness, and thermal and electrical properties), component thickness, component shape and complexity, required edge quality, and production volume. Select cutting options below for a detailed analysis of techniques.

### CUTTING OPTIONS

(1) _____ : abrasive cutting, removing a kerf of material. Includes cutting with toothed blades and abrasive wheels. More ...

(2) _____ : use of pressure on smooth-edged blades for guillotining and punching. More ...

(3) _____ : removal of material across the full diameter of a hole, or using hole-saws for cutting circumferential kerfs. More ...

(4) _____ : removal of surface layers with multiple cutting wheel passes. More ...

(5) _____ : using oxy fuel (oxygen + combustible gas, often acetylene). More ...

c **Complete the following definitions using the words in the box.**

abrasive wheel guillotine hole-saw kerf punch toothed blade

1 A punch makes holes by applying pressure to shear the material.
2 A _____ makes straight cuts by applying pressure to shear the material.
3 A _____ is the width of the saw cut.
4 A _____ has sharp edges for cutting or milling.
5 A _____ has a hard, rough surface for cutting or grinding.
6 A _____ cuts a circular piece to remove an intact core of material.

**7 a** **Read the following extract of promotional literature from a leading producer of ultra-high-pressure (UHP) waterjet cutting machines. In pairs, explain the phrases in bold.**

Flow

What makes waterjets such a popular cutting option? Water jets require few **secondary operations**, produce **net-shaped parts** with no **heat-affected zone**, heat distortion, or **mechanical stresses** caused by other cutting methods, can cut with a **narrow kerf**, and can provide better usage of raw material since parts can be **tightly nested**. As a result of the FlowMaster™ PC control system and intuitive operation, waterjets are extremely easy to use. Typically, operators can be trained in hours and are producing high-quality parts in hours. Additionally, waterjets can cut virtually any material, leaving a satin-smooth edge.

**b** ▶3.7 **Evan is talking to Mr Barrett about UHP waterjet cutting. Listen to the conversation and match the phrases in the box to the extracts (1–4).**

heat-affected zone  mechanical stresses  narrow kerf  net-shaped parts

Extract 1 _____  Extract 3 _____

Extract 2 _____  Extract 4 _____

**c** **Complete the following extracts from the conversation by underlining the correct phrases.**

1 *So they are **especially good when** / **not so good when** you have intricate shapes.*
2 *Saw blades are obviously **perfect when** / **useless when** you're cutting curved shapes.*
3 *… sawing is **the ideal solution** / **not the best solution** if you want to avoid altering the material.*
4 *… it's **ideal for** / **totally unsuitable for** metals.*

**8** **In pairs, assess the different cutting techniques in terms of**
- **shape/size of cut**
- **material types/characteristics**
- **cut width/quality.**

**Use the phrases in the box.**

ideal/perfect/especially good for + -ing  the ideal/perfect solution for
not particularly suitable / not so good if you need …
not the best solution if you don't want …  totally unsuitable / useless

Cutting techniques
drilling with a bit
drilling with a hole-saw
flame-cutting
grinding
guillotining
milling
punching
sawing
waterjet cutting

Shape/size of cut
angular  blind holes  curved  large  small  straight
thick  thin  through holes

Material types/characteristics
ceramics  metals  plastics  timber  hard  tough
brittle

Cut width/quality
heat-affected zone  narrow kerfs  no kerf  rough edges
smooth edges  wide kerfs

# Explaining jointing and fixing techniques

9 **In pairs, think of some examples of ways of joining materials together.**

10 a ▶3.8 **Pedro, a purchasing manager with a kitchen appliance manufacturer, is talking to Alicia, a sales manager from one of their main suppliers. Listen to the conversation and answer the following questions.**

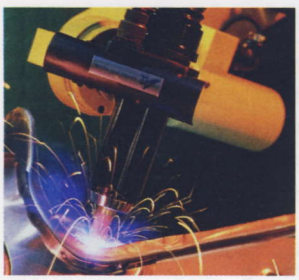
1 What objective does Pedro describe regarding his company's relationship with suppliers?
2 What is Alicia concerned about?
3 How does he respond to her concerns?

b **Complete the following table using the words in the box.**

adhesive ~~bolt~~ clip rivet screw weld

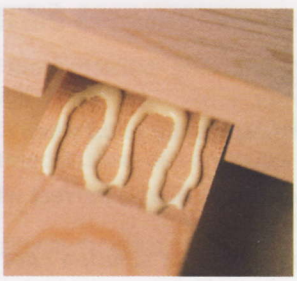
| Mechanical fixings | Non-mechanical fixings |
|---|---|
| bolt | |
| | |
| | |
| | |

c **Label the photos (1–6) with the words in Exercise 10b.**



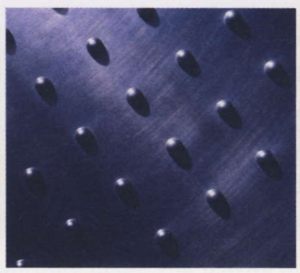
1 weld

2 _____

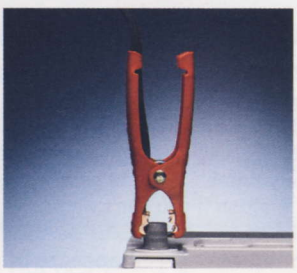


3 _____

4 _____



5 _____



6 _____

d **Match the types of connection in the box to the following groups.**

bolting bonding ~~connecting~~ fixing gluing joining riveting welding

1 connecting _____ _____ = describes any kind of connection.
2 _____ _____ = describes mechanical connections only.
3 _____ _____ _____ = describes non-mechanical connections only.

11 **a** **Complete the following questions using the words in the box.**

each other on onto to together

1 How can we fix these two components _____ ?
2 How can we fix these two components to _____ ?
3 How can we fix this component _____ ?
4 How can we fix this component _____ / _____ this component?

**b** **Complete the following training web page using the words in Exercise 11a.**

## MANUFACTURING TECHNIQUE EVALUATION: JOINTS AND FIXINGS

***The most suitable method of joining components depends on many factors, which extend beyond the obvious issue of required strength.***

- Will the joint need to be disconnected in the future? If a part is bolted (1) _____ , it can obviously be removed at a later date. If two components are bonded to (2) _____ with strong adhesive, or welded (3) _____ then subsequent removal will clearly be more difficult. More ...
- What external factors might affect the joint? Water or heat can weaken adhesive joints. And no matter how tightly nuts are screwed (4) _____ bolts, vibration can cause them to work loose over time. More ...
- How quality-sensitive is the jointing technique? Components are rarely joined (5) _____ each other in ideal conditions. Inadequately tightened fixings, improperly prepared surfaces, or flawed welds are inevitable. How could such imperfections affect the joint negatively? More ...

**c** **In pairs, answer the following questions using the information on the web page in Exercise 11b.**

1 What are the main advantage and disadvantage of mechanical fixings?
2 What is the main disadvantage of non-mechanical jointing?
3 What issues can negatively affect mechanical fixings and non-mechanical joints?

12 **a** **In pairs, discuss the following jointing techniques used in aircraft and say how the parts are fixed together.**

1 Early aircraft: timber frame / adhesive or screws
2 Modern jet aircraft: alloy body panels / rivets
3 Aircraft cabins: seats/floor/bolts
4 Aircraft cockpit: windshield/fuselage/adhesive

**b** **Your company has launched a competition for its engineers to build a homemade model glider that is as cheap as possible to assemble. In pairs, discuss what types of materials and joints you could use.**

## Describing positions of assembled components

**13 a** **In pairs, read the title of the article and suggest ways of making a garden chair fly. Discuss any potential problems.**

**b** **Read the article and match the questions (a–d) to the paragraphs (1–4).**

a How did the actual flight differ from the one that was planned? _____
b What incidents occurred just before and just after the landing? _____
c What is said about the modern equivalent of this type of activity? _____
d What components were used to assemble the flying machine? _____

### CRAZY BUT TRUE: LARRY WALTERS AND THE FLYING GARDEN CHAIR

1 On July 2, 1982, a Californian truck driver named Larry Walters sat outside his house on a garden chair. To say that he was out to get some air is an understatement, for projecting above him a cluster of ropes was tied to 42 helium-filled weather balloons. Anchor ropes, situated underneath the chair, were fastened around the bumper of his car, which was positioned just below the makeshift flying machine.

2 Mr Walters intended to climb gently to an altitude of a few hundred feet, before drifting slowly out of town and across country. He then planned to use an airgun to shoot some balloons and descend gradually to earth. But as the helium gas contained within the balloons warmed up in the summer sun, it progressively generated more lift. When the anchor ropes were released, the self-assembly airship shot up like a rocket. Too shocked to reach for the pistol inserted in his pocket, the first-time pilot held on for life. In just a few minutes, Larry Walters was 16,000 feet above the ground, floating over the city of Long Beach. A short time later, there were further complications; he suddenly found himself inside controlled airspace, adjacent to Long Beach Airport. The occupants of passing Delta Airlines and TWA aircraft looked on at the curious spectacle outside, as wide-eyed as the garden chair pilot hovering beside them.

3 Eventually, after managing to shoot some balloons, Mr Walters descended safely to earth despite an anchor rope, which was still suspended beneath the chair, getting tangled with a power line located alongside the landing site (in someone's garden). He was immediately arrested by waiting police officers, and was later fined for breaking Federal aviation laws.

4 Today, cluster ballooning, while still a fairly marginal sport, is steadily starting to gain in popularity.

**c** **Answer the questions in Exercise 13b.**

**14 a** **Label the diagrams using the prepositions in the box.**

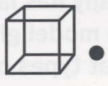
~~above~~ adjacent to alongside around below beneath beside inside outside over underneath within

a  above _____

b  _____

c  _____

d  _____

e  _____

f  _____

**b** **Complete the following sentences about the flying garden chair using the prepositions in the box. Check your answers against the text in Exercise 13b.**

| in | above | around | beneath | within |
|---|---|---|---|---|

1 Projecting _____ the chair was a cluster of ropes, tied to 42 helium-filled weather balloons.
2 Anchor ropes were fastened _____ the bumper of the car.
3 Larry Walters had an airgun inserted _____ his pocket.
4 The helium contained _____ the balloons warmed up in the sun.
5 After takeoff, the anchor ropes remained suspended _____ the chair.

**c** **Complete the following descriptions of how the garden chair airship was assembled by underlining the correct words.**

1 A quantity of helium gas was **contained/suspended** inside each balloon.
2 A tube was **inserted/projected** inside the openings of the balloons, to inflate them.
3 The balloons were **situated/suspended** over the chair, in a large cluster.
4 The chair was **contained/suspended** under the balloons by ropes.
5 Arm rests, **contained/located** beside the pilot, at each side, helped to hold him in place.
6 The landing gear, **inserting/projecting** below the seat, consisted, simply, of the chair legs.
7 The pilot was **positioned/projected** underneath the balloons, so his weight was low down.

**d** **Which two other words have the same meaning as *positioned*?**

| contained | fastened | inserted | located | projected | situated | suspended |
|---|---|---|---|---|---|---|

15 **a** **In pairs, look at the photo and describe how you think the cluster balloon is assembled from the following components.**

| bags | balloons | helium | nylon ropes | nylon straps | paragliding harness |
|---|---|---|---|---|---|
| plastic cable | sand/water ballast | ties | tape | | |

**b** ▶3.9 **Eva and Lenny, two engineers working for an extreme sports equipment manufacturer, are discussing cluster ballooning. Listen to the conversation and summarise what they say about the following issues.**

1 assembly time
2 how plastic cable ties are used
3 a tree structure
4 how water bags are used
5 the advantage of tying each individual balloon
6 the problem of using a net to contain the balloons

**c** **In pairs, discuss ways of overcoming the problems mentioned in the conversation. How could cluster ballooning be made more accessible to a mass market? What other equipment/assemblies could be used?**