

1 Prototypes

- Start here** 1 Work in pairs or small groups and brainstorm this question: What applications would a perfect smartphone have?
- Reading** 2 Read the review of a new prototype and answer these questions.
- 1 Which figure illustrates this prototype?
 - 2 How does it work?
 - 3 What technologies does it use?

New developments in smartphone technology

Virtual reality (VR) was once called the big new idea in ICT, but no commercial applications were discovered during the years of research. VR has now been replaced by a new concept: augmented reality (AR). AR stays in the real (not virtual) world, adding digital value to what people see around them.

AR software has been created which can locate and recognise objects, instantly labelling them with relevant information obtained from the web.

Combining data from a camera, GPS, tilt sensors, digital compass and wireless broadband, it can determine exactly what is being looked at. Once the object has been identified, the internet is searched for relevant information. Once retrieved, the information is displayed as a label superimposed on the image.

When pointed at a mountain, for example, the device adds its name, height and other information to its image. The equipment can also find a nearby friend in a street, or guide you to a destination like a SatNav.

In the past, only static data (e.g. from Wikipedia) was used for the labels. More recently, ways of retrieving live data (such as aircraft departure times) have been developed.

Current research is being carried out into methods of building social networks into the system, so that you can see live information about people when the camera is pointed at them (if their smartphone is also switched on).

The small size of the smartphone screen, however, is still a problem, and more work needs to be done to solve it.

In the future, the main areas of research are likely to give smartphones the ability to find people's locations anywhere in the world and to provide relevant information about everyone you point your camera at.



- | | | | |
|---|-----------------------|---|---|
| A | aim of system | 1 | study ways to include data about people from social websites |
| B | components | 2 | device works in this way: (1) obtains data from GPS and sensors to locate object (2) retrieves data from internet to identify object (3) finds relevant data from internet to add value to object |
| C | user operation | 3 | point camera at object + device displays information as label superimposed on image |
| D | method | 4 | test live data in AR prototypes |
| E | outdated technology | 5 | solve problem of small display |
| F | recent development | 6 | device can locate people anywhere + show information about everyone you meet |
| G | currently in progress | 7 | add digital value to the real world |
| H | action still required | 8 | find only static data in AR applications |
| I | future target | 9 | phone, camera, GPS, tilt sensors, compass, wireless broadband, internet |

- Language** 4 What is the most appropriate language form 1–9 to perform the functions in A–I in 3?
- | | | | |
|---|--|---|--|
| 1 | present continuous + time phrase (e.g. <i>currently</i>) | 6 | <i>have to / need to</i> + infinitive |
| 2 | present perfect + time phrase (e.g. <i>recently</i>) | 7 | past simple + time phrase (e.g. <i>in the past</i>) |
| 3 | <i>the aim / objective</i> + <i>of</i> + noun + <i>is</i> + <i>to</i> + infinitive | 8 | <i>by</i> + verb -ing |
| 4 | <i>will (no doubt) / is (probably) going to</i> | 9 | present simple |
| 5 | <i>consist of</i> | | |

- Speaking** 5 Describe the AR system in Fig. 1, without looking at the text in 2. Use the table in 3 and the language forms in 4. Use the passive where appropriate.
- 6 Work in groups. Discuss the SixthSense prototype illustrated in Fig. 2, using the data in the table below and the language in 4. Take turns to talk about different aspects.

aim	project images and data about an object onto surface of object
components	camera, projector, smartphone (worn round neck); coloured caps on fingers
operation	user points camera at object + makes gestures with coloured finger caps + device projects relevant information onto surface of object
method	finds GPS co-ordinates; obtains data from internet; recognises finger gestures
outdated technology	device provides only static data on small smartphone screen
recent development	researchers find ways to provide live data and projects it <i>outside</i> the smartphone
work in progress	researchers teach device to recognise many more finger gestures (e.g. circle for clock, @ sign to download email)
further work required	reduce size of equipment so it can be worn as glasses
future target	turn the whole world into an interactive screen for the smartphone; increase amount of live data available

- Writing** 7 Work individually. Write a description of the SixthSense prototype following the order of the information in the table in 6 and using the phrases in the left-hand column as headings. Use the passive where appropriate.

Begin:

Aim

Although AR technology is very powerful, a new system is now being developed to overcome the limitations of smartphone screen size. This is the SixthSense smartphone, which aims to project ...

Components

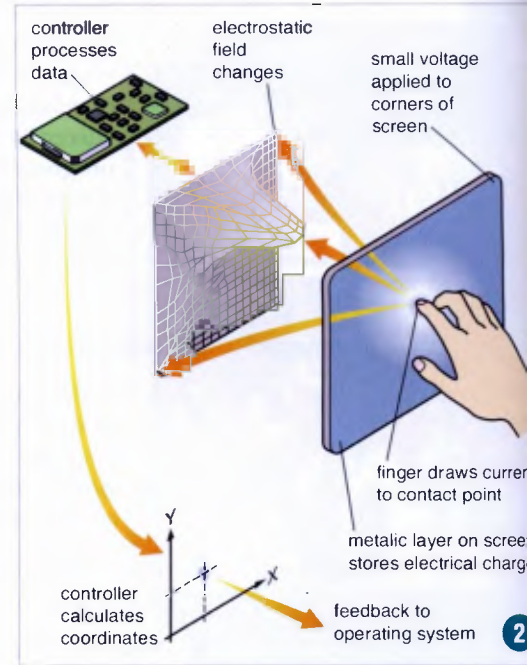
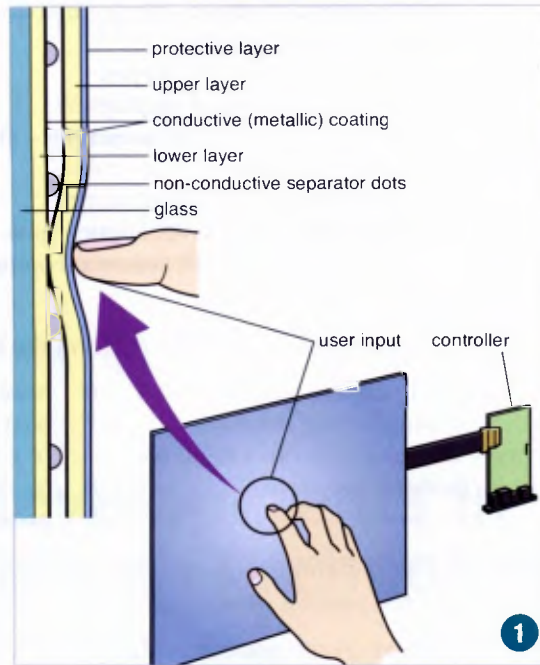
The system consists of ...

2 Comparisons

Start here

1  19 Listen to a discussion about touch screens and answer these questions.

- 1 What are the names of the two types of touch screen illustrated below?
- 2 How many metallic layers does each touch screen have?



Listening

2 Study the diagrams above and write R (resistive), C (capacitive), B (both) or N (neither) next to each feature below.

- | | | |
|---------------|---|--|
| 1 principle: | electrical circuit <u>R</u> | stored electrical charge ___ |
| 2 action: | light contact ___ | pressure ___ |
| 3 result: | pushes metallic layers together to close circuit at contact point ___ | pulls current to contact point on screen ___ |
| 4 input by: | finger only ___ | any object ___ |
| 5 clarity: | poor (more light filtered out) ___ | less light filtered out ___ |
| 6 surface: | good scratch resistance ___ | poor scratch resistance ___ |
| 7 durability: | wears down less quickly ___ | wears down more quickly ___ |

3 Listen to the discussion again, and check your answers to 2.

Language

Comparing and contrasting

- *The clarity of the capacitive screen is **much greater than that** (= the clarity) of the resistive one.*
- ***Unlike** the resistive screen, the capacitive one only has one metallic layer.*
- *With a capacitive screen, **instead of using pressure**, you touch it very lightly.*
- *You can only use your finger with a capacitive screen, **while / whereas** you can use any object with a resistive screen.*
- *You could say it's a disadvantage of the capacitive screen. **On the other hand**, you're less likely to scratch the screen surface.*
- ***Compared with** the capacitive screen, the resistive one can wear out very quickly.*

Speaking

4 Work in pairs. Discuss the advantages and disadvantages of the two systems, with one person arguing in favour of the resistive system and the other supporting the capacitive one. Use a variety of language from the box above.

- Task 5** A technical writer is planning to write a report comparing the two touch screen systems in the factsheets below. Look at the information in the factsheets and study the following notes that the writer has made.

Introduction

Purpose: compare IR and SAW; help company buy best system

Similarities

Paragraph explaining similarities: 1. good clarity in both systems – because no metallic layers; 2. both systems use signals on or over screen surface

Differences in technology

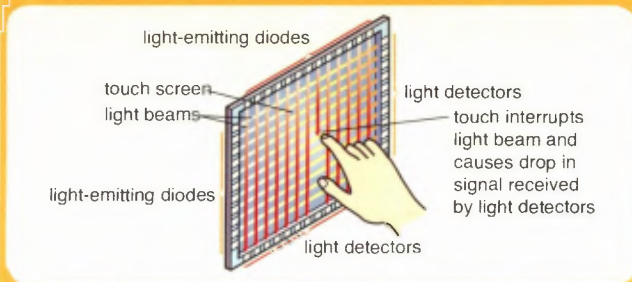
Paragraph about IR: LEDs / light beams / detectors / touch / interrupts beam / drop in signal / controller / determines location of touch

Paragraph about SAW: transducers / sound waves / reflectors / touch / absorbs energy / controller / wave amplitude / location

Differences in performance resulting from technology (4 short paragraphs comparing IR and SAW for:)

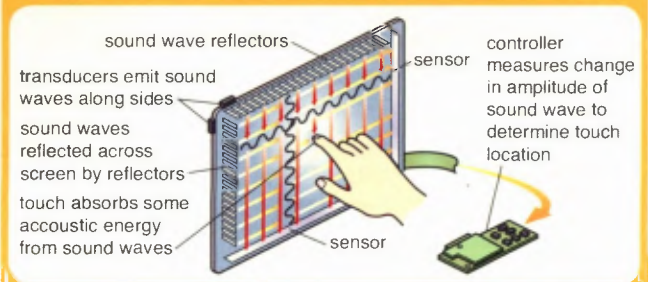
- 1 Input
- 2 Effect of bright light / loud music
- 3 Resistance to moisture and contaminants
- 4 Applications

INFRARED (IR) TOUCH SCREEN



- No metallic layer over screen, so high clarity
- Technology: light beams slightly above screen surface
- Method: touch interrupts beams
- Responds to any input: finger, pen
- Affected by bright ambient light
- Can be sealed and protected against weather and contaminants
- Applications: outdoors, medical, industrial

SURFACE ACOUSTIC WAVE (SAW) TOUCH SCREEN



- No metallic overlay: high clarity
- Technology: sound waves on screen surface
- Method: touch absorbs acoustic energy
- Responds to soft objects: finger, soft stylus
- Affected by loud ambient noise
- Cannot be sealed: badly affected by moisture or contaminants
- Applications: indoors, banks, payphones

- Scanning 6** Practise your speed reading. Look for the information you need on the SPEED SEARCH pages (116–117). Try to be first to complete the information below.

- 1 The IR screen has *more* / *less* clarity (i.e. transmits more light) than the SAW.
- 2 The SAW screen operates in a *wider* / *narrower* temperature range than the IR.

- Writing 7** Write a product comparison report based on the information and the notes in 5, comparing the two touch screen systems. Use language from the box on the opposite page where appropriate.

Begin:

Introduction

The purpose of this brief report is to compare touch screen systems: infrared (IR) and surface acoustic wave (SAW), to assist in the process of selecting the best touch screen system for our company's needs.

Similarities


Both touch screen systems have very high clarity because (unlike resistive or capacitive screens) there are no ...

3 Products

- Start here** 1 Work in pairs. Discuss this problem and brainstorm some possible solutions. Make a list of the best solutions.

RADIO AERIALS are essential equipment for telecommunications of all kinds. And yet, despite their importance, they are very delicate pieces of equipment. They are often made of materials which break easily, such as copper. For many decades, complaints have been received from professionals working in emergency situations – policing, war zones, fire fighting or disaster relief – that their radio aerials have been easily destroyed and that lives have been lost or put in danger as a result.



- Listening** 2  20 Listen to a product launch of a new type of aerial and answer these questions.
- 1 How does the new aerial solve the problem in 1? Compare with your list of solutions in 1.
 - 2 The new aerial is made of an alloy of which two metals?
 - 3 What method is used to tune the new aerial to the correct wavelength?
- 3 Listen again and do the following.
- 1 List five useful properties of the new aerial that are mentioned.
 - 2 List the four forces or stresses that an aerial is normally subjected to.
- 4 Listen again and complete the speaker's words with the words and phrases in the box.

in other words To put this in everyday terms that is Another way of putting this is that
i.e. To put that in layman's terms or that is to say

- 1 The first is resilience, _____, the ability to bend but not break under pressure.
- 2 And the second is a regenerative capability, _____, the ability to repair itself.
- 3 The four main forces are ... compression, _____ squeezing ...
- 4 ... torsion, _____, a twisting force ...
- 5 ... and finally impact, _____ striking or hitting.
- 6 _____, you can't break it by striking it, pulling it, pressing on it or twisting it.
- 7 _____ we have produced an aerial which bends without breaking ...
- 8 _____, you change the length of the aerial to match the vibration of the wave that's coming in.

Language Words and phrases to signal that you are about to explain something

Explaining single words or short phrases: *or, that is, that is to say, in other words, i.e.*

Explaining longer passages: *another way of putting it is that, to put that another way, to put this in everyday terms / language, to put that in layman's terms / language*

- 5 Match the technical terms in *italics* with their less specialised explanations a–h.

Note: Explanations in a–h are not necessarily scientifically or technically exact.

- | | |
|---|--|
| 1 Aerials use an electrical current that <i>oscillates</i> . | a) it melts at room temperature |
| 2 The current oscillates at a specific <i>frequency</i> . | b) vibrates |
| 3 Aerials send out <i>electromagnetic radiation</i> . | c) speed of vibration |
| 4 They are made of a <i>conductive material</i> . | d) the wave that you're sending out |
| 5 Our team found an alloy with <i>high fluidity</i> . | e) magnetic waves caused by an electric current |
| 6 The alloy has a <i>low melting point</i> . | f) it can stretch like an elastic band |
| 7 The aerial has <i>high elasticity</i> . | g) a substance that can carry electrical current |
| 8 The aerial length must match the frequency of the <i>outgoing radiation</i> . | h) it flows easily |

- 6 Make full statements from the table, using a variety of expressions from the language box on page 56.

Example: *1 Aerials use an electrical current that oscillates, that is, vibrates.*

- 7 Work in pairs. Discuss the differences between the speaker's *technical* description and *everyday* description. What methods does the speaker use to make the meaning clearer to a non-specialist audience?

Technical

Aerials transmit signals by using an oscillating electrical current in a length of conductive material to generate electromagnetic radiation.

Everyday

To put that in everyday language, this is what happens. An aerial is basically a rod made of a material, such as copper, which can conduct, or carry, electrical current. The current vibrates at a particular speed, and the vibration sends out magnetic waves, known as radio waves. It's a bit like throwing a stone into a pool of water. The vibration of the stone hitting the water sends out water waves in all directions. Or think of clapping your hands together and sending out sound waves.

Language To explain technical terms or ideas to a non-technical or non-specialist audience, it often helps to make comparisons with:

- parts or functions of the human body: *an aerial that can repair itself, just as human skin does*
- everyday objects: *an aerial is basically a rod made of a material, such as copper; it can be stretched like an elastic band*
- everyday actions and events: *an aerial which bends without breaking, as a palm tree does in a hurricane; it's a bit like throwing a stone into a pool of water; think of clapping your hands together and sending out sound waves*

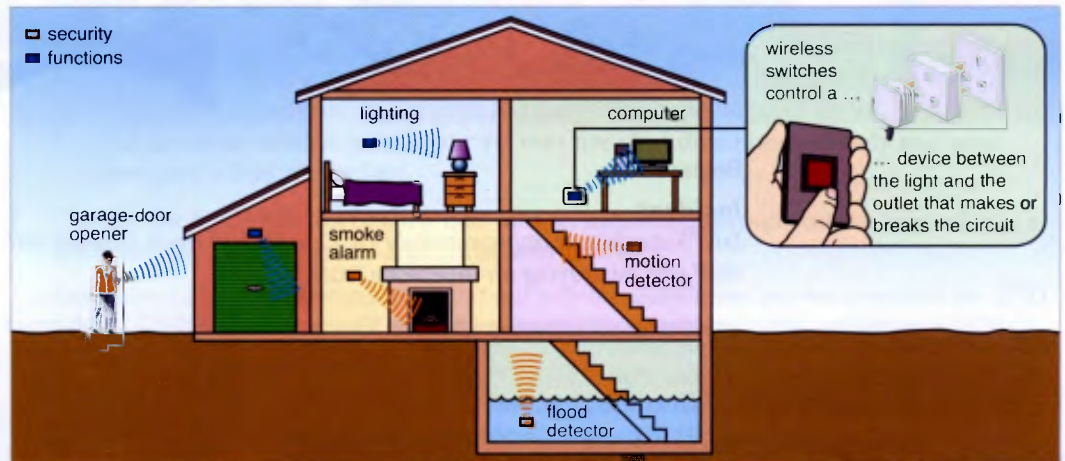
- Task** 8 Work in pairs. Choose two of the following items from this unit, and prepare brief explanations (max 80 words) for a non-technical audience. Use the strategies above. Then explain your items to another pair, without mentioning the name. Can they work out which ones they are?

Augmented Reality (AR), SixthSense, capacitive touch screen, surface acoustic wave touch screen, flexible aerial, capacitor, electrical circuit, electrode

- Writing** 9 Choose a concept, principle, technology or piece of equipment which is important in your technical field or industry. Describe and explain the same information in two different texts – one technical and the other non-technical.

1 Proposals

- Start here** 1 Work in pairs. Discuss what features of an 'intelligent' or automated building you would like in the place where you live or work.



- Listening** 2 24 Listen to these extracts from a meeting between Sigma's technical sales manager and a director of Widgett & Sons, a potential client. Tick the main features below which are mentioned.

SIGMA SYSTEMS: FOR AUTOMATED COMMERCIAL BUILDINGS

MAIN FEATURES

- | | | | |
|--|--|---|---|
| 1 intrusion sensors <input type="checkbox"/> | 3 smoke detectors <input type="checkbox"/> | 5 thermostats <input type="checkbox"/> | 7 radio-enabled sensors <input type="checkbox"/> |
| 2 light sensors <input type="checkbox"/> | 4 motion sensors <input type="checkbox"/> | 6 moisture detectors <input type="checkbox"/> | 8 self-healing 'mesh' networks <input type="checkbox"/> |

- 3 Four of the selling points A–F in these notes are used in the meeting. Listen again and number them in the order in which they are discussed.

SELLING POINTS TO MAKE TO PROSPECTIVE CLIENT

- | | |
|--|---|
| <p>A <input type="checkbox"/> break-in by intruder – intrusion sensors – trigger alarm + series of events: master lights, emergency service, video, activate locks – simultaneously
<i>Proposal: full security package</i></p> <p>B <input type="checkbox"/> control of network = central computer + mobile input devices – mobile phone / PDA – supervisors walk around factory – input/receive data – system updated automatically – password protected
<i>Proposal: Sigma mobile input devices</i></p> <p>C <input type="checkbox"/> sensor battery (in smoke detector) dead? – no problem – mesh networks – self-healing – repair themselves – rest of network raises alarm – signals go around failed device – use different route
<i>Proposal: choose self-healing mesh network option</i></p> | <p>D <input type="checkbox"/> scalable – (virtually) unlimited number of devices can be connected to network – allows factory to expand after network installed – very wide range – can cover 250 m² (large factory)
<i>Proposal: scalable network system option</i></p> <p>E <input type="checkbox"/> devices – control heating, cooling, lighting, air quality – lights + radio-enabled motion sensors – programmed – turn on / off as staff walk in / out – reduce energy costs
<i>Proposal: utilities package</i></p> <p>F <input type="checkbox"/> radio chips – use low power – default mode 'asleep' – only activate when needed – transmit, receive small amounts of data – high speed not necessary – batteries last up to 5 years – unlike other systems
<i>Proposal: Sigma batteries – 5-year-guaranteed life</i></p> |
|--|---|

4 Match the verbs in the box with the verb phrases in italics below.

pinpoint select enter tackle lose power reduce go around monitor

- 1 How would your system *keep an eye on* security issues?
- 2 Video cameras would *home in on* the area.
- 3 How would you *go about* reducing our energy costs?
- 4 Lights turn themselves on whenever staff *make their way into* a workshop.
- 5 This would help you to *cut down on* energy costs.
- 6 I strongly recommend that you *go for* the full utilities package.
- 7 Some Wi-Fi systems have batteries that *run down* after a few hours.
- 8 All the signals would *by-pass* the failed device.

Language

Ways of making proposals

We propose that your company (should) install our system.

We propose installing our system in your factory.

We would like to make / submit / put forward a proposal to install / for installing our system.

- **propose + that** specifies who will carry out the proposed action: *We propose that a team of specialists (should) inspect your current system.*
- **propose + -ing** does not specify the actor, and is often used when the actor and the proposer are the same: *We propose bringing in a team of specialists.*
- the words **propose** and **proposal** in business or work contexts often signal a formal (or official) proposal which requires formal acceptance or rejection.
- **suggest** or **recommend** are commonly used in proposals without signalling a formal proposal: *We (would) (strongly) recommend / suggest installing / that you (should) install our system.*

5 Complete this text, using a variety of forms from the language box above.

The planning committee made a number of proposals (1) _____ (deal with) the difficulties of building companies during the economic downturn. First, they proposed (2) _____ (carry out) a large-scale survey of the needs of the building industry in the region. The second proposal was (3) _____ (set up) up a special bank to give cheap loans to struggling builders. The third proposal was (4) _____ (hold) a regional conference of all small and medium-sized building companies to discuss the issues. Fourthly, one of the major building companies proposed (5) _____ (ask / government) to help out with subsidies and loans where necessary. To speed things up, this company suggested (6) _____ (committee / circulate) a draft letter for everyone to sign. They also recommended (7) _____ (contact) local government officials to see if they could help.

Speaking

6 Work in pairs. Role play a conversation between the Widgett director (Student A) and the Sigma technical sales manager (Student B) about points A–F in 3. Use the notes in 3 and language from the box above.

Student A: Ask questions to elicit the answers in the selling points in 3. Respond to B's answers in a positive way before B makes proposals.

Student B: Use the selling points in 3 to answer A's questions and wait for A's response to your answers before making your proposals.

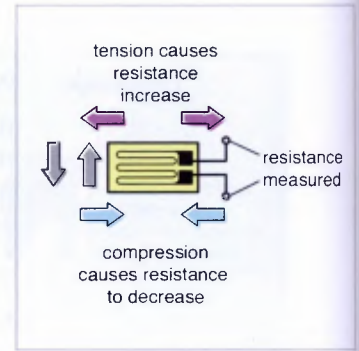
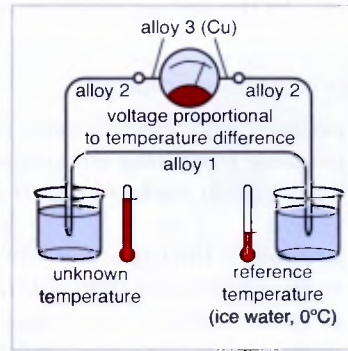
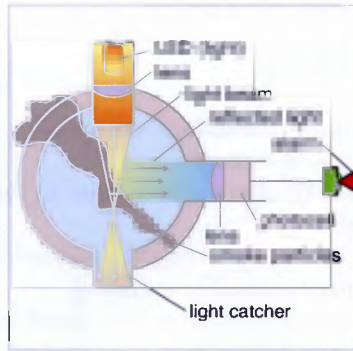
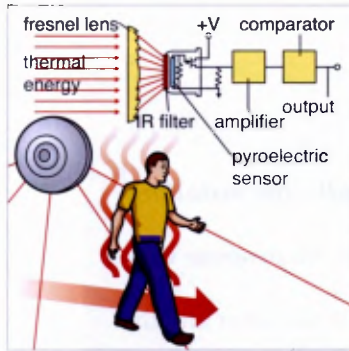
7 When you have finished, work with a different partner and switch roles.

2 Definitions

Start here 1 Work in groups. Discuss the sensors illustrated below and match them with their main function 1–4.

For detecting / measuring ...

- 1 slight changes in the surrounding temperature
- 2 bending or other changes of shape in a rigid structural component
- 3 the movement of any object capable of giving out heat
- 4 presence of carbon particles arising from combustion



Reading 2 Match the definitions A–D with the sensors above.

- A A photoelectric smoke detector is a security device, containing an LED and a photocell, that detects smoke particles by bouncing light off them onto the photocell.
- B A PIR (passive infra-red) motion detector is an electronic sensor, made of pyroelectric material, which detects the movement of a heat-emitting body by generating an electric charge when exposed to infra-red radiation.
- C A strain gauge is a device used for measuring the mechanical deformation of a concrete beam or similar structure and consisting of a metal coil and terminals, that changes its electrical resistance when its shape changes.
- D A thermocouple is a small heat-sensitive electrical device consisting of two wires made of dissimilar metals, which is used for measuring variations in temperature and is frequently found in heating and cooling systems.

Language Basic definition of an item

name	be	generic noun	main function
A thermocouple	is	a device	for measuring temperature.
A PIR motion detector	is	a sensor	which detects human movement.

Definitions normally contain the four elements above, although more complex ones can have optional elements before and after the generic noun. For example:

- A thermocouple is a **simple electrical device** for measuring temperature.
- A PIR motion detector is an **electronic sensor, made of pyroelectric material**, which detects human movement.

3 Identify the four elements from the language box in A and C in 2.

4 Identify the four elements from the language box in this definition.

Electric Potential Sensors (EPS) are wideband (quasi DC to 200 MHz) ultra-high-impedance sensors used for detecting spatial potential, electric field or charge.

Language Expanded definition

Note: the white rows are optional and not necessarily in the order shown here.

name	A thermocouple
be	is
appearance	(a) small
property	heat-sensitive
type	electrical
generic noun	(a) device
components	consisting of two wires
material	made of dissimilar metals
main function	which is used for measuring changes in temperature
application	and is frequently found in heating and cooling systems.

Other functions are possible in the white rows (see 5 below).

Clauses can be linked by a variety of forms, such as:

- past participle: *made of dissimilar metals*
- present participle: *consisting of two wires*
- (which is) (used) for -ing: *(which is) (used) for measuring temperature*
- which / that / who: *which / that measures temperature*

5 Make similar charts for definitions A–C in 2. Use the headings shown for the white rows.

Definition A: type / material / method

Definition B: type / components / method


Definition C: components / property

Vocabulary 6 Complete these definitions with the most appropriate generic noun from the box.

device system standard process instrument

- 1 IEEE 802.15.4 is a(n) _____ which was created specifically for control and sensor networks.
- 2 Basic oxygen steelmaking is a(n) _____ by which raw iron is converted into steel by removing most of the carbon.
- 3 A voltmeter is a(n) _____ which gives a precise measurement of electrical potential differences between two points in an electric circuit.
- 4 A sensor is a(n) _____ that detects a change in its surroundings and converts it into a signal which can be read by an observer or by an instrument.
- 5 Global positioning is a space-based global navigation satellite _____ that provides reliable location and time information at all times and in all weather.

Writing 7 Write the definition of this instrument, using the following words and phrases in the correct order.




mounted on for measuring a small a surveying
 A theodolite is telescope consisting of horizontal and vertical angles, a tripod.
 instrument

8 Write six definitions from your industry or technical field. Use a variety of generic nouns.

3 Contracts



Start here 1 Work in pairs. Discuss briefly when contracts are used and why they are important.

Listening 2  25 Listen to this discussion between the Widgett director and the head of his legal team. Complete the notes.

- 1 We will only pay them in full on condition that _____
- 2 They'll give us a 15% discount on the total price provided that _____
- 3 They can select the starting date as long as _____
- 4 In case they miss the deadline, _____
- 5 We have the option of cancelling the contract and getting our money back in case _____
- 6 Even if we have to close the factory for a short time, _____

Reading 3 Match these extracts from the contract with the completed notes in 2.

A The Work shall commence at a date to be nominated by the Contractor with the proviso that the Contractor shall give the Client 14 days' prior warning of the intended date of commencement.

D The Work shall be carried out only by named direct employees of the Contractor. Should the Contractor breach this condition, the Client shall have the option to terminate this Agreement, in which case the Contractor shall repay all monies received from the Client.

B In the event that an unforeseen circumstance should force the temporary closure of the Location, there shall be no variation to the deadline stipulated in the Schedule other than as agreed by both Parties in an exchange of letters.

E In the event that the Contractor fails to complete the Work within the time specified in the Schedule, the Contract Price shall be reduced by the percentage stipulated in the Schedule pro-rata for each week of delay beyond the specified deadline.

C The Contract Price shall be reduced by the percentage stipulated in the Schedule, provided that the Client allows the Contractor to nominate the date of commencement of the Work.

F The Client shall pay the Contractor the Contract Price stipulated in the Schedule for the Work, provided that the Work is completed to the satisfaction of the Client and in accordance with the terms of this Agreement.

4 Answer these questions about the contract.

- 1 Under what circumstances can the deadline be changed?
- 2 What action would lead to cancellation of the contract?
- 3 What would happen if the work was completed two and a half weeks late?
- 4 Where are the details of how much money the client will pay?

5 Find words or phrases in the contract with the same meaning 1–6.

- 1 chosen 2 earlier in time 3 unexpected 4 specified 5 break 6 compliance

6 Write generic definitions for these terms in the contract.

Example: 1 'The Work' refers to the goods and / or services that will be supplied and / or carried out by the Contractor for the Client.

2 'The Location' is the site or building where ...

- 1 the Work 3 the Client 5 the Contract Price
2 the Location 4 the Contractor

Language

Language commonly used when discussing and reading contracts

Conditions	We will reduce the price provided (that) / on condition that / as long as / so long as / with the proviso that they pay on time.
Circumstances	In the event that the factory closes, the deadline can be changed. In case of / In the event of factory closure, the deadline can be changed.
Precautions	We need to take out insurance in case the factory burns down.
Regardless of circumstances	Even if there is a transport strike, the goods must be delivered by the deadline.
Alternatives	This offer must be accepted within 14 days; otherwise (= if not), the offer will be withdrawn.
Formal writing	Should the client fail to pay the balance within 30 days (= If the client fails to pay ...), there will be a penalty of ...

7 Complete these sentences, using each word or phrase once only.

even if otherwise provided that in the event of as long as in case

- 1 I would be happy to take on this new project _____ you agree to raise my salary.
- 2 The new factory extension must be opened by the end of the year _____ the building is not a hundred per cent complete.
- 3 The staff have been instructed and drilled in safety procedures _____ fire or other emergency.
- 4 We need to look for another one or two potential suppliers for these essential goods _____ our current supplier goes bankrupt.
- 5 The balance of the money you owe us must be paid within one week. _____, we will begin legal action against you.
- 6 You can make changes to the contract _____ you contact the other party and get their agreement to the changes.

Scanning

8 Practise your speed reading. Look for the information you need on the SPEED SEARCH pages (116–117). Try to be first to find the meanings of these terms used in contracts.

- a) aforementioned b) notwithstanding c) hereinafter

Writing

9 Write the follow-up memo from the Widgett director to the head of the legal team, confirming the six conditions in the phone call in 2. Add the following conditions.

- 1 pay Sigma's expenses – condition: must be reasonable, submit receipts
- 2 pay balance within 30 days of completion – condition: full test of system completed

Begin: *As promised in our phone discussion yesterday, here are the main terms and conditions that I have agreed with Sigma. Could you turn them into a draft contract for me to look at next week?*

1. Widgett will only pay Sigma in full on condition ...

Review Unit E

- 1 Complete these sentences. Use the words and phrases in the box once only. Two of the words / phrases are not needed.

propose that recommend submitted proposals to recommend that you should
suggestion that propose put forward a proposal proposal

- 1 Our technicians _____ supplying your factory with a wireless system.
- 2 The contractors have _____ for providing a mesh network for the system.
- 3 Our consultants _____ specifying the IEEE 802.15.4 standard for the network.
- 4 Our legal team _____ a five-year warranty should be added to the contract.
- 5 We _____ install heat and smoke detectors throughout your factory.
- 6 The sales team have _____ overhaul all the motion sensors in our workshops.

**NATIONAL POWER
GRIDS SHUT DOWN BY
COMPUTER WORM**

**Increase in
deepwater
drilling threatens
more oil spills**

**EVERY SQUARE KM
OF OCEAN HAS 18,000
PIECES OF FLOATING
PLASTIC, SAYS UN**

**Energy and
construction costs
of Olympic Games
soar again**

**WATER SHORTAGES
INCREASE AS POPULATIONS
GROW AND CLIMATE
CHANGES**

**Social networking
websites destroy lives
as well as privacy**

- 2 Work in pairs. You both work in a problem-solving think-tank. Discuss three of these problems (left) and come up with at least two recommendations for each one. Then tell the class what steps you propose to take and how you recommend solving them.
- 3 Replace the words and phrases in the sentences below with the words and phrases in the box to give the same meaning. Use each word / phrase in the box once only.

in case if not provided regardless of whether in the event
should there be as long as

- 1 Full payment shall be made *on condition* that the work is completed.
- 2 We will send your goods by courier so that, *even if* there is a postal strike, you will receive your goods on time.
- 3 *If there are* any unforeseen manufacturing delays, we must inform our customers within 24 hours.
- 4 I'm interested in buying your company's products *with the proviso that* you agree to give us a small discount for volume sales.
- 5 *In case* of accidents or near-miss incidents at work, supervisors must report to management immediately. *Otherwise*, disciplinary action will be taken.
- 6 Full protective equipment must be worn when handling these containers *to guard against the possibility that* the chemicals leak out.

- 4 Complete these sentences, using the correct form of the verbs in the box.

go (x2) make keep put home cut run draw follow

- 1 I would strongly recommend keeping an eye on your energy costs in case they rise too much.
- 2 We look forward to hearing your proposals for _____ down on carbon emissions.
- 3 I suggest that you _____ up your phone discussion with your client by _____ forward a formal proposal immediately.
- 4 So how do you plan to _____ about _____ up the draft contract?
- 5 If unauthorised persons _____ their way into the factory, digital video cameras will _____ in on them automatically.
- 6 I propose that we should _____ for rechargeable batteries. If we buy non-rechargeable ones, it's possible that they will _____ down too quickly.

1 Investigations

Start here 1 Work in pairs. Study this photograph of a hydroelectric power station, where a serious accident occurred (in the location circled in white). Discuss what happened and where it happened by referring to the three diagrams on the opposite page.



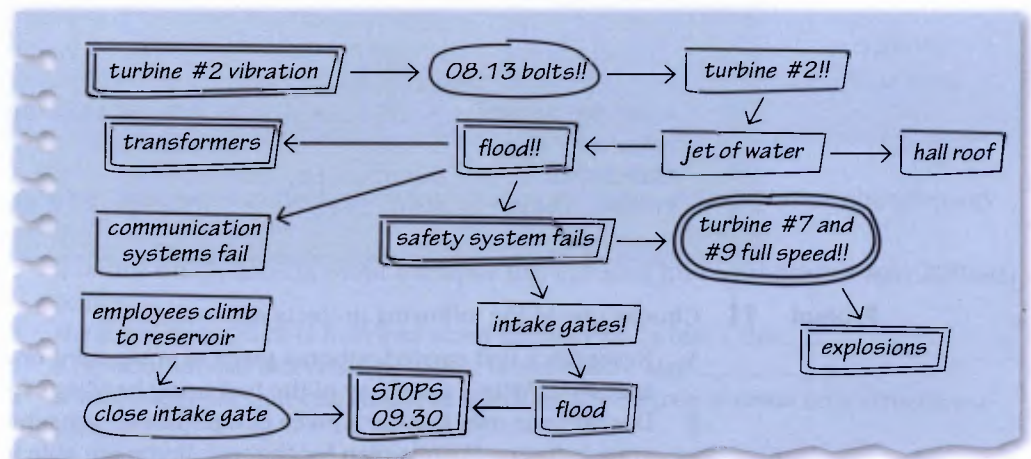
Scanning 2 Practise your speed reading. Look for the information you need on the SPEED SEARCH pages (116–117). Try to be first to complete the data in the notes below.

The Accident in Numbers

(1) _____	weight of each turbine	(4) _____	population supplied with electricity
(2) _____	speed of water shooting up to roof of hall	80 storeys	height of dam
276m litres	extent of flooding	5012 m ³	debris caused by the accident
(3) _____	length of penstock	(5) _____	maximum speed of turbines
6,400 MW	power generated by power station	290 m	total length of turbine hall

Task 3 Work in small groups. The diagrams, notes and cuttings on this page and the opposite page belong to a journalist who is assembling data for a report on the accident. Discuss the material and reach agreement on the three questions below.

- 1 What happened and in what order? Make notes of the sequence of events referring to the journalist's flow chart below.
- 2 What caused the accident? Make notes of the known and probable causes.
- 3 What action(s) could have prevented the accident? What could prevent a repetition of such accidents in the future? Note down some ideas.



4 With your group, meet up with another group and compare your notes. Refine them in the light of your meeting. Keep your notes for use on page 87.

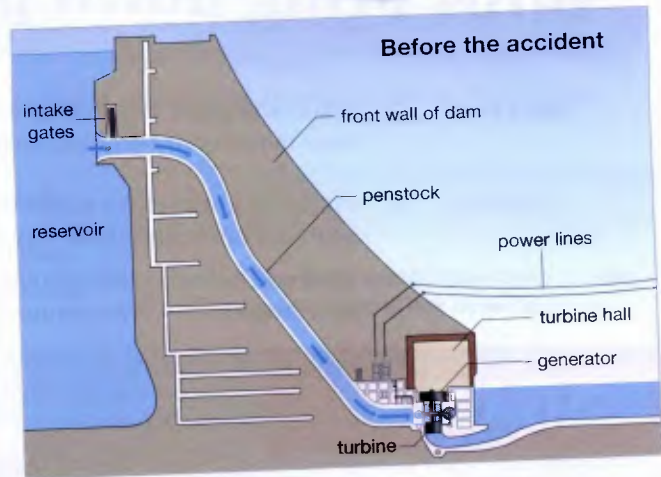
Overview

- Sayano-Shushenskaya HEP station
- Siberia, Russia, 2,000 miles E of Moscow
- major accident 17 August 2009
- destroys part of turbine hall
- explosions, flooding, 3 turbines destroyed, 7 damaged, huge oil spill
- 75 deaths, 14 rescued from debris, many injuries

Old news report from the 1980s?

The new automated safety system has been installed to prevent damage in case of flooding. If the turbine hall floods, the system will automatically shut down the turbines to stop them operating under water. This will prevent short circuits and explosions. The system will also close the intake gates to the penstock.

system faulty? or just flooded?



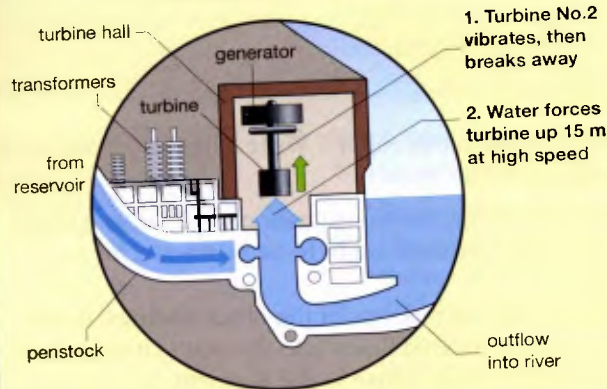
Must interview these people

- technicians - probably knew Turbine 2 wasn't ready for use on 16th
- managers - probably didn't install 2nd safety system as backup
- workers - possibly recorded incidents on mobile phone cameras

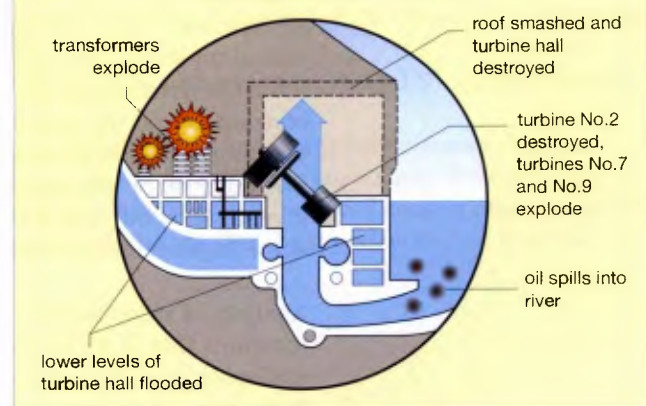
Extract from report by search team

Found in debris of accident: 49 large bolts (that secured Turbine 2 to supports in floor of turbine hall). 41 of them contain cracks (metal fatigue); eight have cracks in > 90% of width.

The start of the accident



Next stage of the accident



Background - before Aug 17

- Turbine 2 taken offline for repairs (vibrations)
- Turbine 2 offline several months during repairs
- sudden demand for more energy on Aug 16
- Turbine 2 put back online Aug 16 (repairs not complete?)
- still vibrating excessively night of Aug 16

From interview with maintenance technicians

normal service life of turbines: 30 years BUT age of Turbine 2 on 17/8/09: 29 years, 10 months!! (but past use-by date?)

Safety chief resigns after report leak

Report blames faulty brakes

Birds bring down plane, report claims

Start here 1 Discuss in pairs. Why are investigative reports important? Describe an investigation in your industry or technical field, or in any area. What was the outcome?

Reading 2 Read this abstract (or summary) section of an investigative report and match the sentences A–F with these report headings.

Method Background Introduction
Conclusions Recommendations Findings

ABSTRACT

This report presents and analyses the preliminary findings of our investigation into the disappearance of the XJ1 private aircraft last month (A). After making radio contact for the last time, the aircraft completely disappeared, resulting in an extensive

air–sea search, followed by an investigation by our team (B). The investigative procedure included an examination of debris from the ocean and of in-flight communications prior to the final radio contact (C). The main physical evidence was a section of buckled fuselage, which after analysis was found to have buckled upwards (D).

From this evidence, the investigators have been able to determine that the fuselage probably hit the water in one piece at high speed, which rules out the possibility of explosion or mid-air break-up (E). The report proposes that a search should continue for the flight recorder, which has not yet been recovered from the ocean (F).

3 Where do these sentences belong in an investigative report? Write a heading from 2 after each one. Headings may be used more than once.

- 1 The smoke sensors, which were found during the investigation to be faulty, should be replaced without delay and the manufacturers ought to be contacted for a refund under the warranty. _____
- 2 From the detailed results of the tests and the analysis of the other findings, it was concluded that the introduction of contaminated fluids into the main chamber and the poor filtration method were the most likely cause of the accident. _____
- 3 The purpose of this report is to present the findings and conclusions of the investigation into the warehouse fire in January this year. It also recommends some improvements which should be made to the fire prevention equipment. _____
- 4 Analysis of video footage of the accident, confirmed by interviews with staff, indicates that at 05.23, immediately before the fire started, there was a small explosion near the entrance of the storage area. _____
- 5 In the view of the investigators, a serious mistake was made by the supervisors, who should have ensured a safer method for insulating the electrical equipment. If that had been done, there would probably have been no fatalities or serious injuries. _____
- 6 To ensure the accuracy of their findings and conclusions, the investigating team interviewed a large cross-section of the workforce about the incident and listened to over 80 minutes of mobile phone recordings. In addition, managers were asked to suggest recommendations. _____

- Language**
- 4** Make six concise statements about the Sayano-Shushenskaya accident. Use numbers and units from the 'Accident in Numbers' information on page 84.
Examples: *The 1,360-tonne Turbine 2 broke away from its housing. A 256,000-litre-per-second jet of water shot up to the roof.*
- 5** Make six speculations about the accident. Use *must have*, *can't have*, *may have* or *might have*.
Examples: *Turbine 2 must have been put back online before it was fully repaired. Turbine 2 can't have been ready for use on the night of the 16th. Turbine 2 may have been past its use-by date.*
- 6** Make six criticisms about the accident, using *should* or *ought to* with a perfect infinitive.
Example: *The automated safety system should have stopped Turbines 7 and 9 from operating.*

Conditionals (third conditional)

<i>If they had replaced the turbine bolts,</i>	<i>the accident would (probably) have been avoided. the accident would / might not have happened.</i>
<i>If the turbine bolts had been replaced,</i>	
<i>If turbine 2 had not been used,</i>	

- 7** Make six statements about the accident, using the third conditional.
Example: *If the bolts on Turbine 2 had been checked and replaced regularly, the turbine would (probably) not / might not have broken away from its supports.*

- Writing**
- 8** Work in pairs. Sort your notes about the accident from 2 and 3 on page 84 under these report headings.

Introduction	Findings
Background	Conclusions
Method	Recommendations

- 9** Work individually. Write the investigative report of the accident at the Sayano-Shushenskaya hydroelectric power station. Follow these steps.
- Study different ways of linking clauses.
 - Use your notes and all the data about the accident and the headings in 8 to write the main body of the report.
 - Add an Attachments section, using ideas from pages 84 and 85, as well as your own ideas.
 - Write the Abstract: use clause-linking and condensing techniques to reduce each section of the report (except for Attachments) to a single sentence that summarises its main point(s); the Abstract will therefore consist of six sentences. Note: Although the Abstract should be the last thing you write, put it at the beginning of the report.

3 Communication



Start here 1 Discuss in pairs. In what circumstances might a junior employee tell a supervisor or manager that he or she is wrong? When and how might you do the same thing?

Listening 2 Listen to three situations where an employee is communicating concerns to his / her senior officer or manager. Look at the information for each situation and decide how effectively the employee communicates his / her concerns.

28 Situation 1

A passenger plane is taking off. The co-pilot senses that the take-off speed is too slow. But the airspeed indicator is showing 80, the correct speed. And the pilot is the captain, her senior officer.

Note: Ice in a sensor has caused a false reading on the airspeed indicator: the speed on the indicator is higher than the real speed of the aircraft. The pilot doesn't apply enough power for take off and the aircraft crashes.

29 Situation 2

This situation begins in the same way as situation 1, but has a different outcome.

30 Situation 3

In the turbine hall of a hydroelectric power plant, a senior technician senses that the turbine is vibrating in a dangerous manner. But his supervisor has instructions to increase the turbine speed.

3 Read these communication guidelines. Then listen to audio 29 and 30 again and tick when you hear each guideline being followed.

Communicating your concerns in a crisis		Co-pilot	Technician	
1	Get the other person's attention (e.g. <i>Hey, Chief!</i>)	<input type="checkbox"/>	<input type="checkbox"/>	* Refer to the problem (e.g. <i>The fire is spreading</i>), not to the person (e.g. <i>You haven't noticed that the fire is spreading</i>), which can sound too accusing and emotional. ** Assertiveness is a form of communication in which you state your needs or wishes clearly while showing respect for yourself and the other person.
2	Signal your concern (e.g. <i>There's a problem.</i>)	<input type="checkbox"/>	<input type="checkbox"/>	
3	State the problem directly* (e.g. <i>The fire is spreading.</i>)	<input type="checkbox"/>	<input type="checkbox"/>	
4	If you don't succeed, try again more assertively**	<input type="checkbox"/>	<input type="checkbox"/>	
5	Step back (e.g. <i>Let's stop and re-think for a moment.</i>)	<input type="checkbox"/>	<input type="checkbox"/>	
6	Suggest a solution (e.g. <i>Let's put on breathing gear.</i>)	<input type="checkbox"/>	<input type="checkbox"/>	
7	Obtain their agreement (e.g. <i>How does that sound?</i>)	<input type="checkbox"/>	<input type="checkbox"/>	

Speaking 4 Study audio scripts 29 and 30 on page 125. Notice how the co-pilot and the senior technician follow the steps of the guidelines above.

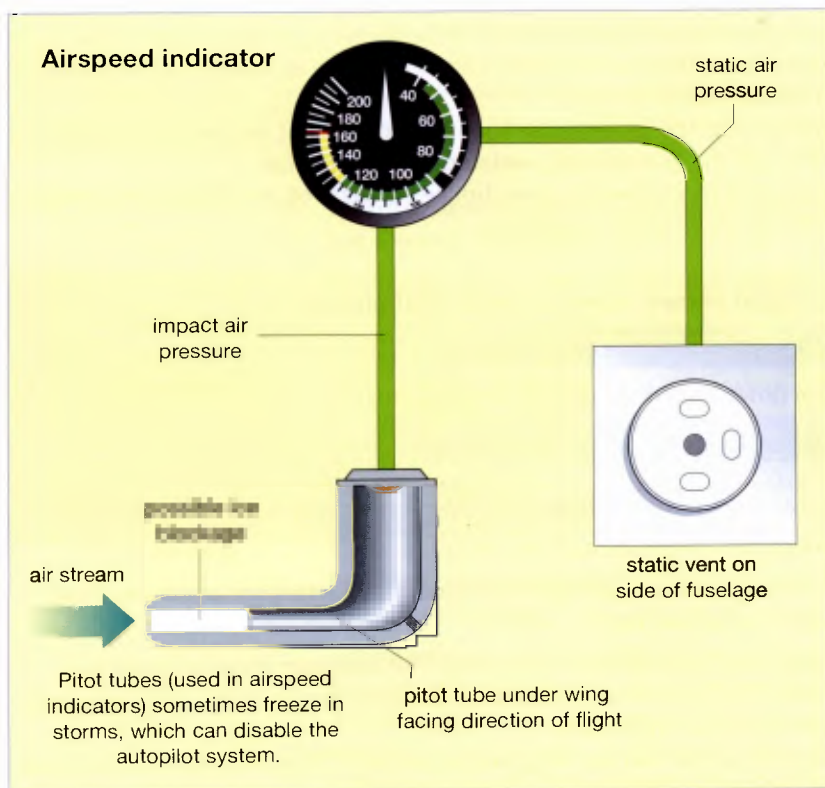
5 Work in pairs. Prepare two similar crisis situations related to your industry or technical field. Role play the situations, taking turns to be higher / lower in the chain of command.

Listening 6 Study the photo and the diagram in 7. What do they tell you about why the aircraft may have crashed?



- Flight 305, Nov 20th, 14.17
- makes final radio transmission
- enters high-altitude thunderstorm
- disappears

7 31 Listen to a reporter interviewing an airline representative about the crash and complete the reporter's notes.



Airline doesn't know what caused crash. But ...
Two theories 1 2
Evidence 1 2
Future changes 1
Attachment contains:

Writing 8 Write the abstract (150–200 words) of the report on the crash of the airliner. Add a short attachment explaining in layman's terms how the airspeed indicator works and how ice under the wing can cause problems.