



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

**COMBINED SCIENCE**

Paper 1 Multiple Choice (Core)

**0653/11**

**May/June 2017**

**45 minutes**

Additional Materials: Multiple Choice Answer Sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)



**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

**DO NOT WRITE IN ANY BARCODES.**

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 20.

Electronic calculators may be used.

This document consists of **17** printed pages and **3** blank pages.

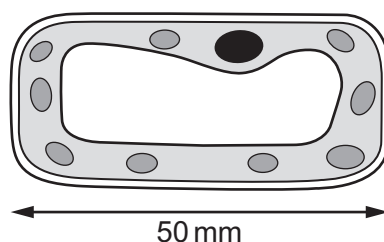


- 1 Process Q happens in cells.

carbohydrates → process Q → energy released

What is process Q?

- A growth
  - B nutrition
  - C respiration
  - D sensitivity
- 2 The diagram shows an image of a plant cell that has been magnified.



The actual length of the cell is 0.02 mm.

How many times has the cell been magnified?

- A × 10
  - B × 100
  - C × 250
  - D × 2500
- 3 Which statements about enzymes are correct?
- 1 Enzymes are proteins.
  - 2 Some enzymes carry out chemical digestion.
  - 3 Enzymes speed up the rate of chemical reactions.
  - 4 All enzymes work fastest at pH 7.
- A 1, 2 and 3
  - B 1 and 2 only
  - C 1 and 3 only
  - D 2, 3 and 4

- 4 The table shows the results when four foods are tested with Benedict's solution and biuret reagent.

Which food contains protein but **not** reducing sugar?

|          | colour obtained with Benedict's solution | colour obtained with biuret reagent |
|----------|------------------------------------------|-------------------------------------|
| <b>A</b> | blue                                     | green                               |
| <b>B</b> | blue                                     | violet                              |
| <b>C</b> | red                                      | green                               |
| <b>D</b> | red                                      | violet                              |

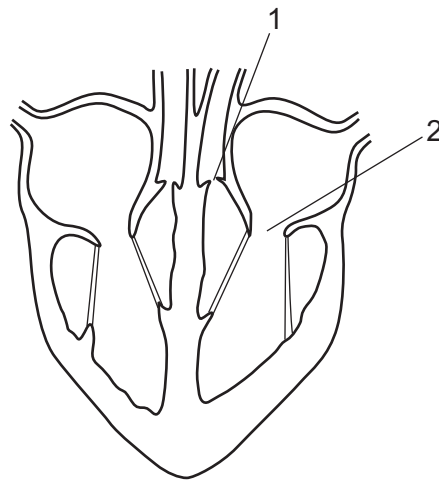
- 5 What are the products of photosynthesis?

- A** carbohydrates + oxygen
- B** carbohydrates + water
- C** carbon dioxide + oxygen
- D** carbon dioxide + water

- 6 During transpiration, from which part of a leaf does evaporation of water occur?

- A** cuticle
- B** mesophyll cells
- C** stomata
- D** xylem

7 The diagram shows a section through the heart.

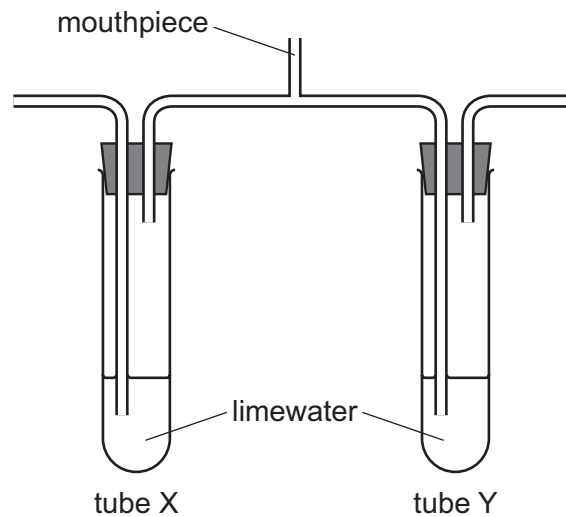


The ventricles contract and blood is forced into the arteries.

What is the state of valves 1 and 2 when this happens?

|          | valve 1 | valve 2 |
|----------|---------|---------|
| <b>A</b> | closed  | closed  |
| <b>B</b> | closed  | open    |
| <b>C</b> | open    | closed  |
| <b>D</b> | open    | open    |

- 8 The diagram shows apparatus at the start of a breathing experiment.



A person breathes in and out through the mouthpiece for a short time.

Which row shows the results?

|          | limewater in tube X | limewater in tube Y |
|----------|---------------------|---------------------|
| <b>A</b> | stays clear         | stays clear         |
| <b>B</b> | stays clear         | turns cloudy        |
| <b>C</b> | turns cloudy        | stays clear         |
| <b>D</b> | turns cloudy        | turns cloudy        |

- 9 Which statement about hormones in humans is correct?

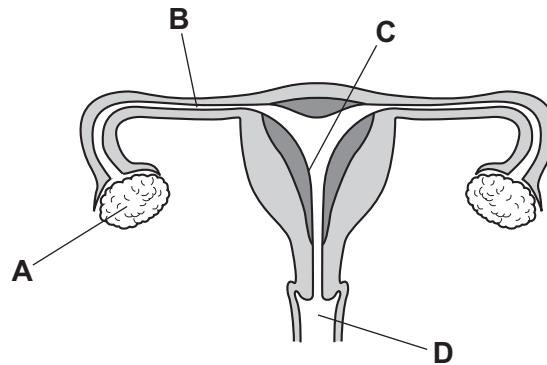
- A** They are destroyed by the liver.
- B** They are destroyed by the pancreas.
- C** They are produced by target organs.
- D** They are produced by the blood.

- 10 Which part of a plant protects the flower when it is a bud?

- A** petal
- B** sepal
- C** stem
- D** stigma

11 The diagram shows the female reproductive system.

Where does implantation of the embryo normally occur?



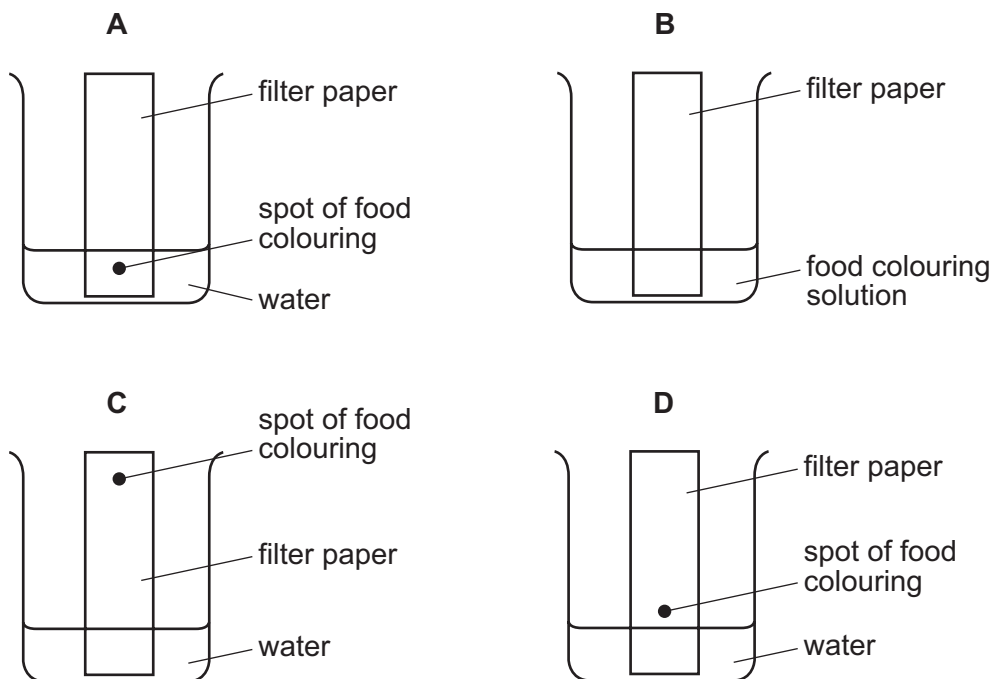
12 Which type of organism makes its own organic nutrients?

- A carnivore
- B consumer
- C herbivore
- D producer

13 What is **not** an effect of deforestation?

- A extinction of plant species
- B flooding of river valleys
- C increase of oxygen in the air
- D loss of soil by erosion

14 Which diagram shows how a mixture of dyes in a food colouring are separated?



15 Which process produces a chemical change?

- A adding ethanol to water
- B adding sodium to water
- C boiling water
- D melting ice

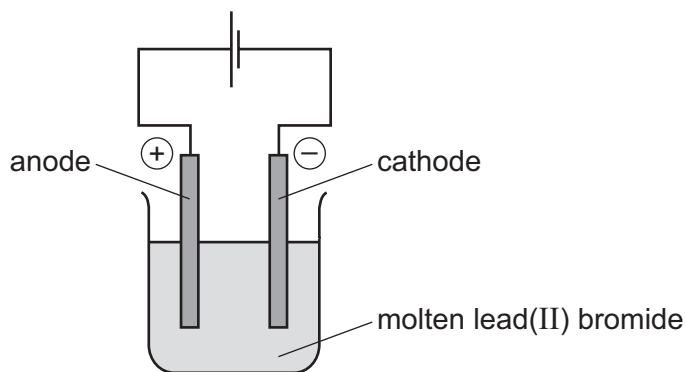
16 Sodium and potassium are Group I metals.

Chlorine and bromine are Group VII non-metals.

Which statement describes the formation of a covalent bond?

- A Potassium and bromine combine by sharing a pair of electrons.
- B Sodium and chlorine combine by electron loss and gain.
- C Two bromine atoms combine by electron loss and gain.
- D Two chlorine atoms combine by sharing a pair of electrons.

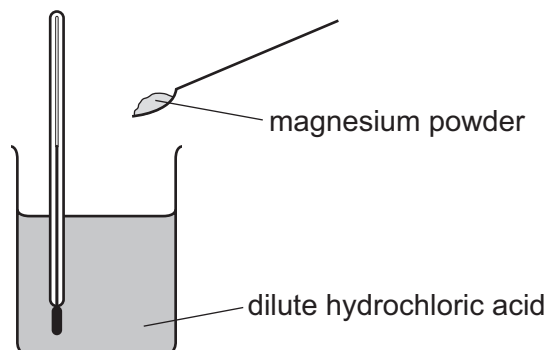
17 The diagram shows the electrolysis of molten lead(II) bromide.



What is produced at the electrodes?

|          | anode          | cathode        |
|----------|----------------|----------------|
| <b>A</b> | brown gas      | colourless gas |
| <b>B</b> | brown gas      | grey liquid    |
| <b>C</b> | colourless gas | brown gas      |
| <b>D</b> | grey liquid    | brown gas      |

18 The diagram shows how the temperature change is measured when magnesium powder reacts with dilute hydrochloric acid.



Thermometer reading before adding magnesium powder = 20.6 °C

Thermometer reading after adding magnesium powder = 32.4 °C

Which statement is correct?

- A** The reaction is endothermic and gives out heat.
- B** The reaction is endothermic and takes in heat.
- C** The reaction is exothermic and gives out heat.
- D** The reaction is exothermic and takes in heat.

19 Hydrogen peroxide decomposes to form water and oxygen.

Which changes in temperature and in concentration **both** reduce the rate of this reaction?

|          | temperature of hydrogen peroxide | concentration of hydrogen peroxide |
|----------|----------------------------------|------------------------------------|
| <b>A</b> | decrease                         | decrease                           |
| <b>B</b> | decrease                         | increase                           |
| <b>C</b> | increase                         | decrease                           |
| <b>D</b> | increase                         | increase                           |

20 In which word equation is copper reduced?

- A** anhydrous copper sulfate + water → hydrated copper sulfate
- B** copper carbonate + hydrochloric acid → copper chloride + water + carbon dioxide
- C** copper oxide + hydrogen → copper + water
- D** copper + oxygen → copper oxide

21 Magnesium hydroxide is an insoluble solid.

Magnesium sulfate is a soluble solid which is formed when magnesium hydroxide reacts with sulfuric acid.

Which method is used to make **pure** magnesium sulfate?

- A** React excess dilute sulfuric acid with magnesium hydroxide, filter and crystallise.
- B** React excess dilute sulfuric acid with magnesium hydroxide then evaporate until dry.
- C** React excess magnesium hydroxide with dilute sulfuric acid, filter and crystallise.
- D** React excess magnesium hydroxide with dilute sulfuric acid then evaporate until dry.

22 Acidified barium nitrate solution is added to solution X. A white precipitate forms.

What is X?

- A** hydrochloric acid
- B** limewater
- C** potassium chloride
- D** sulfuric acid

**23** The diagram shows part of the Periodic Table.

The letters U to Z are **not** the symbols of the elements.

| I | II |  |  |  |  |  |   |  |  |  |  | III | IV | V | VI | VII | VIII |
|---|----|--|--|--|--|--|---|--|--|--|--|-----|----|---|----|-----|------|
|   |    |  |  |  |  |  |   |  |  |  |  |     |    |   |    |     |      |
| U |    |  |  |  |  |  |   |  |  |  |  |     |    |   |    | Y   | Z    |
|   |    |  |  |  |  |  |   |  |  |  |  |     |    |   | X  |     |      |
|   | V  |  |  |  |  |  | W |  |  |  |  |     |    |   |    |     |      |

Which elements are metals?

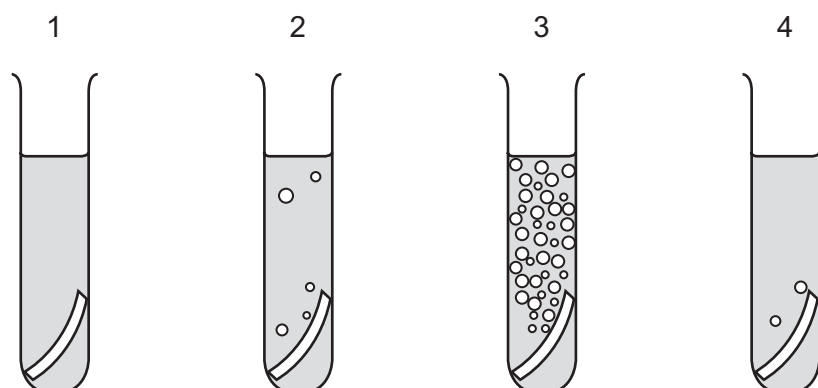
- A** U, V and W    **B** U and V only    **C** W and X    **D** X, Y and Z

**24** What is an alloy?

- A** a compound containing two metallic elements  
**B** a compound containing two non-metallic elements  
**C** a mixture containing two metallic elements  
**D** a mixture containing two non-metallic elements

- 25** Equal sized pieces of four different metals are added to separate samples of dilute hydrochloric acid.

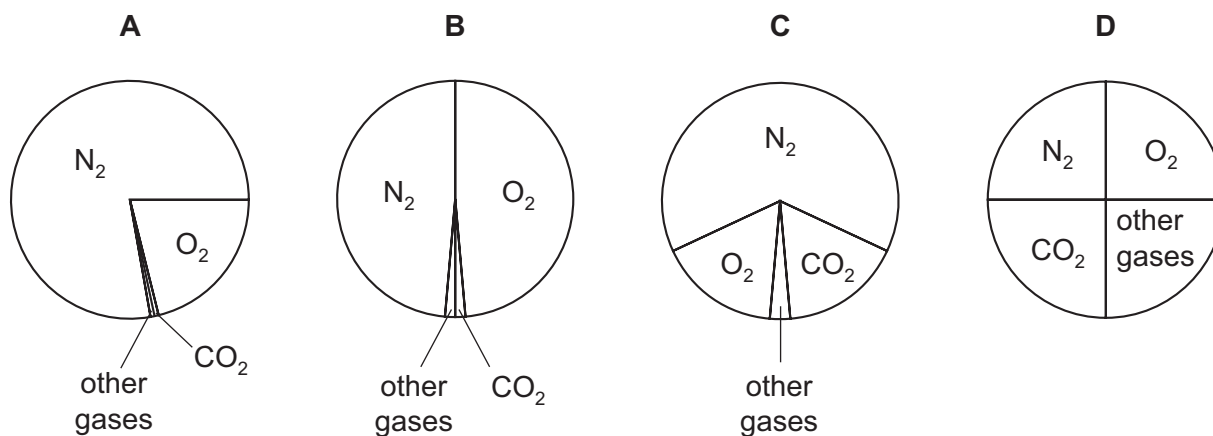
The results are shown.



Which row identifies the metals in the tubes?

|          | tube 1  | tube 2    | tube 3    | tube 4    |
|----------|---------|-----------|-----------|-----------|
| <b>A</b> | calcium | copper    | sodium    | iron      |
| <b>B</b> | copper  | iron      | potassium | sodium    |
| <b>C</b> | copper  | magnesium | calcium   | zinc      |
| <b>D</b> | iron    | zinc      | copper    | magnesium |

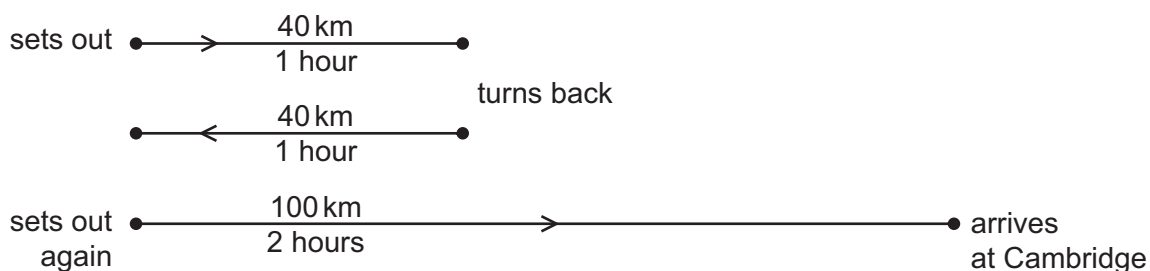
- 26** Which pie chart shows the proportions of gases in clean air?



- 27** Which property of the compounds in petroleum is used to separate it into useful fractions?

- A** boiling point
- B** density
- C** melting point
- D** solubility

- 28** A car driver sets out from home to travel to Cambridge. After 1 hour he is 40 km from home. He discovers that he must return home to collect his briefcase. This journey also takes him 1 hour. He sets off again immediately. He reaches Cambridge, 100 km from home, 2 hours later.



What is the average speed for the whole of his journey from leaving home the first time?

- A** 25 km/h      **B** 45 km/h      **C** 50 km/h      **D** 90 km/h
- 29** Which row shows the unit for force, the unit for mass and the unit for weight?

|          | force | mass | weight |
|----------|-------|------|--------|
| <b>A</b> | kg    | kg   | N      |
| <b>B</b> | kg    | N    | kg     |
| <b>C</b> | N     | kg   | N      |
| <b>D</b> | N     | N    | kg     |

- 30** A heavy ball is dropped from the top of a tower.

Which form of energy decreases as the ball falls?

- A** gravitational  
**B** kinetic  
**C** thermal  
**D** sound
- 31** Which force does the greatest amount of work?
- A** a force of 10 N moving an object a distance of 3.0 m  
**B** a force of 10 N moving an object a distance of 5.0 m  
**C** a force of 15 N moving an object a distance of 3.0 m  
**D** a force of 15 N moving an object a distance of 5.0 m

**32** A liquid changes into a gas and this causes the temperature of the liquid to change.

What is the name of this process, and how does the temperature change?

|          | name of process | temperature change |
|----------|-----------------|--------------------|
| <b>A</b> | condensation    | decreases          |
| <b>B</b> | condensation    | increases          |
| <b>C</b> | evaporation     | decreases          |
| <b>D</b> | evaporation     | increases          |

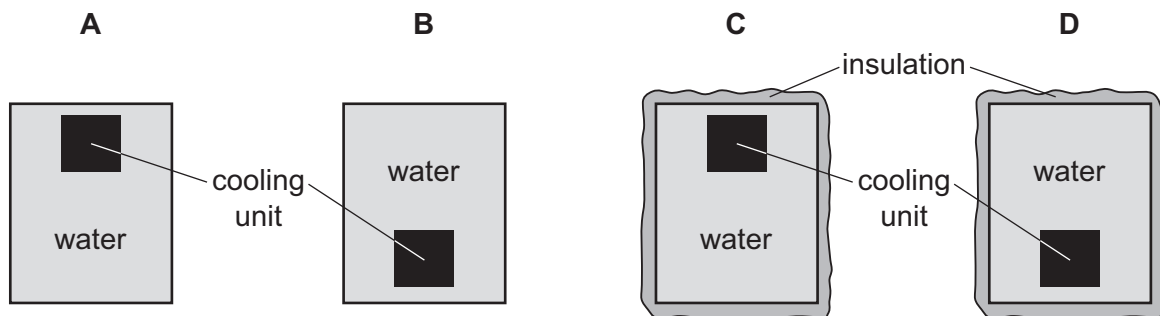
**33** Four identical metal tanks in a room each contain the same amount of water.

The water is at the same temperature as the room.

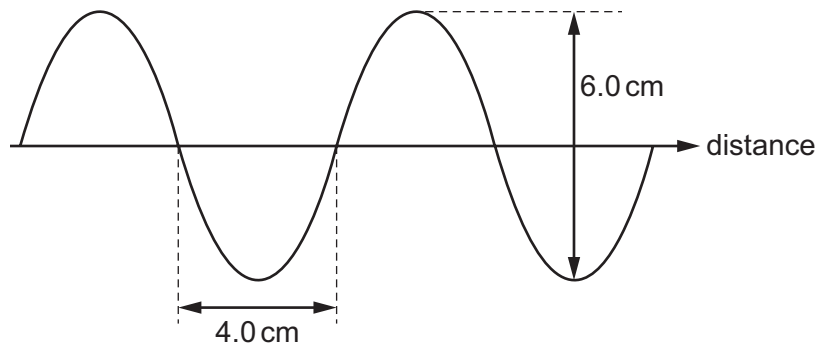
Two of the tanks are insulated, and two of the tanks are not insulated.

A cooling unit is placed in each of the tanks, in the position shown.

In which tank does all the water become cool the most quickly?



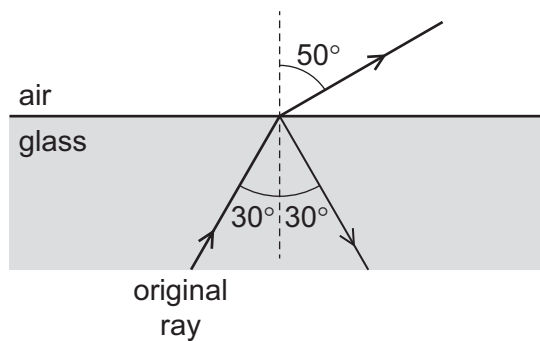
- 34 The diagram represents a wave on the surface of water. Some measurements are shown.



Which row gives the amplitude and the wavelength of the wave?

|          | amplitude<br>/cm | wavelength<br>/cm |
|----------|------------------|-------------------|
| <b>A</b> | 3.0              | 4.0               |
| <b>B</b> | 3.0              | 8.0               |
| <b>C</b> | 6.0              | 4.0               |
| <b>D</b> | 6.0              | 8.0               |

- 35 A ray of light is travelling in glass. The ray reaches a boundary with air and splits into two rays as shown.



What has happened to the original ray?

- A** It has been partially internally reflected.
- B** It has been partially internally refracted.
- C** It has been totally internally reflected.
- D** It has been totally internally refracted.

36 Which electromagnetic wave is used by a remote controller for a television?

- A infra-red
- B microwaves
- C radio
- D ultraviolet

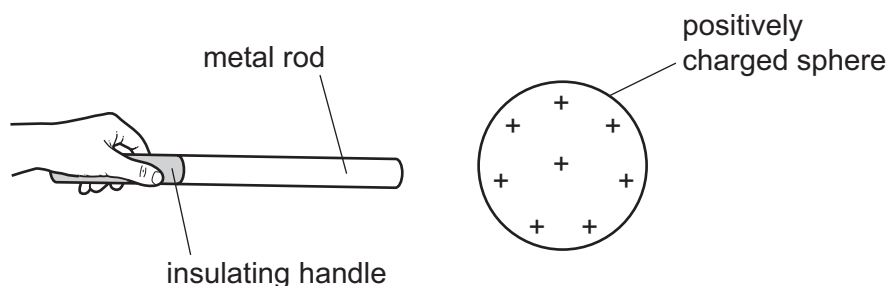
37 An electronic circuit in a fire alarm makes a loudspeaker vibrate alternately at two different frequencies.

Which pair of frequencies is suitable to use in the alarm to alert people to the danger of fire?

- A 1.5 Hz and 15 Hz
- B 15 Hz and 150 000 Hz
- C 150 Hz and 15 000 Hz
- D 150 000 Hz and 15 000 000 Hz

38 An uncharged metal rod is held by an insulating handle.

The rod is brought near to a positively charged sphere. This causes some particles in the rod to move.



Which particles in the rod move and in which direction do the particles move?

|          | particles that move | direction of movement |
|----------|---------------------|-----------------------|
| <b>A</b> | electrons           | away from the sphere  |
| <b>B</b> | electrons           | towards the sphere    |
| <b>C</b> | protons             | away from the sphere  |
| <b>D</b> | protons             | towards the sphere    |

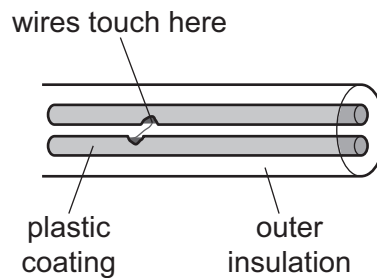
- 39 A power supply causes a current in a circuit.

The potential difference (p.d.) of the power supply and the resistance of the circuit are both changed.

Which pair of changes **must** result in a smaller current in the circuit?

|          | p.d.      | resistance |
|----------|-----------|------------|
| <b>A</b> | decreased | decreased  |
| <b>B</b> | decreased | increased  |
| <b>C</b> | increased | decreased  |
| <b>D</b> | increased | increased  |

- 40 Each wire inside a cable leading from an electric socket to a hairdryer is covered with a plastic coating. This plastic coating splits and the two wires inside the cable touch each other.



What could happen because of this?

- A** An appliance plugged into a different socket could become switched on.
- B** A large current could flow in the wires making them overheat to cause a fire.
- C** A person near the hairdryer could receive an electric shock.
- D** The hairdryer plugged into the socket could be damaged.

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                              |                               |                           |  |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|------------------------------|-------------------------------|---------------------------|--|
| I                          | II                          | 1<br>H<br>hydrogen<br>1                                                                     |                             |                                 |                              |                              |                              |                            |                              |                                |                               | III                           | IV                          | V                           | VI                           | VII                           | VIII                      |  |
|                            |                             | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                              |                               |                           |  |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               | 5<br>B<br>boron<br>11         | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14    | 8<br>O<br>oxygen<br>16       | 9<br>F<br>fluorine<br>19      | 10<br>Ne<br>neon<br>20    |  |
| 11<br>Na<br>sodium<br>23   | 12<br>Mg<br>magnesium<br>24 |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               | 13<br>Al<br>aluminium<br>27   | 14<br>Si<br>silicon<br>28   | 15<br>P<br>phosphorus<br>31 | 16<br>S<br>sulfur<br>32      | 17<br>Cl<br>chlorine<br>35.5  | 18<br>Ar<br>argon<br>40   |  |
| 19<br>K<br>potassium<br>39 | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45                                                                  | 22<br>Ti<br>titanium<br>48  | 23<br>V<br>vanadium<br>51       | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55  | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59   | 28<br>Ni<br>nickel<br>59     | 29<br>Cu<br>copper<br>64       | 30<br>Zn<br>zinc<br>65        | 31<br>Ga<br>gallium<br>70     | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75   | 34<br>Se<br>selenium<br>79   | 35<br>Br<br>bromine<br>80     | 36<br>Kr<br>krypton<br>84 |  |
| 37<br>Rb<br>rubidium<br>85 | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89                                                                    | 40<br>Zr<br>zirconium<br>91 | 41<br>Nb<br>niobium<br>93       | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>—  | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103 | 46<br>Pd<br>palladium<br>106 | 47<br>Ag<br>silver<br>108      | 48<br>Cd<br>cadmium<br>112    | 49<br>In<br>indium<br>115     | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122 | 52<br>Te<br>tellurium<br>128 | 53<br>I<br>iodine<br>127      | 54<br>Xe<br>xenon<br>131  |  |
| 55<br>Cs<br>caesium<br>133 | 56<br>Ba<br>barium<br>137   | 57–71<br>lanthanoids                                                                        |                             | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181  | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186   | 76<br>Os<br>osmium<br>190  | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201    | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209   | 84<br>Po<br>polonium<br>—     | 85<br>At<br>astatine<br>— |  |
| 87<br>Fr<br>francium<br>—  | 88<br>Ra<br>radium<br>—     | 89–103<br>actinoids                                                                         |                             | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—    | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—    | 108<br>Hs<br>hassium<br>—  | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>— |                             | 114<br>Fl<br>flerovium<br>— |                              | 116<br>Lv<br>livermorium<br>— | —                         |  |

lanthanoids

actinoids

|                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 57<br>La<br>lanthanum<br>139 | 58<br>Ce<br>cerium<br>140  | 59<br>Pr<br>praseodymium<br>141 | 60<br>Nd<br>neodymium<br>144 | 61<br>Pm<br>promethium<br>— | 62<br>Sm<br>samarium<br>150 | 63<br>Eu<br>europium<br>152 | 64<br>Gd<br>gadolinium<br>157 | 65<br>Tb<br>terbium<br>159 | 66<br>Dy<br>dysprosium<br>163 | 67<br>Ho<br>holmium<br>165   | 68<br>Er<br>erbium<br>167 | 69<br>Tm<br>thulium<br>169    | 70<br>Yb<br>ytterbium<br>173 | 71<br>Lu<br>lutetium<br>175  |
| 89<br>Ac<br>actinium<br>—    | 90<br>Th<br>thorium<br>232 | 91<br>Pa<br>protactinium<br>231 | 92<br>U<br>uranium<br>238    | 93<br>Np<br>neptunium<br>—  | 94<br>Pu<br>plutonium<br>—  | 95<br>Am<br>americium<br>—  | 96<br>Cm<br>curium<br>—       | 97<br>Bk<br>berkelium<br>— | 98<br>Cf<br>californium<br>—  | 99<br>Es<br>einsteinium<br>— | 100<br>Fm<br>fermium<br>— | 101<br>Md<br>mendelevium<br>— | 102<br>No<br>nobelium<br>—   | 103<br>Lr<br>lawrencium<br>— |

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).



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**COMBINED SCIENCE**

Paper 1 Multiple Choice (Core)

**0653/12**

**May/June 2017**

**45 minutes**

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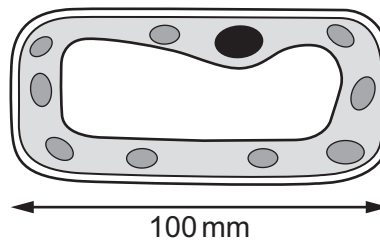


- 1 A person moves their hand away from a hot object.

Which characteristic of living organisms is this?

- A growth
- B nutrition
- C reproduction
- D sensitivity

- 2 The diagram shows an image of a plant cell that has been magnified.



The magnification is  $\times 200$ .

What is the length of the actual cell?

- A 0.2 mm
  - B 0.5 mm
  - C 2 mm
  - D 20 000 mm
- 3 Which statement about enzymes is correct?
- A They are killed by high temperatures.
  - B They are made from amino acids.
  - C They are unaffected by pH.
  - D They are used up in biological reactions.

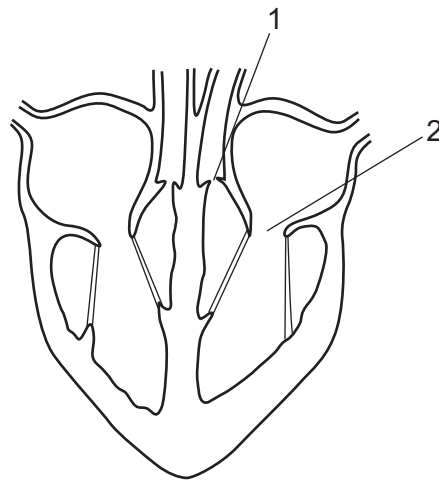
- 4 An unknown liquid is divided into three test-tubes and tested as shown in the table.

| test-tube number | test solution added to mixture | final colour in test-tube |
|------------------|--------------------------------|---------------------------|
| 1                | Benedict's solution            | blue                      |
| 2                | biuret                         | violet                    |
| 3                | iodine solution                | yellow                    |

Which conclusion about the unknown liquid is correct?

- A It contains reducing sugar and starch.
  - B It contains protein and a reducing sugar.
  - C It only contains protein.
  - D It only contains starch.
- 5 What are the products of photosynthesis?
- A carbohydrates + oxygen
  - B carbohydrates + water
  - C carbon dioxide + oxygen
  - D carbon dioxide + water
- 6 What is transpiration?
- A absorption of water by root hair cells
  - B evaporation of water at the surfaces of mesophyll cells
  - C loss of water vapour from the roots of plants
  - D transport of food substances in the phloem

7 The diagram shows a section through the heart.

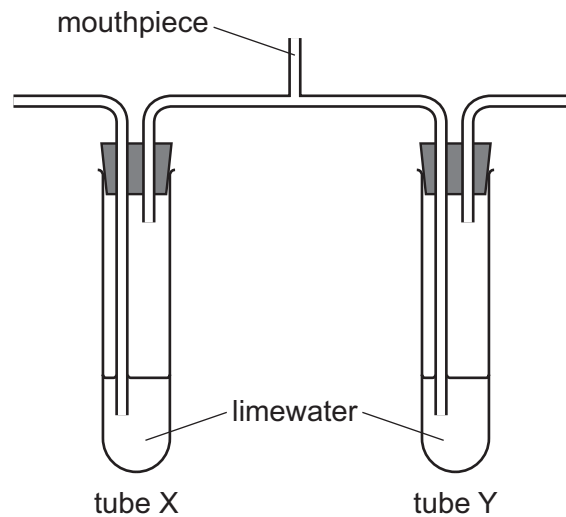


The ventricles contract and blood is forced into the arteries.

What is the state of valves 1 and 2 when this happens?

|          | valve 1 | valve 2 |
|----------|---------|---------|
| <b>A</b> | closed  | closed  |
| <b>B</b> | closed  | open    |
| <b>C</b> | open    | closed  |
| <b>D</b> | open    | open    |

- 8 The diagram shows apparatus at the start of a breathing experiment.



A person breathes in and out through the mouthpiece for a short time.

Which row shows the results?

|          | limewater in tube X | limewater in tube Y |
|----------|---------------------|---------------------|
| <b>A</b> | stays clear         | stays clear         |
| <b>B</b> | stays clear         | turns cloudy        |
| <b>C</b> | turns cloudy        | stays clear         |
| <b>D</b> | turns cloudy        | turns cloudy        |

- 9 Which characteristics of living organisms does a plant show during a geotropism?

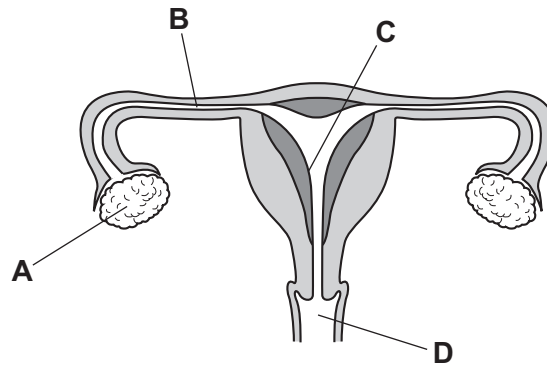
|          | growth | movement | sensitivity |
|----------|--------|----------|-------------|
| <b>A</b> | ✓      | ✓        | ✓           |
| <b>B</b> | ✓      | ✓        | x           |
| <b>C</b> | ✓      | x        | x           |
| <b>D</b> | x      | ✓        | ✓           |

- 10 Which environmental factor is **not** a requirement for the germination of most seeds?

- A** light
- B** oxygen
- C** suitable temperature
- D** water

11 The diagram shows the female reproductive system.

Where does implantation of the embryo normally occur?

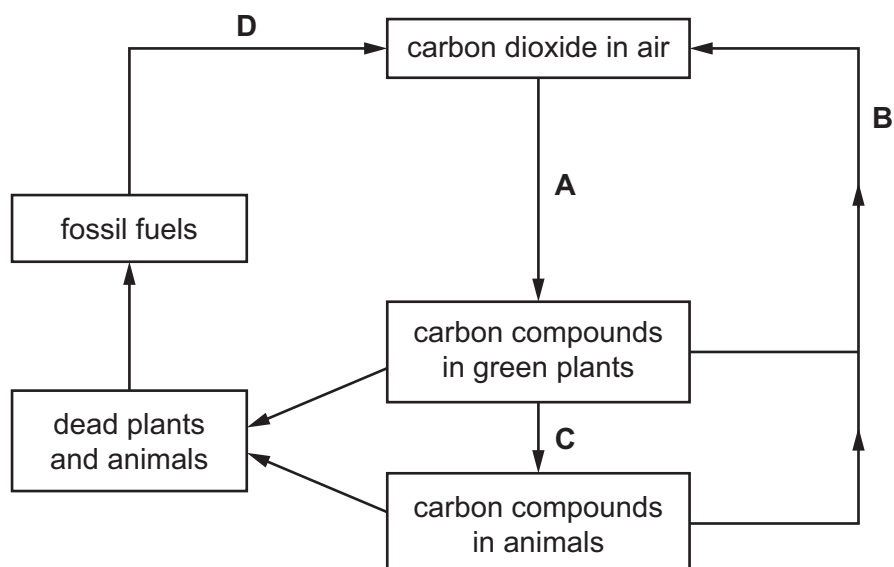


12 What is the correct name for organisms that get their energy by eating plants?

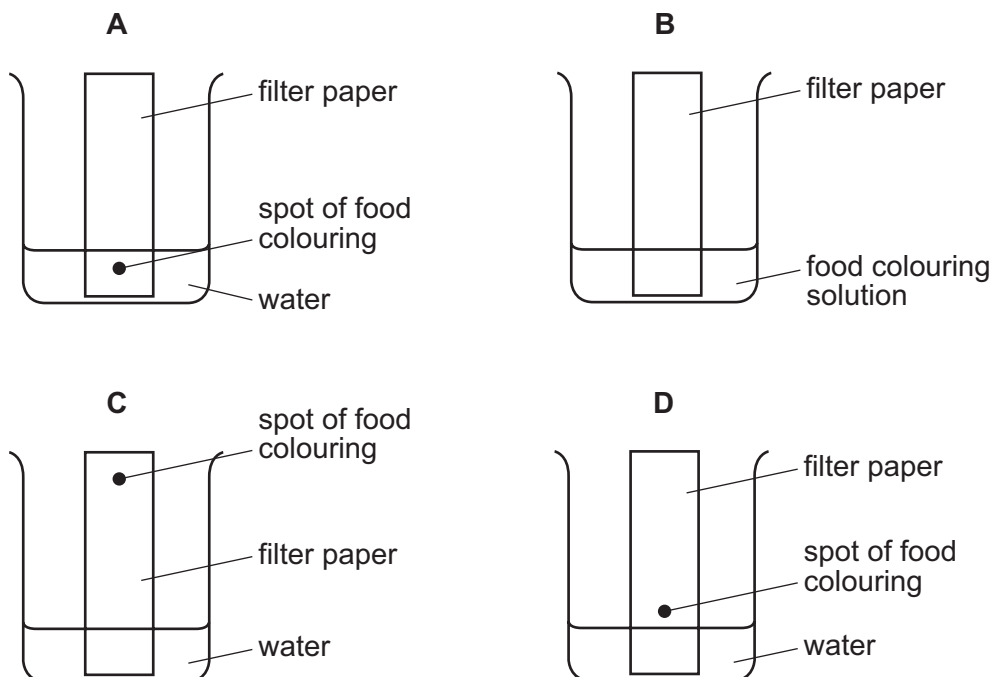
- A carnivores
- B herbivores
- C producers
- D secondary consumers

13 The diagram shows the carbon cycle.

Which arrow represents combustion?



14 Which diagram shows how a mixture of dyes in a food colouring are separated?



15 Which process is a physical change?

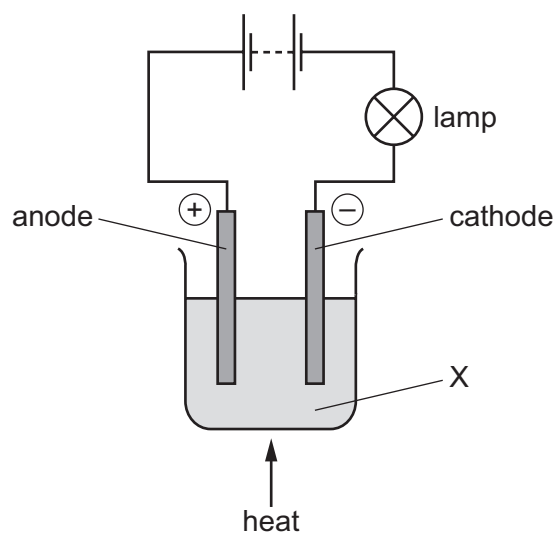
- A adding zinc to dilute sulfuric acid
- B bubbling carbon dioxide through limewater
- C electrolysis molten lead bromide
- D separating petroleum by fractional distillation

16 A neutral atom of chlorine contains 17 electrons and 18 neutrons.

What is the atomic (proton) number and what is the mass (nucleon) number of this atom?

|   | atomic number | mass number |
|---|---------------|-------------|
| A | 17            | 35          |
| B | 17            | 52          |
| C | 18            | 35          |
| D | 18            | 52          |

17 A molten compound X is electrolysed as shown.

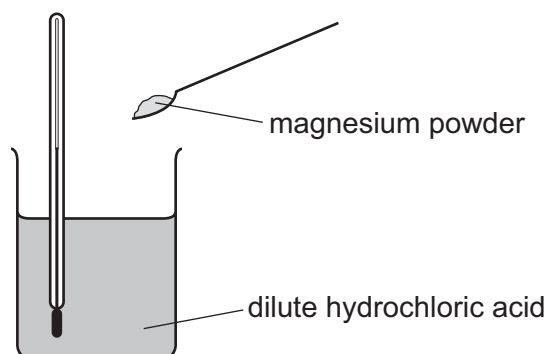


A brown gas is produced at the anode and a grey metal is produced at the cathode.

What is X?

- A** aluminium oxide
- B** copper chloride
- C** lead(II) bromide
- D** sodium chloride

- 18 The diagram shows how the temperature change is measured when magnesium powder reacts with dilute hydrochloric acid.



Thermometer reading before adding magnesium powder =  $20.6^{\circ}\text{C}$

Thermometer reading after adding magnesium powder =  $32.4^{\circ}\text{C}$

Which statement is correct?

- A The reaction is endothermic and gives out heat.
  - B The reaction is endothermic and takes in heat.
  - C The reaction is exothermic and gives out heat.
  - D The reaction is exothermic and takes in heat.
- 19 Magnesium ribbon reacts with dilute hydrochloric acid to form hydrogen gas.

Which change increases the rate of the reaction?

- A adding water to the mixture
  - B trapping the hydrogen gas
  - C using a lower temperature
  - D using powdered magnesium
- 20 In which reactions is the underlined substance oxidised?
- 1 iron when it rusts
  - 2 methane when it burns in air
  - 3 copper oxide when it reacts with carbon
- A 1, 2 and 3      B 1 and 2 only      C 1 and 3 only      D 2 and 3 only

- 21** Magnesium sulfate is a soluble solid produced by reacting excess solid magnesium oxide with dilute sulfuric acid.

Which processes produce **pure** magnesium sulfate crystals?

- A** distilling the reaction mixture and leaving the distillate to crystallise
- B** evaporating the water from the reaction mixture
- C** filtering and drying the solid from the reaction mixture
- D** filtering the reaction mixture and leaving the filtrate to crystallise

- 22** Substance X is warmed with aqueous sodium hydroxide and aluminium.

A gas is produced which turns damp red litmus paper blue.

Which anion is present in X?

- A** carbonate  
**B** hydroxide  
**C** nitrate  
**D** sulfate

- 23** Part of the Periodic Table is shown.

The letters are **not** the symbols of the elements.

Which element is a non-metal?

- ## 24 What is an alloy?

- A** a compound containing two metallic elements
- B** a compound containing two non-metallic elements
- C** a mixture containing two metallic elements
- D** a mixture containing two non-metallic elements

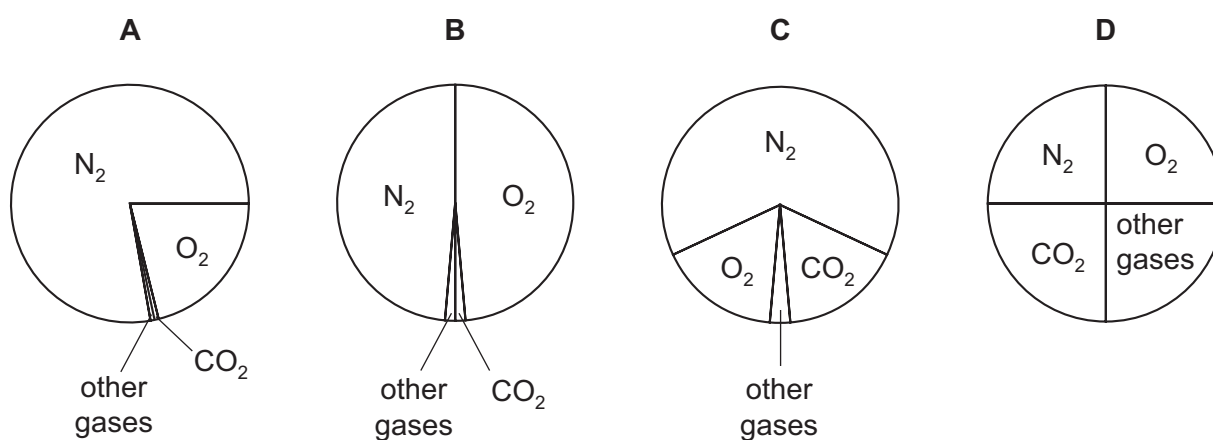
**25** A mixture of copper(II) oxide and substance Q is heated.

The reaction produces copper.

What is Q?

- A** aluminium oxide
- B** carbon
- C** carbon dioxide
- D** oxygen

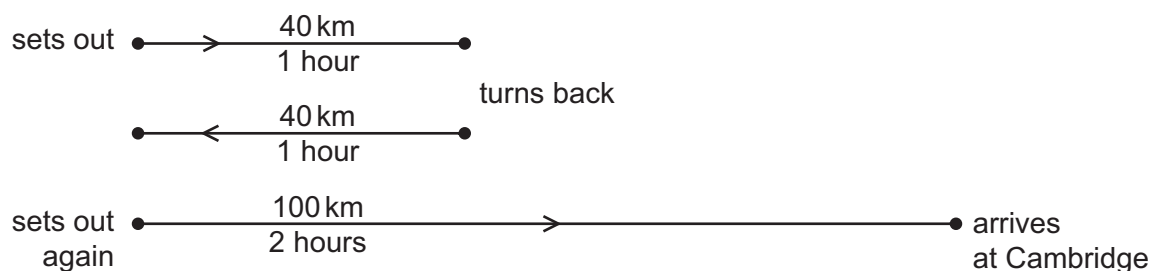
**26** Which pie chart shows the proportions of gases in clean air?



**27** Which property of the compounds in petroleum is used to separate it into useful fractions?

- A** boiling point
- B** density
- C** melting point
- D** solubility

- 28** A car driver sets out from home to travel to Cambridge. After 1 hour he is 40 km from home. He discovers that he must return home to collect his briefcase. This journey also takes him 1 hour. He sets off again immediately. He reaches Cambridge, 100 km from home, 2 hours later.



What is the average speed for the whole of his journey from leaving home the first time?

- A** 25 km/h      **B** 45 km/h      **C** 50 km/h      **D** 90 km/h
- 29** Which row shows the unit for force, the unit for mass and the unit for weight?

|          | force | mass | weight |
|----------|-------|------|--------|
| <b>A</b> | kg    | kg   | N      |
| <b>B</b> | kg    | N    | kg     |
| <b>C</b> | N     | kg   | N      |
| <b>D</b> | N     | N    | kg     |

- 30** A car uses petrol as fuel. The car has been parked overnight.

The engine is now started and the car is driven along a horizontal road at an increasing speed.

Which two forms of energy of the car both increase as the car moves?

- A** chemical and gravitational  
**B** chemical and thermal  
**C** gravitational and kinetic  
**D** kinetic and thermal

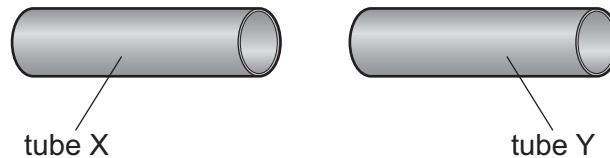
**31** Four different forces move an object by different distances in different times.

Which row shows the situation in which the greatest power is produced by the force?

|          | time taken<br>/s | force<br>/N | distance<br>moved / m |
|----------|------------------|-------------|-----------------------|
| <b>A</b> | 10               | 400         | 3.0                   |
| <b>B</b> | 20               | 200         | 2.0                   |
| <b>C</b> | 30               | 400         | 2.0                   |
| <b>D</b> | 40               | 200         | 3.0                   |

**32** The diagram shows two thin steel tubes X and Y. The tubes have identical dimensions at room temperature.

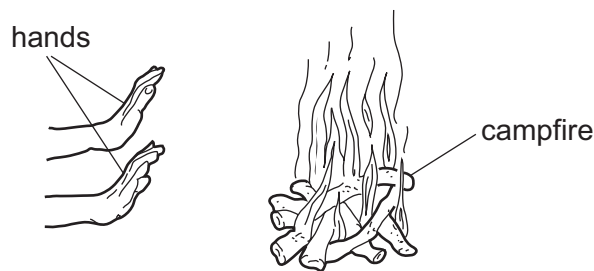
Tube X needs to be made to fit inside tube Y.



How can this be done?

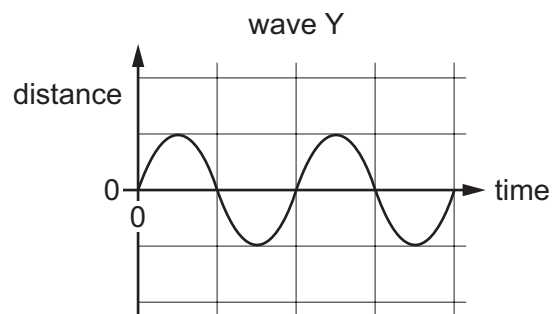
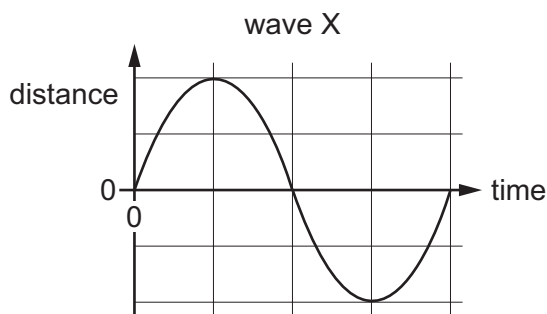
- A** Cool both tubes to the same low temperature.
- B** Cool tube X only, to a low temperature.
- C** Heat both tubes to the same high temperature.
- D** Heat tube X only, to a high temperature.

- 33 On a cold night, a person stands near a campfire. He holds his hands out towards the fire. His hands are heated by the fire.



Which process is responsible for transferring thermal energy from the fire to his hands?

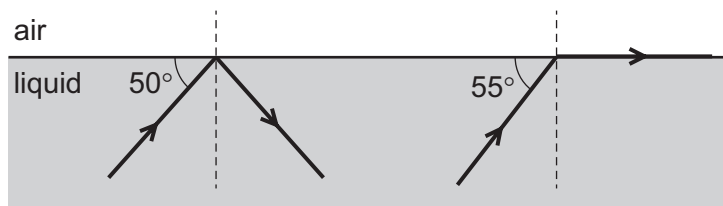
- A conduction
  - B convection
  - C evaporation
  - D radiation
- 34 The diagrams represent two waves X and Y. The diagrams are drawn to the same scale.



From this information, which property must be greater for wave X, and which property must be greater for wave Y?

|   | greater for wave X | greater for wave Y |
|---|--------------------|--------------------|
| A | amplitude          | frequency          |
| B | amplitude          | wavelength         |
| C | frequency          | amplitude          |
| D | frequency          | wavelength         |

- 35** The diagram represents the surface of a transparent liquid. Two rays of light are travelling within the liquid. They both reach the surface. The path of each ray is shown.

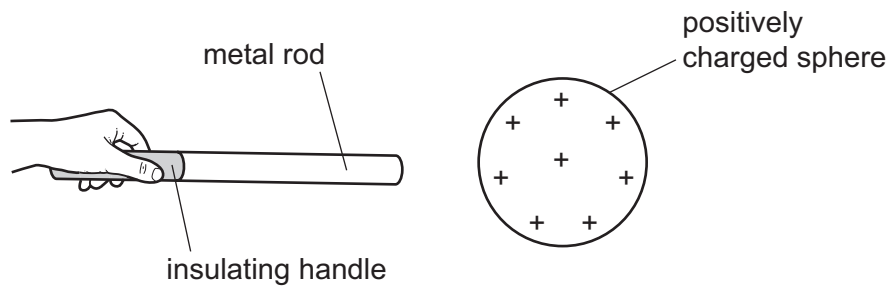


What is the critical angle for this liquid?

- A**  $35^\circ$                       **B**  $40^\circ$                       **C**  $50^\circ$                       **D**  $55^\circ$
- 36** Which type of electromagnetic wave is used in airport security scanners?
- A** gamma-rays  
**B** microwaves  
**C** radio waves  
**D** X-rays
- 37** An electronic circuit in a fire alarm makes a loudspeaker vibrate alternately at two different frequencies.
- Which pair of frequencies is suitable to use in the alarm to alert people to the danger of fire?
- A** 1.5 Hz and 15 Hz  
**B** 15 Hz and 150 000 Hz  
**C** 150 Hz and 15 000 Hz  
**D** 150 000 Hz and 15 000 000 Hz

**38** An uncharged metal rod is held by an insulating handle.

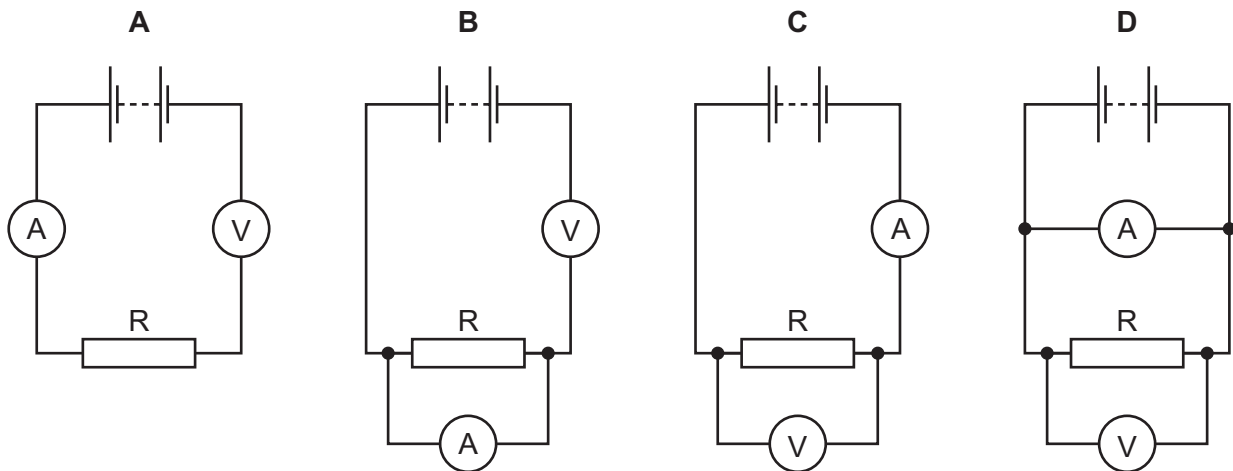
The rod is brought near to a positively charged sphere. This causes some particles in the rod to move.



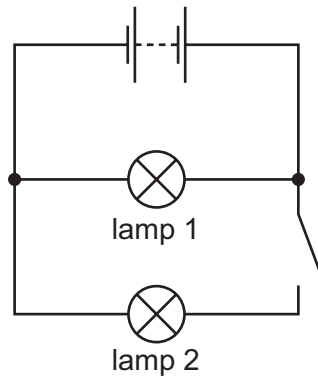
Which particles in the rod move and in which direction do the particles move?

|          | particles that move | direction of movement |
|----------|---------------------|-----------------------|
| <b>A</b> | electrons           | away from the sphere  |
| <b>B</b> | electrons           | towards the sphere    |
| <b>C</b> | protons             | away from the sphere  |
| <b>D</b> | protons             | towards the sphere    |

**39** Which circuit can be used when determining the resistance of resistor R?



- 40 The circuit shown includes two identical lamps and an open switch.



The switch is now closed.

Which statement is now correct?

- A** Lamp 1 is brighter than lamp 2.
- B** The brightness of lamp 1 increases.
- C** The p.d. across each lamp is the same.
- D** The total resistance of the circuit is greater.

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                           |                           |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|---------------------------|
| I                          | II                          | 1<br>H<br>hydrogen<br>1                                                                     |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                       | VIII                      |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 5<br>B<br>boron<br>11       | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14    | 8<br>O<br>oxygen<br>16        | 9<br>F<br>fluorine<br>19  | 10<br>Ne<br>neon<br>20    |
|                            | 11<br>Na<br>sodium<br>23    | 12<br>Mg<br>magnesium<br>24                                                                 | 13<br>Al<br>aluminium<br>27     | 14<br>Si<br>silicon<br>28   | 15<br>P<br>phosphorus<br>31  | 16<br>S<br>sulfur<br>32     | 17<br>Cl<br>chlorine<br>35.5 | 18<br>Ar<br>argon<br>40      |                                |                               |                               |                             |                             |                             |                               |                           |                           |
| 19<br>K<br>potassium<br>39 | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45                                                                  | 22<br>Ti<br>titanium<br>48      | 23<br>V<br>vanadium<br>51   | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55 | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59     | 28<br>Ni<br>nickel<br>59       | 29<br>Cu<br>copper<br>64      | 30<br>Zn<br>zinc<br>65        | 31<br>Ga<br>gallium<br>70   | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75   | 34<br>Se<br>selenium<br>79    | 35<br>Br<br>bromine<br>80 | 36<br>Kr<br>krypton<br>84 |
| 37<br>Rb<br>rubidium<br>85 | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89                                                                    | 40<br>Zr<br>zirconium<br>91     | 41<br>Nb<br>niobium<br>93   | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>— | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103   | 46<br>Pd<br>palladium<br>106   | 47<br>Ag<br>silver<br>108     | 48<br>Cd<br>cadmium<br>112    | 49<br>In<br>indium<br>115   | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122 | 52<br>Te<br>tellurium<br>128  | 53<br>I<br>iodine<br>127  | 54<br>Xe<br>xenon<br>131  |
| 55<br>Cs<br>caesium<br>133 | 56<br>Ba<br>barium<br>137   | 57–71<br>lanthanoids                                                                        | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181 | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186  | 76<br>Os<br>osmium<br>190    | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201    | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209  | 84<br>Po<br>polonium<br>—     | 85<br>At<br>astatine<br>— | 86<br>Rn<br>radon<br>—    |
| 87<br>Fr<br>francium<br>—  | 88<br>Ra<br>radium<br>—     | 89–103<br>actinoids                                                                         | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—   | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—   | 108<br>Hs<br>hassium<br>—    | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>— |                             | 114<br>Fl<br>flerovium<br>— |                             | 116<br>Lv<br>livermorium<br>— |                           |                           |

lanthanoids

actinoids

|                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 57<br>La<br>lanthanum<br>139 | 58<br>Ce<br>cerium<br>140  | 59<br>Pr<br>praseodymium<br>141 | 60<br>Nd<br>neodymium<br>144 | 61<br>Pm<br>promethium<br>— | 62<br>Sm<br>samarium<br>150 | 63<br>Eu<br>europium<br>152 | 64<br>Gd<br>gadolinium<br>157 | 65<br>Tb<br>terbium<br>159 | 66<br>Dy<br>dysprosium<br>163 | 67<br>Ho<br>holmium<br>165   | 68<br>Er<br>erbium<br>167 | 69<br>Tm<br>thulium<br>169    | 70<br>Yb<br>ytterbium<br>173 | 71<br>Lu<br>lutetium<br>175  |
| 89<br>Ac<br>actinium<br>—    | 90<br>Th<br>thorium<br>232 | 91<br>Pa<br>protactinium<br>231 | 92<br>U<br>uranium<br>238    | 93<br>Np<br>neptunium<br>—  | 94<br>Pu<br>plutonium<br>—  | 95<br>Am<br>americium<br>—  | 96<br>Cm<br>curium<br>—       | 97<br>Bk<br>berkelium<br>— | 98<br>Cf<br>californium<br>—  | 99<br>Es<br>einsteinium<br>— | 100<br>Fm<br>fermium<br>— | 101<br>Md<br>mendelevium<br>— | 102<br>No<br>nobelium<br>—   | 103<br>Lr<br>lawrencium<br>— |

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

**COMBINED SCIENCE**

Paper 1 Multiple Choice (Core)

**0653/13**

**May/June 2017**

**45 minutes**

Additional Materials: Multiple Choice Answer Sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

\* 2 0 5 2 5 0 1 3 2 2 \*



**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

**DO NOT WRITE IN ANY BARCODES.**

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 20.

Electronic calculators may be used.

This document consists of **18** printed pages and **2** blank pages.

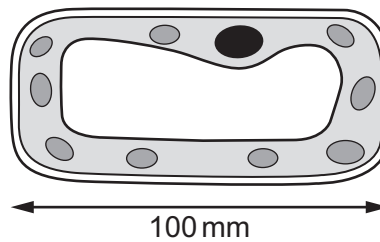


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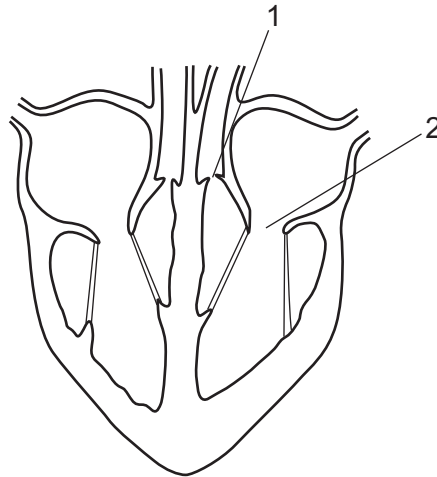
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|------------------|--------------------------------|---------------------------|
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  - D transport of food substances in the phloem

7 The diagram shows a section through the heart.

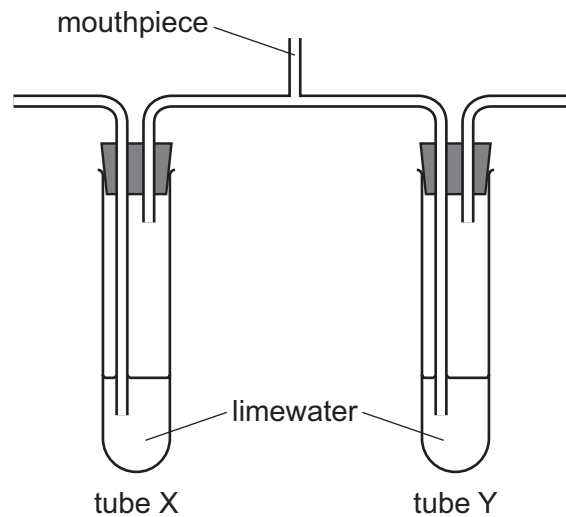


The ventricles contract and blood is forced into the arteries.

What is the state of valves 1 and 2 when this happens?

|          | valve 1 | valve 2 |
|----------|---------|---------|
| <b>A</b> | closed  | closed  |
| <b>B</b> | closed  | open    |
| <b>C</b> | open    | closed  |
| <b>D</b> | open    | open    |

- 8 The diagram shows apparatus at the start of a breathing experiment.



A person breathes in and out through the mouthpiece for a short time.

Which row shows the results?

|          | limewater in tube X | limewater in tube Y |
|----------|---------------------|---------------------|
| <b>A</b> | stays clear         | stays clear         |
| <b>B</b> | stays clear         | turns cloudy        |
| <b>C</b> | turns cloudy        | stays clear         |
| <b>D</b> | turns cloudy        | turns cloudy        |

- 9 Which characteristics of living organisms does a plant show during a geotropism?

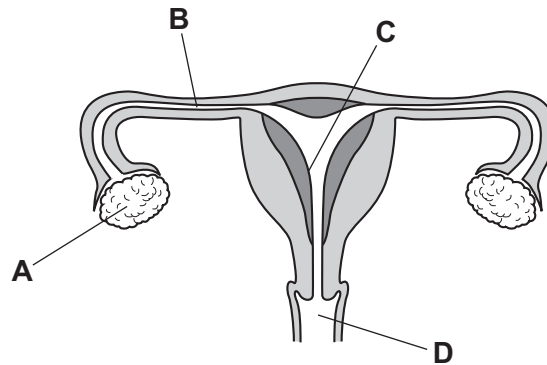
|          | growth | movement | sensitivity |
|----------|--------|----------|-------------|
| <b>A</b> | ✓      | ✓        | ✓           |
| <b>B</b> | ✓      | ✓        | x           |
| <b>C</b> | ✓      | x        | x           |
| <b>D</b> | x      | ✓        | ✓           |

- 10 Which environmental factor is **not** a requirement for the germination of most seeds?

- A** light
- B** oxygen
- C** suitable temperature
- D** water

11 The diagram shows the female reproductive system.

Where does implantation of the embryo normally occur?

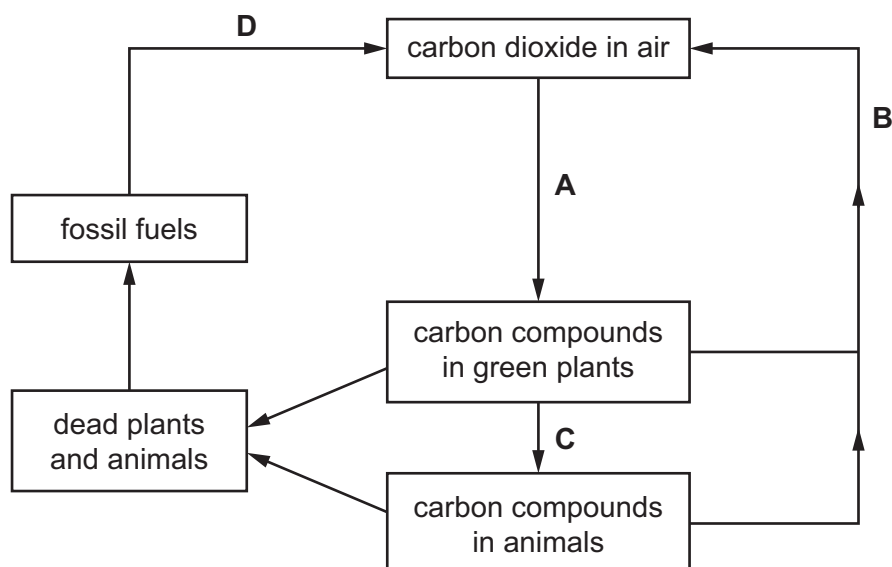


12 What is the correct name for organisms that get their energy by eating plants?

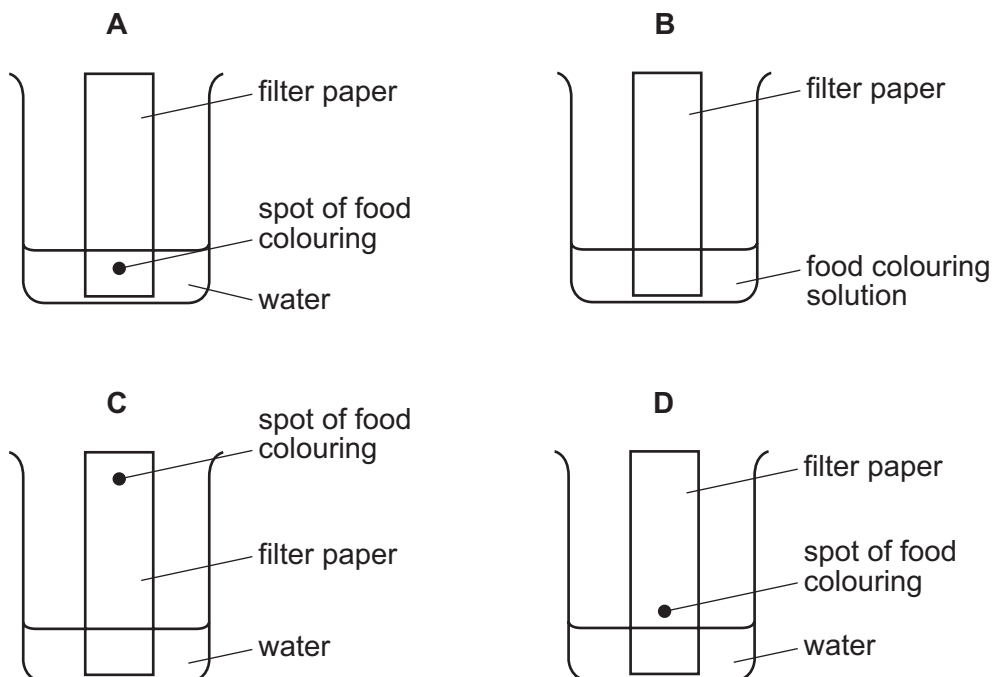
- A carnivores
- B herbivores
- C producers
- D secondary consumers

13 The diagram shows the carbon cycle.

Which arrow represents combustion?



14 Which diagram shows how a mixture of dyes in a food colouring are separated?



15 Which process is a physical change?

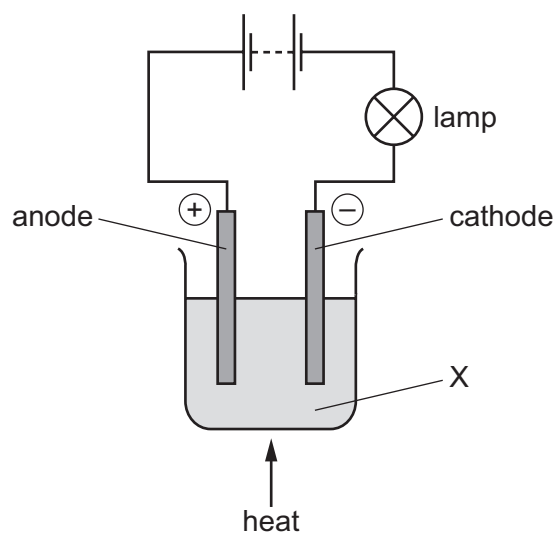
- A adding zinc to dilute sulfuric acid
- B bubbling carbon dioxide through limewater
- C electrolysis molten lead bromide
- D separating petroleum by fractional distillation

16 A neutral atom of chlorine contains 17 electrons and 18 neutrons.

What is the atomic (proton) number and what is the mass (nucleon) number of this atom?

|   | atomic number | mass number |
|---|---------------|-------------|
| A | 17            | 35          |
| B | 17            | 52          |
| C | 18            | 35          |
| D | 18            | 52          |

17 A molten compound X is electrolysed as shown.

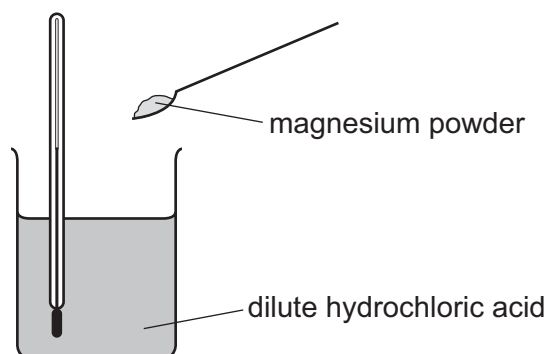


A brown gas is produced at the anode and a grey metal is produced at the cathode.

What is X?

- A** aluminium oxide
- B** copper chloride
- C** lead(II) bromide
- D** sodium chloride

- 18 The diagram shows how the temperature change is measured when magnesium powder reacts with dilute hydrochloric acid.



Thermometer reading before adding magnesium powder =  $20.6^{\circ}\text{C}$

Thermometer reading after adding magnesium powder =  $32.4^{\circ}\text{C}$

Which statement is correct?

- A The reaction is endothermic and gives out heat.
  - B The reaction is endothermic and takes in heat.
  - C The reaction is exothermic and gives out heat.
  - D The reaction is exothermic and takes in heat.
- 19 Magnesium ribbon reacts with dilute hydrochloric acid to form hydrogen gas.

Which change increases the rate of the reaction?

- A adding water to the mixture
  - B trapping the hydrogen gas
  - C using a lower temperature
  - D using powdered magnesium
- 20 In which reactions is the underlined substance oxidised?
- 1 iron when it rusts
  - 2 methane when it burns in air
  - 3 copper oxide when it reacts with carbon
- A 1, 2 and 3      B 1 and 2 only      C 1 and 3 only      D 2 and 3 only

- 21** Magnesium sulfate is a soluble solid produced by reacting excess solid magnesium oxide with dilute sulfuric acid.

Which processes produce **pure** magnesium sulfate crystals?

- A** distilling the reaction mixture and leaving the distillate to crystallise
- B** evaporating the water from the reaction mixture
- C** filtering and drying the solid from the reaction mixture
- D** filtering the reaction mixture and leaving the filtrate to crystallise

- 22** Substance X is warmed with aqueous sodium hydroxide and aluminium.

A gas is produced which turns damp red litmus paper blue.

Which anion is present in X?

- A** carbonate  
**B** hydroxide  
**C** nitrate  
**D** sulfate

- 23** Part of the Periodic Table is shown.

The letters are **not** the symbols of the elements.

Which element is a non-metal?

- ## 24 What is an alloy?

- A** a compound containing two metallic elements
- B** a compound containing two non-metallic elements
- C** a mixture containing two metallic elements
- D** a mixture containing two non-metallic elements

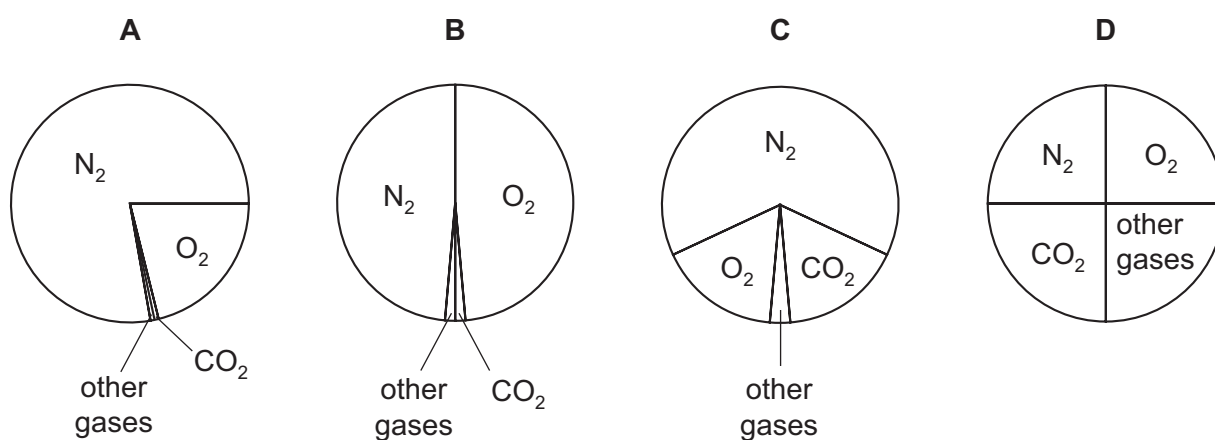
**25** A mixture of copper(II) oxide and substance Q is heated.

The reaction produces copper.

What is Q?

- A** aluminium oxide
- B** carbon
- C** carbon dioxide
- D** oxygen

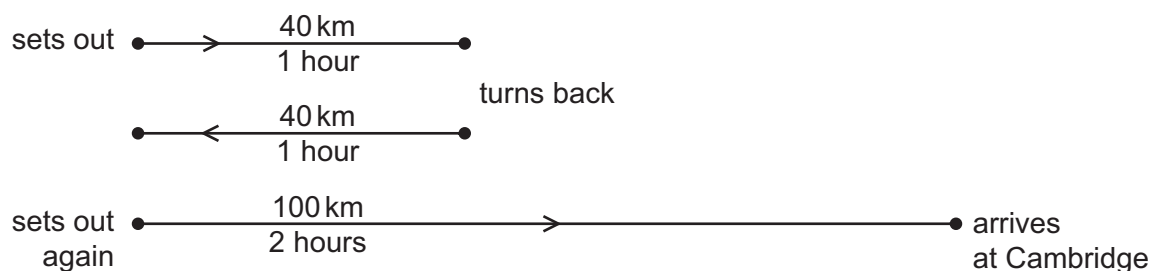
**26** Which pie chart shows the proportions of gases in clean air?



**27** Which property of the compounds in petroleum is used to separate it into useful fractions?

- A** boiling point
- B** density
- C** melting point
- D** solubility

- 28** A car driver sets out from home to travel to Cambridge. After 1 hour he is 40 km from home. He discovers that he must return home to collect his briefcase. This journey also takes him 1 hour. He sets off again immediately. He reaches Cambridge, 100 km from home, 2 hours later.



What is the average speed for the whole of his journey from leaving home the first time?

- A** 25 km/h      **B** 45 km/h      **C** 50 km/h      **D** 90 km/h
- 29** Which row shows the unit for force, the unit for mass and the unit for weight?

|          | force | mass | weight |
|----------|-------|------|--------|
| <b>A</b> | kg    | kg   | N      |
| <b>B</b> | kg    | N    | kg     |
| <b>C</b> | N     | kg   | N      |
| <b>D</b> | N     | N    | kg     |

- 30** A car uses petrol as fuel. The car has been parked overnight.

The engine is now started and the car is driven along a horizontal road at an increasing speed.

Which two forms of energy of the car both increase as the car moves?

- A** chemical and gravitational  
**B** chemical and thermal  
**C** gravitational and kinetic  
**D** kinetic and thermal

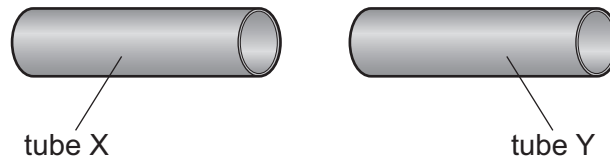
**31** Four different forces move an object by different distances in different times.

Which row shows the situation in which the greatest power is produced by the force?

|          | time taken<br>/s | force<br>/N | distance<br>moved / m |
|----------|------------------|-------------|-----------------------|
| <b>A</b> | 10               | 400         | 3.0                   |
| <b>B</b> | 20               | 200         | 2.0                   |
| <b>C</b> | 30               | 400         | 2.0                   |
| <b>D</b> | 40               | 200         | 3.0                   |

**32** The diagram shows two thin steel tubes X and Y. The tubes have identical dimensions at room temperature.

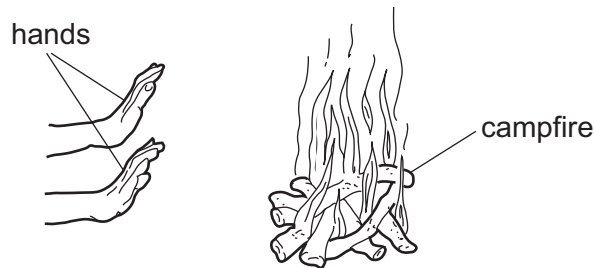
Tube X needs to be made to fit inside tube Y.



How can this be done?

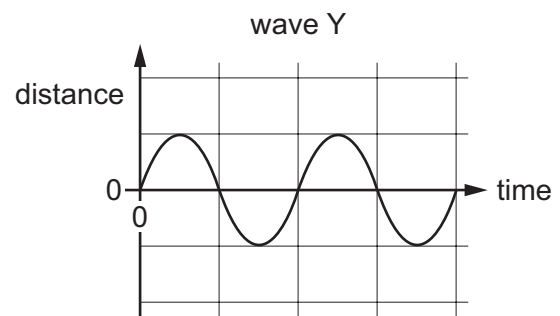
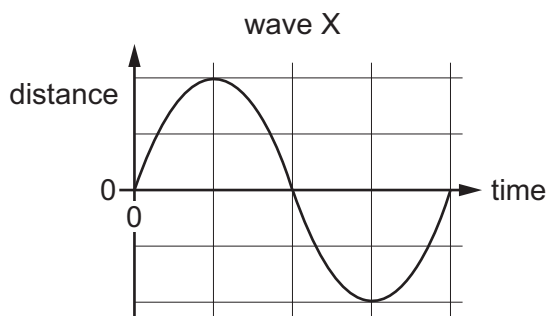
- A** Cool both tubes to the same low temperature.
- B** Cool tube X only, to a low temperature.
- C** Heat both tubes to the same high temperature.
- D** Heat tube X only, to a high temperature.

- 33 On a cold night, a person stands near a campfire. He holds his hands out towards the fire. His hands are heated by the fire.



Which process is responsible for transferring thermal energy from the fire to his hands?

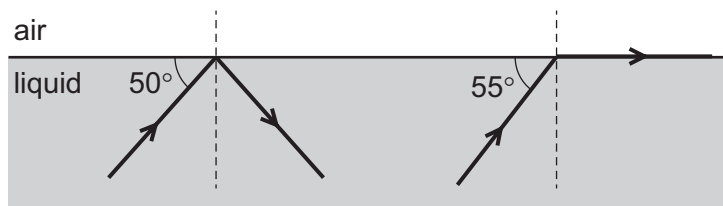
- A conduction
  - B convection
  - C evaporation
  - D radiation
- 34 The diagrams represent two waves X and Y. The diagrams are drawn to the same scale.



From this information, which property must be greater for wave X, and which property must be greater for wave Y?

|   | greater for wave X | greater for wave Y |
|---|--------------------|--------------------|
| A | amplitude          | frequency          |
| B | amplitude          | wavelength         |
| C | frequency          | amplitude          |
| D | frequency          | wavelength         |

- 35** The diagram represents the surface of a transparent liquid. Two rays of light are travelling within the liquid. They both reach the surface. The path of each ray is shown.

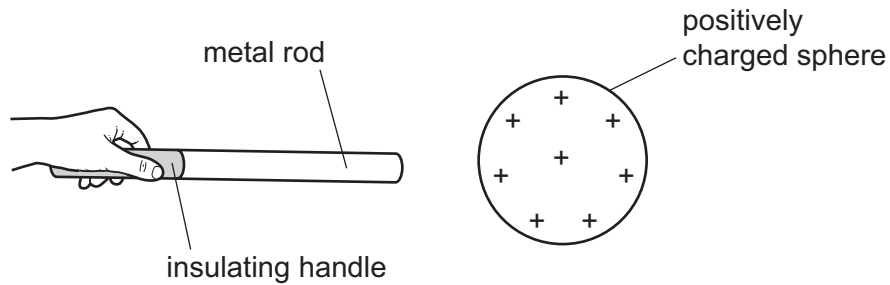


What is the critical angle for this liquid?

- A**  $35^\circ$                       **B**  $40^\circ$                       **C**  $50^\circ$                       **D**  $55^\circ$
- 36** Which type of electromagnetic wave is used in airport security scanners?
- A** gamma-rays  
**B** microwaves  
**C** radio waves  
**D** X-rays
- 37** An electronic circuit in a fire alarm makes a loudspeaker vibrate alternately at two different frequencies.
- Which pair of frequencies is suitable to use in the alarm to alert people to the danger of fire?
- A** 1.5 Hz and 15 Hz  
**B** 15 Hz and 150 000 Hz  
**C** 150 Hz and 15 000 Hz  
**D** 150 000 Hz and 15 000 000 Hz

**38** An uncharged metal rod is held by an insulating handle.

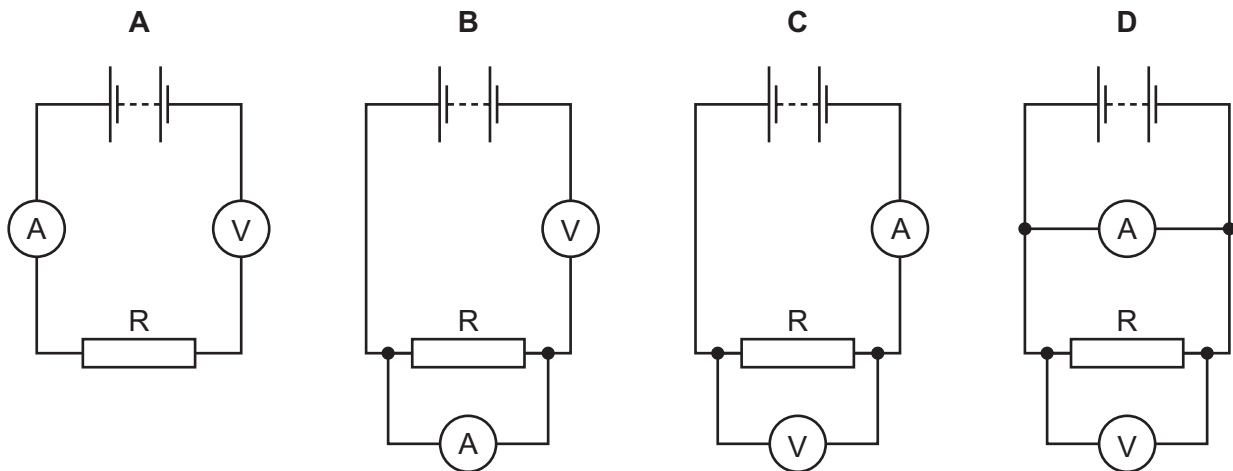
The rod is brought near to a positively charged sphere. This causes some particles in the rod to move.



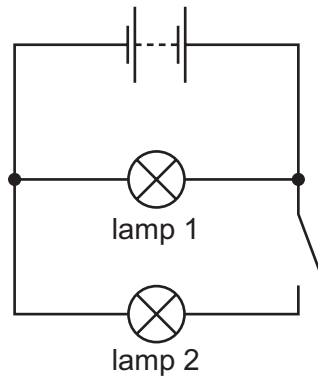
Which particles in the rod move and in which direction do the particles move?

|          | particles that move | direction of movement |
|----------|---------------------|-----------------------|
| <b>A</b> | electrons           | away from the sphere  |
| <b>B</b> | electrons           | towards the sphere    |
| <b>C</b> | protons             | away from the sphere  |
| <b>D</b> | protons             | towards the sphere    |

**39** Which circuit can be used when determining the resistance of resistor R?



- 40 The circuit shown includes two identical lamps and an open switch.



The switch is now closed.

Which statement is now correct?

- A** Lamp 1 is brighter than lamp 2.
- B** The brightness of lamp 1 increases.
- C** The p.d. across each lamp is the same.
- D** The total resistance of the circuit is greater.

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## The Periodic Table of Elements

| Group                      |                             |                                                                                            |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                           |                           |
|----------------------------|-----------------------------|--------------------------------------------------------------------------------------------|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------------|---------------------------|
| I                          | II                          | 1<br>H<br>hydrogen<br>1                                                                    |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                       | VIII                      |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   | <div>atomic number</div> <div>atomic symbol<br/>name</div> <div>relative atomic mass</div> |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 5<br>B<br>boron<br>11       | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14    | 8<br>O<br>oxygen<br>16        | 9<br>F<br>fluorine<br>19  | 10<br>Ne<br>neon<br>20    |
|                            | 11<br>Na<br>sodium<br>23    |                                                                                            |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                           |                           |
| 19<br>K<br>potassium<br>39 | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45                                                                 | 22<br>Ti<br>titanium<br>48      | 23<br>V<br>vanadium<br>51   | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55 | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59     | 28<br>Ni<br>nickel<br>59       | 29<br>Cu<br>copper<br>64      | 30<br>Zn<br>zinc<br>65        | 31<br>Ga<br>gallium<br>70   | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75   | 34<br>Se<br>selenium<br>79    | 35<br>Br<br>bromine<br>80 | 36<br>Kr<br>krypton<br>84 |
| 37<br>Rb<br>rubidium<br>85 | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89                                                                   | 40<br>Zr<br>zirconium<br>91     | 41<br>Nb<br>niobium<br>93   | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>— | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103   | 46<br>Pd<br>palladium<br>106   | 47<br>Ag<br>silver<br>108     | 48<br>Cd<br>cadmium<br>112    | 49<br>In<br>indium<br>115   | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122 | 52<br>Te<br>tellurium<br>128  | 53<br>I<br>iodine<br>127  | 54<br>Xe<br>xenon<br>131  |
| 55<br>Cs<br>caesium<br>133 | 56<br>Ba<br>barium<br>137   | 57–71<br>lanthanoids                                                                       | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181 | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186  | 76<br>Os<br>osmium<br>190    | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201    | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209  | 84<br>Po<br>polonium<br>—     | 85<br>At<br>astatine<br>— | 86<br>Rn<br>radon<br>—    |
| 87<br>Fr<br>francium<br>—  | 88<br>Ra<br>radium<br>—     | 89–103<br>actinoids                                                                        | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—   | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—   | 108<br>Hs<br>hassium<br>—    | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>— |                             | 114<br>Fl<br>flerovium<br>— |                             | 116<br>Lv<br>livermorium<br>— |                           |                           |

lanthanoids

actinoids

|                                     |                                   |                                        |                                     |                                    |                                    |                                    |                                      |                                   |                                      |                                     |                                  |                                      |                                     |                                     |
|-------------------------------------|-----------------------------------|----------------------------------------|-------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| 57<br><b>La</b><br>lanthanum<br>139 | 58<br><b>Ce</b><br>cerium<br>140  | 59<br><b>Pr</b><br>praseodymium<br>141 | 60<br><b>Nd</b><br>neodymium<br>144 | 61<br><b>Pm</b><br>promethium<br>— | 62<br><b>Sm</b><br>samarium<br>150 | 63<br><b>Eu</b><br>europium<br>152 | 64<br><b>Gd</b><br>gadolinium<br>157 | 65<br><b>Tb</b><br>terbium<br>159 | 66<br><b>Dy</b><br>dysprosium<br>163 | 67<br><b>Ho</b><br>holmium<br>165   | 68<br><b>Er</b><br>erbium<br>167 | 69<br><b>Tm</b><br>thulium<br>169    | 70<br><b>Yb</b><br>ytterbium<br>173 | 71<br><b>Lu</b><br>lutetium<br>175  |
| 89<br><b>Ac</b><br>actinium<br>—    | 90<br><b>Th</b><br>thorium<br>232 | 91<br><b>Pa</b><br>protactinium<br>231 | 92<br><b>U</b><br>uranium<br>238    | 93<br><b>Np</b><br>neptunium<br>—  | 94<br><b>Pu</b><br>plutonium<br>—  | 95<br><b>Am</b><br>americium<br>—  | 96<br><b>Cm</b><br>curium<br>—       | 97<br><b>Bk</b><br>berkelium<br>— | 98<br><b>Cf</b><br>californium<br>—  | 99<br><b>Es</b><br>einsteinium<br>— | 100<br><b>Fm</b><br>fermium<br>— | 101<br><b>Md</b><br>mendelevium<br>— | 102<br><b>No</b><br>nobelium<br>—   | 103<br><b>Lr</b><br>lawrencium<br>— |

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).