



# Cambridge IGCSE™

## COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/21

May/June 2023

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

### INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



- 1 Which characteristic of living organisms involves chemical reactions in cells that break down nutrient molecules and release energy?

A excretion  
 B nutrition  
 C respiration  
 D sensitivity

- 2 Which structures are present in an animal cell?

|   | cell membrane | cell wall | cytoplasm | nucleus |
|---|---------------|-----------|-----------|---------|
| A | ✓             | x         | ✓         | ✓       |
| B | ✓             | ✓         | x         | ✓       |
| C | ✓             | x         | x         | ✓       |
| D | x             | ✓         | ✓         | x       |

key

✓ = present

x = not present

- 3 Which row describes the movement of water by osmosis?

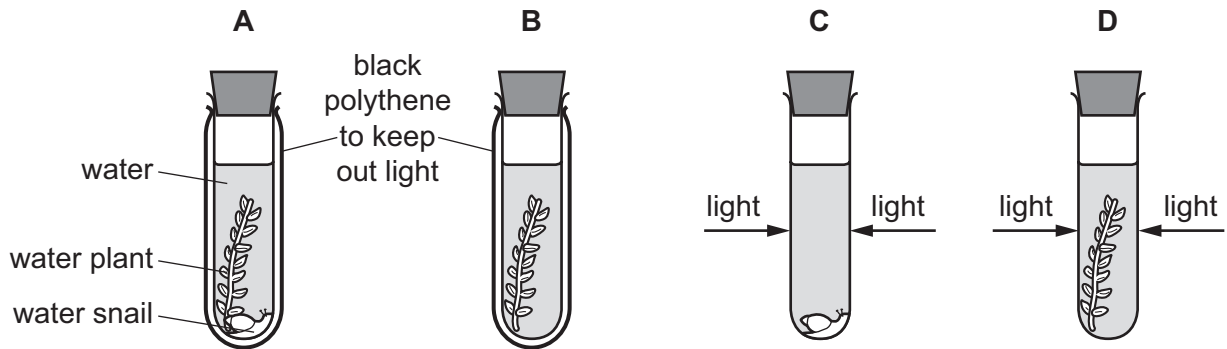
|   | from a region of     | to a region of       | through                        |
|---|----------------------|----------------------|--------------------------------|
| A | low water potential  | high water potential | a partially permeable membrane |
| B | low water potential  | high water potential | a totally permeable membrane   |
| C | high water potential | low water potential  | a totally permeable membrane   |
| D | high water potential | low water potential  | a partially permeable membrane |

- 4 Which combination of pH and temperature does **not** denature a protease enzyme from the stomach?

|   | pH | temperature / °C |
|---|----|------------------|
| A | 3  | 37               |
| B | 3  | 60               |
| C | 10 | 37               |
| D | 10 | 60               |

5 Four test-tubes are set up as shown.

In which test-tube is there an increase in oxygen concentration after 4 hours?



6 What is the purpose of chemical digestion?

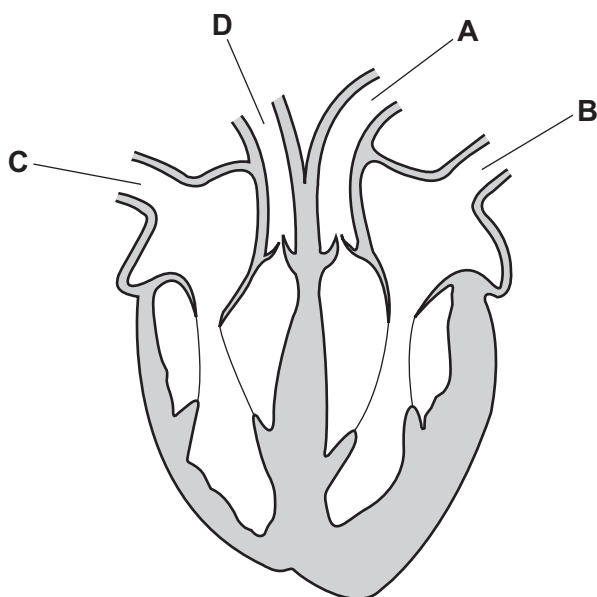
- A** to absorb minerals including calcium and iron
- B** to pass food out as faeces
- C** to break down large nutrient molecules into smaller molecules
- D** to secrete enzymes

7 Which row matches the adaptation of a root hair cell to its function?

|          | adaptation         | function                    |
|----------|--------------------|-----------------------------|
| <b>A</b> | large surface area | uptake of water and glucose |
| <b>B</b> | large surface area | uptake of water and ions    |
| <b>C</b> | small surface area | uptake of water and glucose |
| <b>D</b> | small surface area | uptake of water and ions    |

8 The diagram shows a section through the heart.

Which vessel is the pulmonary vein?



9 Which molecule contains the energy that is released in aerobic respiration?

**A**  $\text{C}_6\text{H}_{12}\text{O}_6$

**B**  $\text{CO}_2$

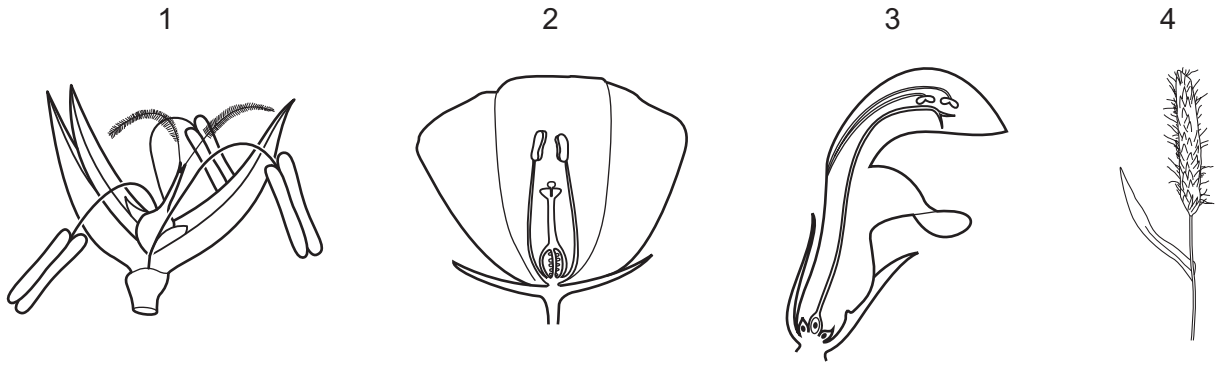
**C**  $\text{H}_2\text{O}$

**D**  $\text{O}_2$

10 What are features of sexual reproduction?

|          | fusion<br>of nuclei | nature of offspring   |
|----------|---------------------|-----------------------|
| <b>A</b> | no                  | genetically different |
| <b>B</b> | yes                 | genetically identical |
| <b>C</b> | no                  | genetically identical |
| <b>D</b> | yes                 | genetically different |

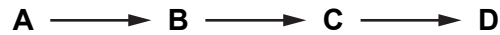
11 The diagrams show four different flowers.



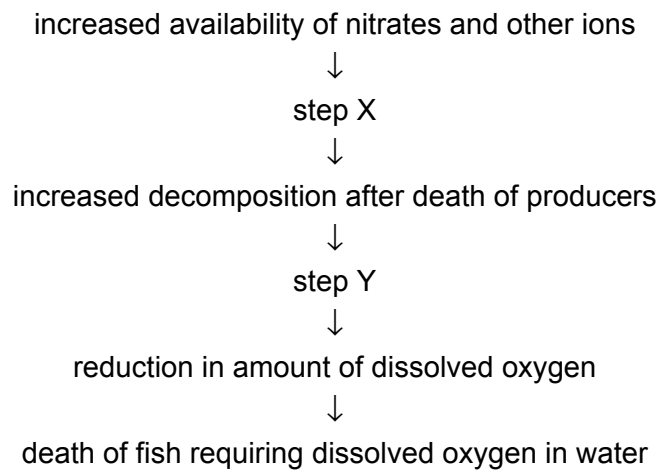
Which flowers are wind pollinated?

- A** 1 and 3      **B** 1 and 4      **C** 2 and 3      **D** 2 and 4

12 Which letter represents the secondary consumer in the food chain shown?



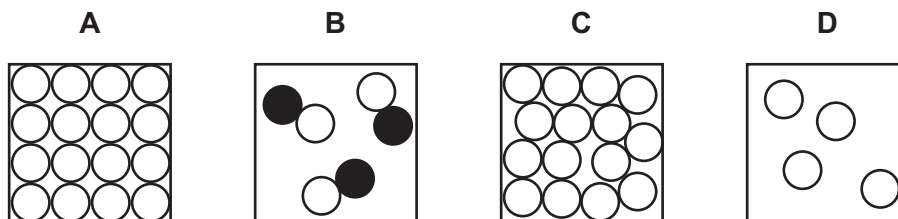
13 The flow chart shows some of the steps in the process of eutrophication.



What is happening at step Y?

- A** increased aerobic respiration by decomposers  
**B** decreased aerobic respiration by decomposers  
**C** increased growth of aquatic plants  
**D** decreased growth of aquatic plants

14 Which diagram represents particles in a gaseous element?



15 What is the relative mass of a proton and the relative charge on a proton?

|          | relative mass | relative charge |
|----------|---------------|-----------------|
| <b>A</b> | 0.0005        | +1              |
| <b>B</b> | 0.0005        | -1              |
| <b>C</b> | 1             | -1              |
| <b>D</b> | 1             | +1              |

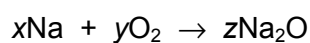
16 Sodium reacts with chlorine to form sodium chloride.

Which statement describes a change that occurs during this reaction?

- A** Each chlorine atom loses one proton.
- B** Each sodium atom loses one electron.
- C** The mass number of each chlorine atom increases.
- D** The atomic number of sodium decreases.

17 Sodium burns in oxygen forming sodium oxide.

An equation for this reaction is shown.



What are  $x$ ,  $y$  and  $z$ ?

|          | $x$ | $y$ | $z$ |
|----------|-----|-----|-----|
| <b>A</b> | 2   | 1   | 2   |
| <b>B</b> | 2   | 2   | 1   |
| <b>C</b> | 4   | 1   | 2   |
| <b>D</b> | 4   | 2   | 2   |

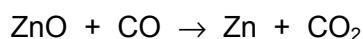
18 Which statement about the electrolysis of molten lead(II) bromide is correct?

- A Lead anions move to the anode where they gain electrons.
- B Lead anions move to the cathode where they lose electrons.
- C Lead cations move to the anode where they lose electrons.
- D Lead cations move to the cathode where they gain electrons.

19 Which process is endothermic?

- A the reaction of petrol with air in a car engine
- B  $\text{Cl}-\text{Cl} \rightarrow \text{Cl} + \text{Cl}$
- C the reaction of potassium with water
- D  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

20 The equation for the reaction of zinc oxide with carbon monoxide is shown.



Which statement explains the role of carbon monoxide in this reaction?

- A It is the oxidising agent and it is oxidised.
- B It is the oxidising agent and it is reduced.
- C It is the reducing agent and it is oxidised.
- D It is the reducing agent and it is reduced.

21 Dilute hydrochloric acid is tested with universal indicator and with calcium carbonate.

Which row shows the pH and describes the reaction with calcium carbonate?

|   | pH | reaction with calcium carbonate |
|---|----|---------------------------------|
| A | 2  | a colourless gas is given off   |
| B | 2  | no reaction                     |
| C | 10 | a colourless gas is given off   |
| D | 10 | no reaction                     |

**22** The results of two tests on a solution of substance R are shown.

| test                                                              | result                                            |
|-------------------------------------------------------------------|---------------------------------------------------|
| aqueous sodium hydroxide added                                    | red-brown precipitate formed, insoluble in excess |
| dilute nitric acid added followed by aqueous silver nitrate added | white precipitate formed                          |

What is R?

- A** iron(II) carbonate
  - B** iron(III) carbonate
  - C** iron(II) chloride
  - D** iron(III) chloride
- 23** The character of the elements changes from metallic to non-metallic across a period of the Periodic Table.

Which statement explains this change?

- A** Metal atoms need to gain electrons to form metal ions.
  - B** It becomes more difficult for elements to lose electrons across a period.
  - C** Non-metal atoms lose electrons more easily than metal atoms.
  - D** Atoms get bigger across a period.
- 24** Copper oxide and excess carbon are mixed together.

The mass before heating is 12.2 g.

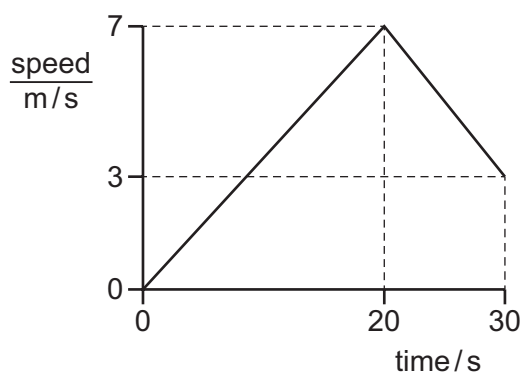
The mixture is heated strongly and allowed to cool.

The mass after heating is 10.4 g.

Why does the mass change?

- A** Carbon forms carbon dioxide which then combines with the copper oxide.
- B** Carbon reduces the copper oxide and leaves the test-tube as carbon dioxide.
- C** Copper oxide loses oxygen, turns into copper and the carbon remains unchanged.
- D** Carbon oxidises the copper oxide and leaves the test-tube as carbon dioxide.

- 25 Which statement about both carbon dioxide and methane is correct?
- A Increased concentrations of carbon dioxide and methane in the air cause an enhanced greenhouse effect.
  - B Methane and carbon dioxide are hydrocarbons.
  - C Respiration increases the concentration of carbon dioxide and methane in the air.
  - D The combustion of fossil fuels increases the concentration of carbon dioxide and methane in the air.
- 26 Why are alkanes members of the same homologous series?
- A They are all hydrocarbons.
  - B They have similar physical properties.
  - C They have the same general formula.
  - D They all undergo combustion to give carbon dioxide and water.
- 27 What are the products of cracking large alkane molecules?
- A smaller alkanes only
  - B smaller alkenes only
  - C smaller alkanes, alkenes and hydrogen
  - D smaller alkanes and hydrogen only
- 28 The graph shows the motion of a cyclist over a period of 30 s.

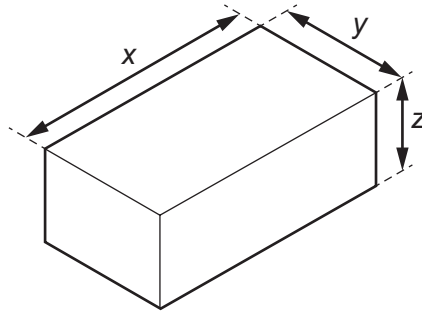


Which distance does the cyclist travel?

- A 90 m                      B 105 m                      C 115 m                      D 120 m

- 29 A solid cuboid block of metal has density  $\rho$ .

The diagram shows its dimensions.



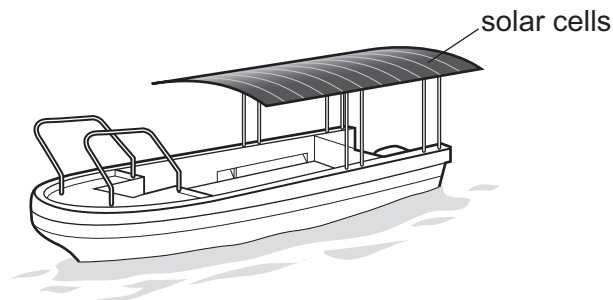
Which expression is used to calculate the mass of the block?

- A**  $\frac{\rho}{xy}$       **B**  $\frac{\rho}{xyz}$       **C**  $\rho xy$       **D**  $\rho xyz$
- 30 A spring that obeys Hooke's law is fixed at one end.
- When the spring is pulled by a force of 30 N, it has a stretched length of 14 cm.
- When the spring is pulled by a force of 48 N, it has a stretched length of 20 cm.
- What is the spring constant of the spring?
- A** 2.1 N/cm      **B** 2.4 N/cm      **C** 3.0 N/cm      **D** 8.0 N/cm
- 31 A 3.0 kW electric kettle is switched on for 30 seconds.

Which row gives the equation that defines power and gives the energy transferred in the kettle?

|          | equation                 | energy / J |
|----------|--------------------------|------------|
| <b>A</b> | $P = \frac{\Delta E}{t}$ | 90         |
| <b>B</b> | $P = \frac{\Delta E}{t}$ | 90 000     |
| <b>C</b> | $P = \Delta E t$         | 0.10       |
| <b>D</b> | $P = \Delta E t$         | 100        |

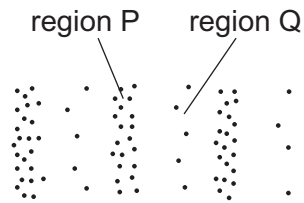
- 32 Solar cells mounted on a boat produce electrical energy to power the motor.



Which resource does this energy come from?

- A hydroelectric energy
  - B light energy
  - C tidal energy
  - D wind energy
- 33 The molecules in a liquid are close together.
- What are other features of the molecules in a liquid?
- A They are arranged in a regular pattern but change positions with each other.
  - B They are arranged in a regular pattern and vibrate about fixed positions.
  - C They are arranged randomly and change positions with each other.
  - D They are arranged randomly and vibrate about fixed positions.
- 34 What is a method of thermal conduction in a metal?
- A electrons moving through the metal, hitting distant molecules
  - B electrons vibrating and passing on energy to other electrons
  - C molecules moving through the metal, hitting other molecules
  - D protons moving through the metal, hitting distant molecules

- 35 The diagram represents a wave in air. Molecules are closer together in region P than they are in region Q.



What are the names of regions P and Q, and which type of wave is represented?

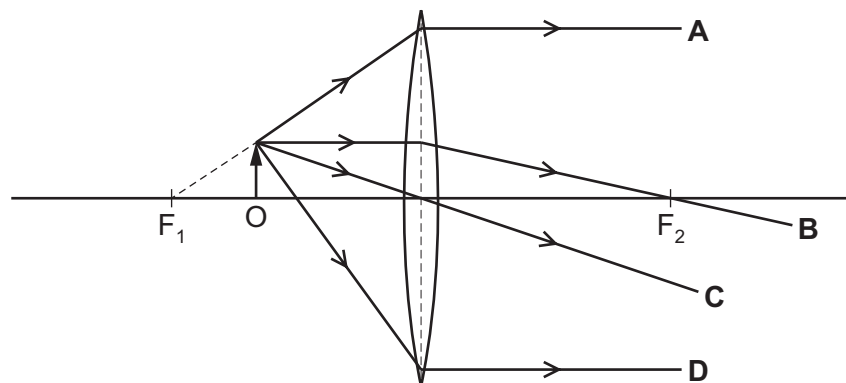
|          | region P    | region Q    | type of wave |
|----------|-------------|-------------|--------------|
| <b>A</b> | compression | rarefaction | longitudinal |
| <b>B</b> | compression | rarefaction | transverse   |
| <b>C</b> | rarefaction | compression | longitudinal |
| <b>D</b> | rarefaction | compression | transverse   |

- 36 The diagram shows an object placed at position O near a thin converging lens.

$F_1$  and  $F_2$  are the principal focuses of the lens.

A student draws four rays that leave the top of the object and pass through the lens.

Which labelled ray is **not** correct?

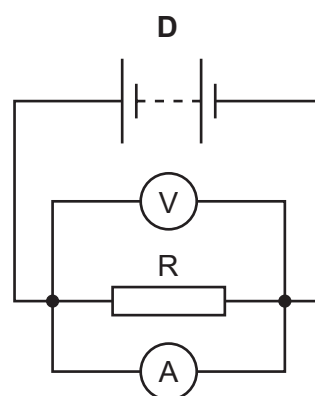
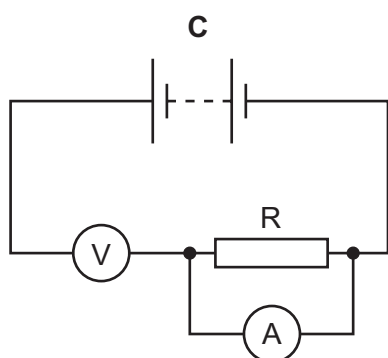
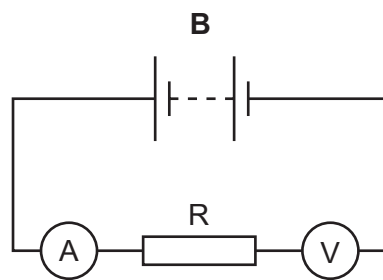
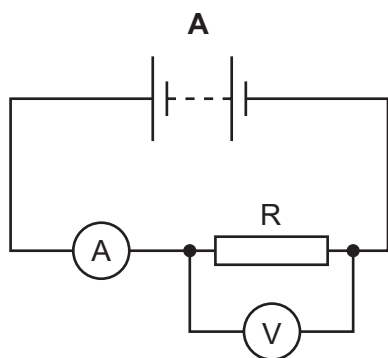


- 37 The unit of electric charge is the coulomb (C).

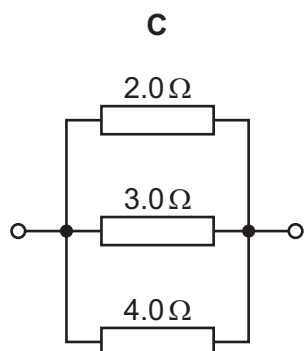
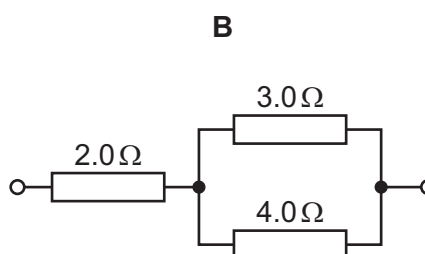
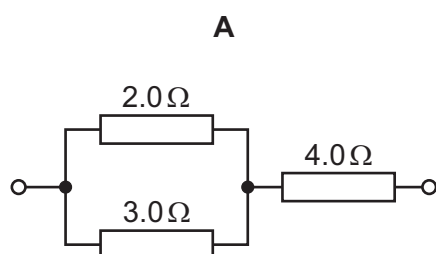
Which combination of other units is equivalent to the coulomb?

- A** A/s      **B** As      **C** V/A      **D** VA

38 Which circuit is used to determine the resistance of resistor R?



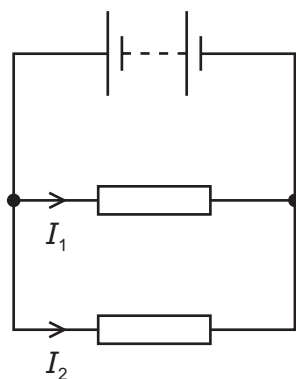
39 Which arrangement of resistors has the smallest combined resistance?



- 40 The diagram shows two resistors connected in parallel to a battery.

Currents  $I_1$  and  $I_2$  are labelled.

Current  $I_1$  is greater than current  $I_2$ .



Which calculation gives the current in the battery?

- A**  $I_1 + I_2$       **B**  $I_1 - I_2$       **C**  $I_1 \times I_2$       **D**  $\frac{(I_1 + I_2)}{2}$

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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   | Key<br>atomic number<br>atomic symbol<br>name<br>relative atomic mass |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 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>— | 113<br>Nh<br>nihonium<br>—  | 114<br>Fl<br>flerovium<br>— | 115<br>Mc<br>moscovium<br>— | 116<br>Lv<br>livermorium<br>— | 117<br>Ts<br>tennessine<br>— | 118<br>Og<br>oganeson<br>— |

|             |                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|-------------|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| lanthanoids | 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 2 Multiple Choice (Extended)

0653/22

May/June 2023

45 minutes

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- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.

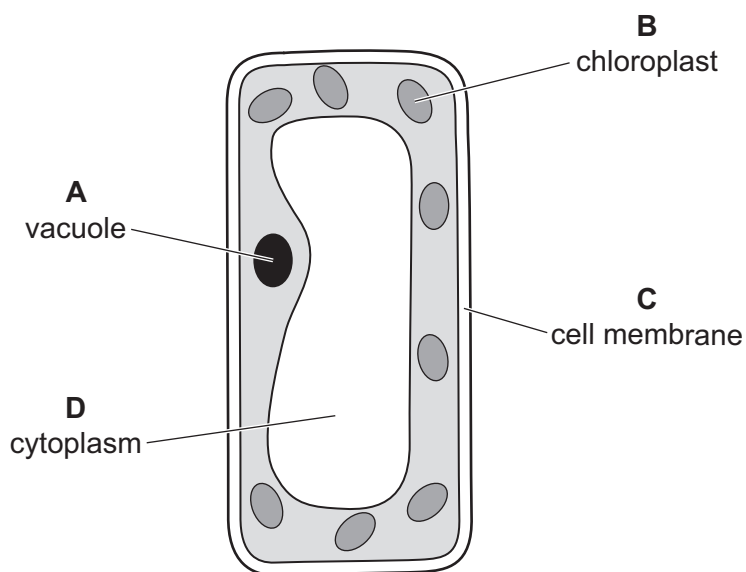


1 Which process removes toxic materials from an organism?

- A digestion
- B egestion
- C excretion
- D respiration

2 The diagram shows a cell as seen with a microscope.

Which label is correct?



3 The activity of an enzyme-catalysed reaction is altered by changes in temperature.

What occurs when the temperature rises above the temperature at which the enzyme works best?

- A The shape of the substrate molecule no longer fits the active site of the enzyme molecule.
- B The increasing temperature causes the substrate molecules to break down.
- C The concentration of the substrate increases and that of the product decreases.
- D The kinetic energy of the substrate particles decreases.

- 4 In plants, photosynthesis takes place in the leaf.

During photosynthesis, .....P..... transfers .....Q..... energy into .....R..... energy. This is used for the synthesis of .....S..... .

Which row correctly completes gaps P, Q, R and S?

|          | P           | Q        | R        | S            |
|----------|-------------|----------|----------|--------------|
| <b>A</b> | chlorophyll | chemical | light    | carbohydrate |
| <b>B</b> | chlorophyll | light    | chemical | carbohydrate |
| <b>C</b> | glucose     | chemical | light    | chlorophyll  |
| <b>D</b> | glucose     | light    | chemical | chlorophyll  |

- 5 What can be caused by a diet containing too little vitamin C?

- A** anaemia
- B** coronary heart disease
- C** rickets
- D** scurvy

- 6 In which order does food pass through parts of the alimentary canal?

- A** oesophagus → anus → large intestine
- B** small intestine → oesophagus → stomach
- C** small intestine → large intestine → anus
- D** stomach → large intestine → small intestine

- 7 The table shows two processes that are involved in transpiration.

What happens to the rate of these processes in high humidity?

|          | diffusion of water vapour through stomata | evaporation of water from surfaces of mesophyll cells |
|----------|-------------------------------------------|-------------------------------------------------------|
| <b>A</b> | rate decreases                            | rate increases                                        |
| <b>B</b> | rate decreases                            | rate decreases                                        |
| <b>C</b> | rate increases                            | rate increases                                        |
| <b>D</b> | rate increases                            | rate decreases                                        |

- 8 A sample of blood is taken from a person who often gets infections.

The blood is also slow to clot.

Which blood components are likely to be at a lower level than normal?

- 1 platelets
- 2 red blood cells
- 3 white blood cells

**A** 1, 2 and 3      **B** 1 and 2 only      **C** 1 and 3 only      **D** 2 and 3 only

- 9 In respiration, glucose is broken down to release energy.

Which row states how humans could use this energy?

|          | growth | keep a constant<br>body temperature | muscle<br>contraction | protein<br>synthesis |
|----------|--------|-------------------------------------|-----------------------|----------------------|
| <b>A</b> | ✓      | ✓                                   | ✓                     | ✓                    |
| <b>B</b> | ✓      | ✓                                   | x                     | ✓                    |
| <b>C</b> | x      | x                                   | ✓                     | ✓                    |
| <b>D</b> | x      | ✓                                   | ✓                     | x                    |

key

✓ = true

x = false

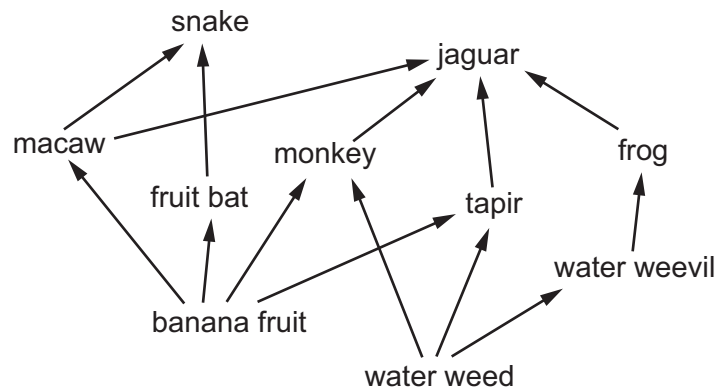
- 10 What happens when adrenaline is released into the blood?

|          | blood glucose<br>concentration | pulse rate |
|----------|--------------------------------|------------|
| <b>A</b> | increases                      | increases  |
| <b>B</b> | increases                      | decreases  |
| <b>C</b> | decreases                      | increases  |
| <b>D</b> | decreases                      | decreases  |

- 11 Which row describes asexual reproduction?

|          | number of<br>parents involved | offspring genetically<br>identical to each other |
|----------|-------------------------------|--------------------------------------------------|
| <b>A</b> | 1                             | yes                                              |
| <b>B</b> | 1                             | no                                               |
| <b>C</b> | 2                             | yes                                              |
| <b>D</b> | 2                             | no                                               |

12 The diagram shows part of a food web.



Which row gives the number of each type of consumer?

|          | primary | secondary | tertiary |
|----------|---------|-----------|----------|
| <b>A</b> | 2       | 2         | 0        |
| <b>B</b> | 2       | 5         | 3        |
| <b>C</b> | 5       | 1         | 0        |
| <b>D</b> | 5       | 3         | 1        |

13 Eutrophication of fresh water occurs because of a series of events in the water.

The list describes these events.

- 1 increased aerobic respiration by decomposers
- 2 increased availability of nitrate and other ions
- 3 increased decomposition after death of producers
- 4 increased growth of producers
- 5 reduction in amount of dissolved oxygen in the water

Which order of these events results in the death of fish and other aquatic organisms?

- A** 2 → 1 → 4 → 5 → 3
- B** 2 → 4 → 3 → 1 → 5
- C** 4 → 2 → 3 → 1 → 5
- D** 4 → 5 → 2 → 1 → 3

14 The formulae of three substances are shown.

| substance | formula          |
|-----------|------------------|
| methane   | CH <sub>4</sub>  |
| water     | H <sub>2</sub> O |
| oxygen    | O <sub>2</sub>   |

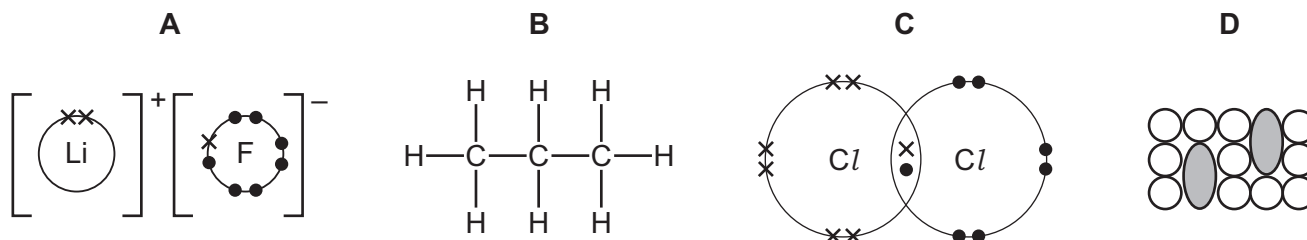
Which statement is correct?

- A Methane is made from five different types of atom.
- B Methane, water and oxygen are molecules.
- C Only methane and water are molecules.
- D Oxygen is made from two different types of atom.

15 What is the definition of nucleon number?

- A the number of protons in an atom
- B the number of electrons in an atom
- C the total number of electrons and neutrons in an atom
- D the total number of neutrons and protons in an atom

16 Which structure represents an ionic compound?



17 Aqueous lead(II) nitrate, Pb(NO<sub>3</sub>)<sub>2</sub>, reacts with aqueous potassium iodide to make a precipitate of lead(II) iodide.

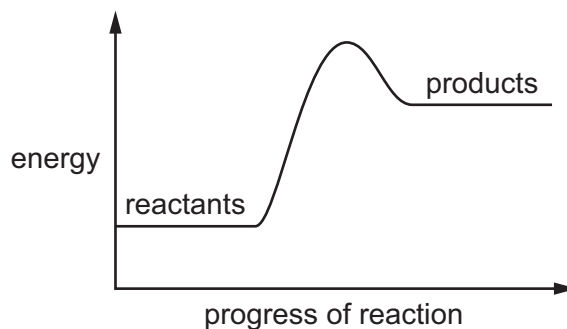
What is the ionic equation for this reaction?

- A  $\text{Pb}^+ + \text{I}^- \rightarrow \text{PbI}$
- B  $\text{Pb}^{2+} + 2\text{I}^- \rightarrow \text{PbI}_2$
- C  $\text{Pb}(\text{NO}_3)_2 + \text{I}^- \rightarrow \text{PbI} + 2\text{NO}_3^-$
- D  $\text{Pb}^{2+} + 2\text{NO}_3^- + 2\text{I}^- \rightarrow \text{PbI}_2 + 2\text{NO}_3^-$

18 Which statement about the electrolysis of ionic substances is correct?

- A Negatively charged ions move to the cathode.
- B At the anode, ions lose electrons.
- C The anions gain electrons during electrolysis.
- D The cations are negatively charged.

19 The energy level diagram for dissolving solid ammonium nitrate in water is shown.



Which statement about this process is correct?

- A Activation energy is given out causing an overall increase in temperature.
- B Energy is taken in to form new bonds at the start of the reaction.
- C During the reaction, the temperature of the water decreases because the reaction takes in energy.
- D The products have a higher energy than the reactants because the reaction is exothermic.

20 Reducing agents are .....1..... in a reaction.

Reducing agents cause the other substance in the reaction to .....2..... oxygen.

Which words complete gaps 1 and 2?

|   | 1        | 2    |
|---|----------|------|
| A | oxidised | gain |
| B | oxidised | lose |
| C | reduced  | gain |
| D | reduced  | lose |

**21** Dilute sulfuric acid reacts with aqueous potassium hydroxide.

What are the products of this reaction?

|          | potassium hydroxide | potassium sulfate | carbon dioxide | water |
|----------|---------------------|-------------------|----------------|-------|
| <b>A</b> | ✓                   | x                 | ✓              | ✓     |
| <b>B</b> | x                   | ✓                 | x              | ✓     |
| <b>C</b> | x                   | ✓                 | ✓              | ✓     |
| <b>D</b> | x                   | ✓                 | x              | x     |

key

✓ = yes

x = no

**22** The results of two tests on solid P are shown.

|   | test                                                       | result                                               |
|---|------------------------------------------------------------|------------------------------------------------------|
| 1 | add aqueous sodium hydroxide to solid                      | gas given off that turns moist red litmus paper blue |
| 2 | dissolve solid in water, add dilute aqueous silver nitrate | white precipitate formed                             |

What is P?

- A** aluminium carbonate
- B** aluminium sulfate
- C** ammonium chloride
- D** ammonium nitrate

**23** Which electronic structure is that of a metal?

- A** 2,8,3
- B** 2,8,4
- C** 2,8,6
- D** 2,8,7

**24** Why are gold alloys, rather than pure gold, used to make jewellery?

- A** Alloys are better electrical conductors.
- B** Alloys are less likely to corrode.
- C** Alloys are harder.
- D** Alloys are less dense.

**25** What is an effect of increasing the amount of carbon dioxide in the atmosphere?

- A** increased acid rain
- B** increased climate change
- C** increased damage to buildings
- D** increased health problems

**26** Which statements about the members of an homologous series are correct?

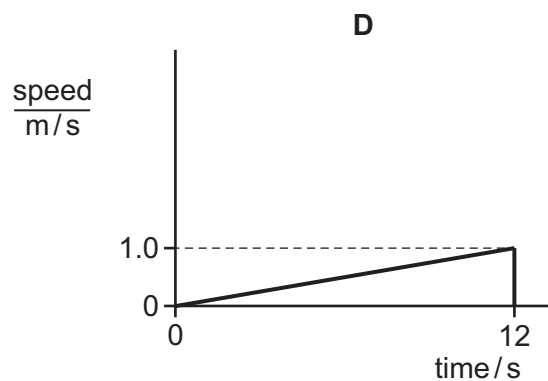
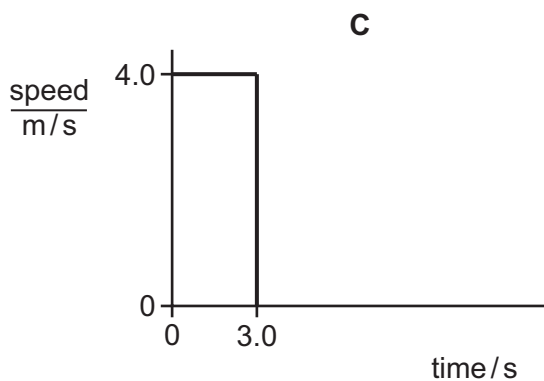
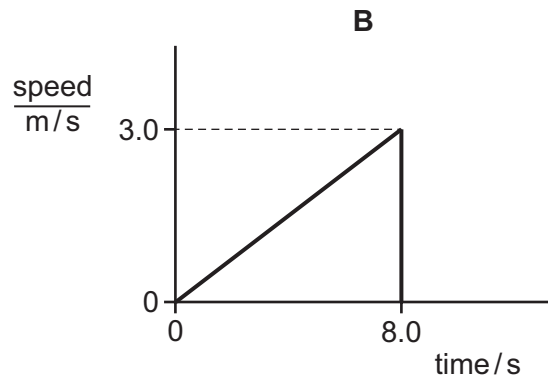
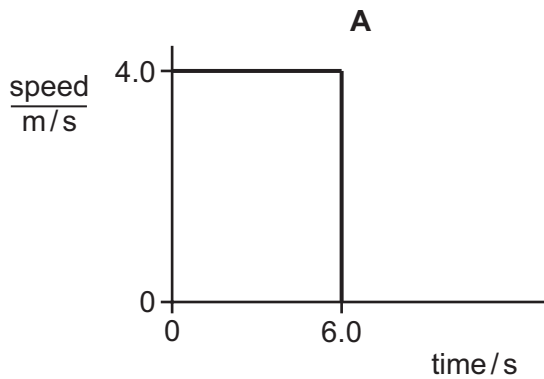
- 1 They have similar chemical properties.
- 2 They have the same boiling points.
- 3 They have the same general formula.

- A** 1, 2 and 3      **B** 1 and 2 only      **C** 1 and 3 only      **D** 2 and 3 only

**27** Which equation represents cracking?

- A**  $\text{C}_6\text{H}_{14} \rightarrow 2\text{C}_3\text{H}_6 + \text{H}_2$
- B**  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
- C**  $n\text{CH}_2=\text{CH}_2 \rightarrow \text{poly(ethene)}$
- D**  $\text{CH}_2=\text{CH}_2 + \text{Br}_2 \rightarrow \text{CH}_2\text{BrCH}_2\text{Br}$

28 Which speed–time graph represents the motion of an object that travels a distance of 24 m?



29 A vehicle is taken from the Earth to the Moon where the gravitational field strength is smaller.

How do the mass and the weight of the vehicle on the Moon compare with their values on the Earth?

- A** smaller mass and smaller weight
- B** smaller mass and the same weight
- C** the same mass and smaller weight
- D** the same mass and the same weight

30 Which form of energy is **not** a form of potential energy?

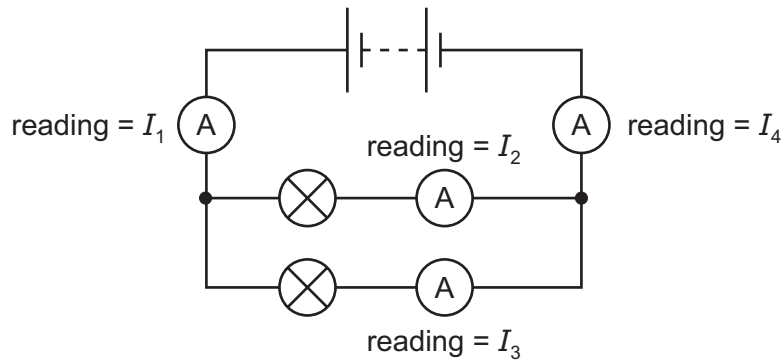
- A** chemical
- B** elastic
- C** gravitational
- D** sound

31 A rock of mass 2000 kg has a kinetic energy of 64 000 J.

What is the speed of the rock?

- A** 5.7 m/s
- B** 8.0 m/s
- C** 32 m/s
- D** 64 m/s

- 32 A circuit contains two lamps and four ammeters. The readings on the ammeters are  $I_1$ ,  $I_2$ ,  $I_3$  and  $I_4$ , as shown.



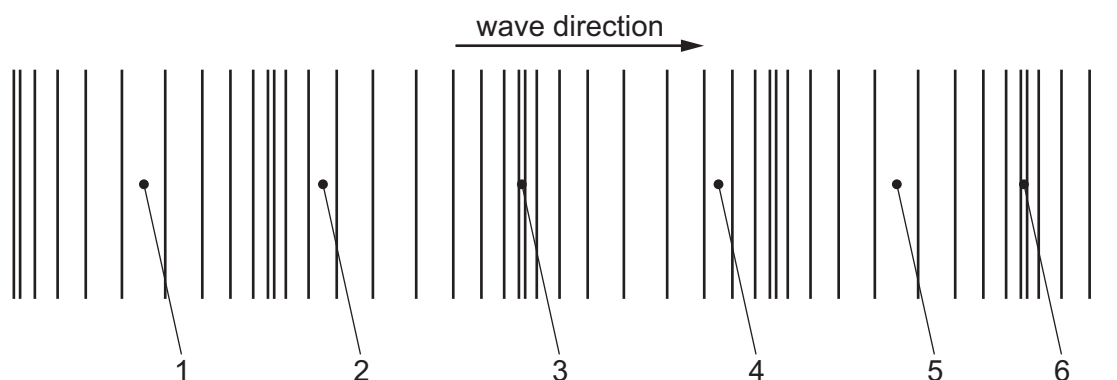
Which equation is correct?

- A**  $I_1 = I_4 = (I_2 + I_3)$
- B**  $(I_1 + I_4) = (I_2 + I_3)$
- C**  $I_1 = I_2 = I_3 = I_4$
- D**  $I_2 = I_3 = (I_1 + I_4)$
- 33 What happens as a liquid starts to evaporate?
- A** The mass of the remaining liquid increases.
- B** The mass of the remaining liquid is constant.
- C** The temperature of the remaining liquid decreases.
- D** The temperature of the remaining liquid increases.
- 34 The temperature of air next to a heater increases. This causes a convection current.

Which row describes what happens to the density of the air next to the heater and states the direction of movement of this air?

|          | density of air | direction of movement of air |
|----------|----------------|------------------------------|
| <b>A</b> | decreases      | downwards                    |
| <b>B</b> | decreases      | upwards                      |
| <b>C</b> | increases      | downwards                    |
| <b>D</b> | increases      | upwards                      |

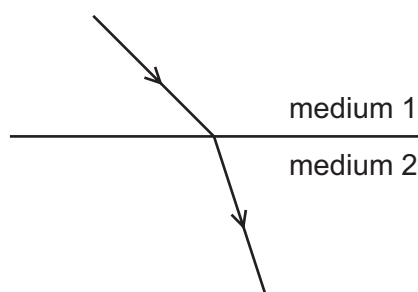
- 35 The diagram represents a sound wave travelling in air.



Which numbered points are at the centre of a compression and which numbered points are at the centre of a rarefaction?

|          | centre of a compression | centre of a rarefaction |
|----------|-------------------------|-------------------------|
| <b>A</b> | 1 and 5                 | 2 and 4                 |
| <b>B</b> | 1 and 5                 | 3 and 6                 |
| <b>C</b> | 3 and 6                 | 1 and 5                 |
| <b>D</b> | 3 and 6                 | 2 and 4                 |

- 36 The diagram shows the change in direction of light as it moves from medium 1 into medium 2.



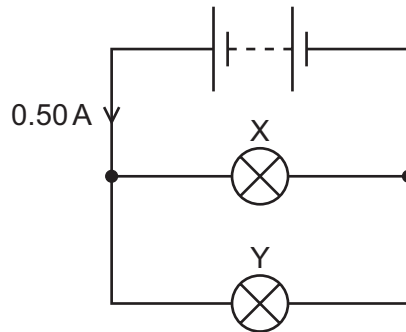
Why does this change of direction happen?

- A** Light is a longitudinal wave in medium 1 but a transverse wave in medium 2.
- B** Light is a transverse wave in medium 1 but a longitudinal wave in medium 2.
- C** The frequency of the light changes as it moves from medium 1 into medium 2.
- D** The speed of the light changes as it moves from medium 1 into medium 2.

- 37** A student uses a thin converging lens as a magnifying glass to view an object.

Where is the object placed?

- A** as far away as possible from the lens
  - B** at a distance from the lens that is slightly greater than the focal length of the lens
  - C** at a distance from the lens that is less than the focal length of the lens
  - D** between the lens and the student's eye
- 38** A battery is connected to two identical lamps X and Y in parallel.



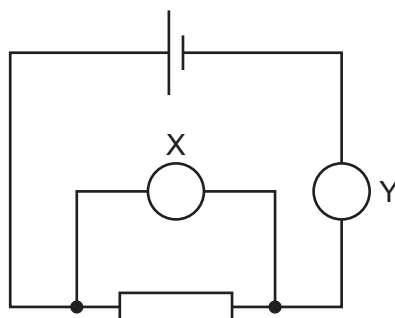
The current in the battery is 0.50 A.

How much charge flows through lamp Y in 10 s?

- A** 0.025 C
- B** 0.050 C
- C** 2.5 C
- D** 5.0 C

- 39 The diagram shows a cell connected to a resistor and two meters, X and Y.

The circuit is used when determining the resistance of the resistor.



What are the quantities measured by meters X and Y, and what are their correct units?

|          | meter X  |      | meter Y  |      |
|----------|----------|------|----------|------|
|          | quantity | unit | quantity | unit |
| <b>A</b> | current  | A    | p.d.     | V    |
| <b>B</b> | current  | V    | p.d.     | A    |
| <b>C</b> | p.d.     | A    | current  | V    |
| <b>D</b> | p.d.     | V    | current  | A    |

- 40 An electrical appliance with a resistance of  $600\ \Omega$  is connected to a  $240\ \text{V}$  supply.

Which fuse rating is appropriate to protect the appliance and the wires from overheating if a fault occurs?

- A**  $0.04\ \text{A}$       **B**  $0.5\ \text{A}$       **C**  $5\ \text{A}$       **D**  $13\ \text{A}$

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                             |                              |                         |  |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|-----------------------------|------------------------------|-------------------------|--|
| I                          | II                          |                                                                                             |                             |                                 |                              |                              |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                          | VIII                        |                              |                         |  |
|                            |                             | <div>1<br/>H<br/>hydrogen<br/>1</div>                                                       |                             |                                 |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                             |                              |                         |  |
|                            |                             | <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     |                         |  |
| 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   | 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>— | 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>— | 113<br>Nh<br>nihonium<br>—  | 114<br>Fl<br>flerovium<br>— | 115<br>Mc<br>moscovium<br>— | 116<br>Lv<br>livermorium<br>— | 117<br>Ts<br>tennessine<br>— | 118<br>Og<br>oganesson<br>— |                              |                         |  |

|             |                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|-------------|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| lanthanoids | 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  |
| actinoids   | 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.).



# Cambridge IGCSE™

## COMBINED SCIENCE

Paper 2 Multiple Choice (Extended)

0653/23

May/June 2023

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

### INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



1 What is a characteristic of all living things?

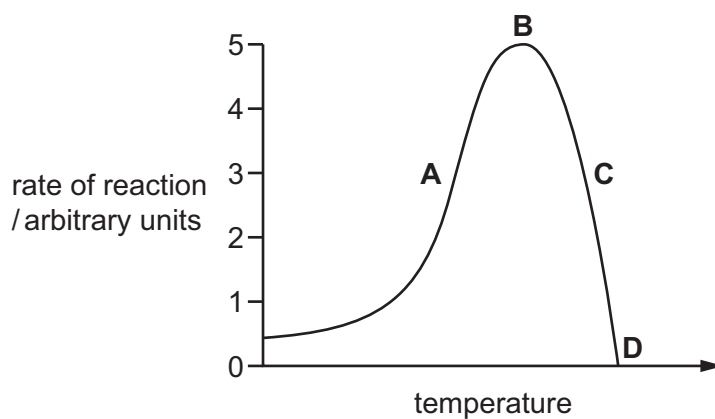
- A egestion
- B ingestion
- C nutrition
- D photosynthesis

2 Which structure is found only in plant cells?

- A cell membrane
- B cytoplasm
- C large vacuole
- D nucleus

3 The graph shows how the rate of an enzyme-controlled reaction varies with temperature.

At which labelled point does the enzyme have the least kinetic energy?



4 In plants, which energy transfer occurs in chlorophyll during photosynthesis?

- A chemical to light
- B heat to chemical
- C light to chemical
- D chemical to heat

5 Which row matches the part of the alimentary canal to its function?

|          | part of the alimentary canal | function of part |
|----------|------------------------------|------------------|
| <b>A</b> | anus                         | absorption       |
| <b>B</b> | oesophagus                   | digestion        |
| <b>C</b> | mouth                        | ingestion        |
| <b>D</b> | small intestines             | egestion         |

6 The list gives two ways in which an environment changes.

- 1 humidity increases
- 2 temperature increases

Which changes cause an increase in the rate of transpiration of plants?

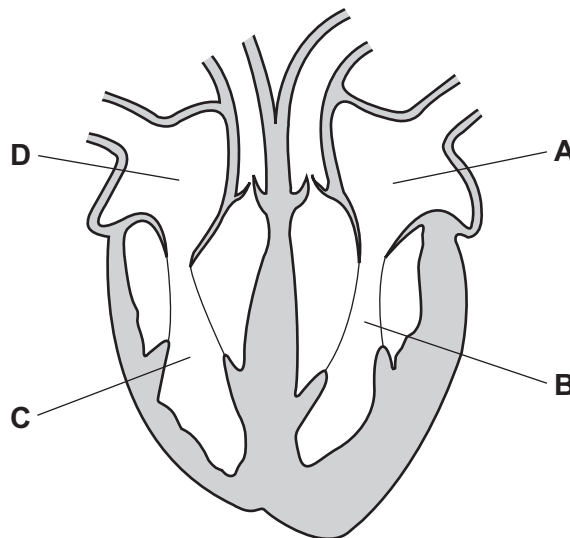
|          | 1 | 2 |
|----------|---|---|
| <b>A</b> | ✓ | ✓ |
| <b>B</b> | ✓ | x |
| <b>C</b> | x | ✓ |
| <b>D</b> | x | x |

key

✓ = increase in rate of transpiration

x = decrease in rate of transpiration

7 From which chamber does the blood leave the heart to travel to the organs of the body?



8 Which processes require energy?

- 1 growth
- 2 maintenance of body temperature
- 3 protein synthesis

**A** 1, 2 and 3      **B** 1 only      **C** 2 and 3 only      **D** 3 only

9 What is caused by the secretion of adrenaline?

|          | blood glucose concentration | pulse rate | pupil size |
|----------|-----------------------------|------------|------------|
| <b>A</b> | decreases                   | decreases  | increases  |
| <b>B</b> | decreases                   | increases  | decreases  |
| <b>C</b> | increases                   | decreases  | decreases  |
| <b>D</b> | increases                   | increases  | increases  |

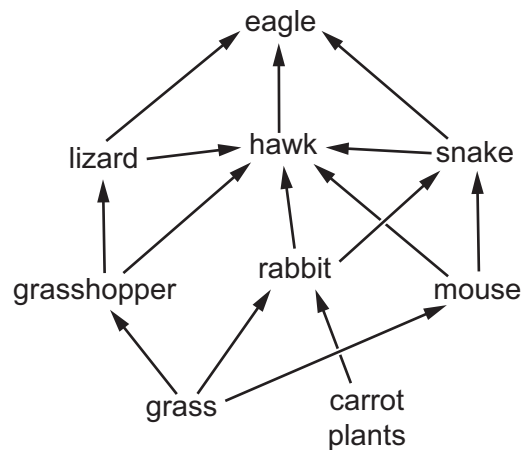
10 Which definition of asexual reproduction is correct?

- A** production of genetically different offspring from one parent
- B** production of genetically different offspring from two parents
- C** production of genetically identical offspring from one parent
- D** production of genetically identical offspring from two parents

11 Which row shows the correct information about a human female gamete?

|          | contains an energy store | can swim |
|----------|--------------------------|----------|
| <b>A</b> | ✓                        | ✗        |
| <b>B</b> | ✓                        | ✓        |
| <b>C</b> | ✗                        | ✓        |
| <b>D</b> | ✗                        | ✗        |

12 The diagram shows part of a food web.



Which row shows the numbers of different types of consumers present in this food web?

|          | primary consumers | secondary consumers | tertiary consumers | quaternary consumers |
|----------|-------------------|---------------------|--------------------|----------------------|
| <b>A</b> | 2                 | 3                   | 3                  | 1                    |
| <b>B</b> | 2                 | 2                   | 1                  | 0                    |
| <b>C</b> | 3                 | 3                   | 1                  | 2                    |
| <b>D</b> | 3                 | 3                   | 2                  | 1                    |

13 Eutrophication typically occurs as the result of nitrates and other ions accumulating in bodies of water. Eutrophication involves the five processes listed.

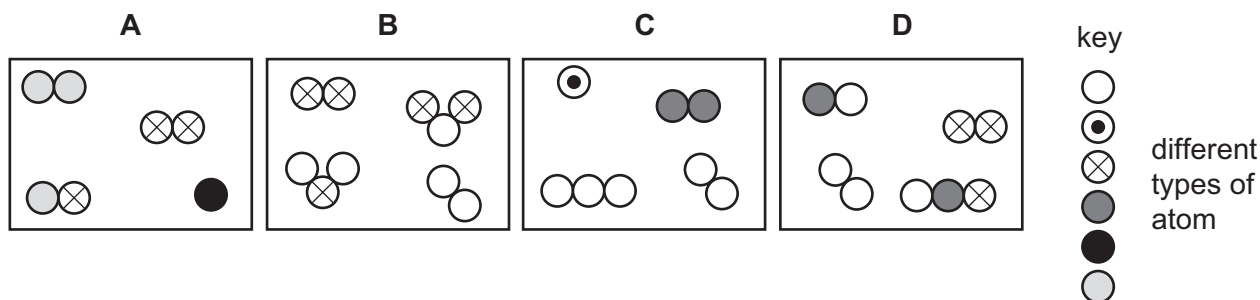
- 1 death of organisms that require dissolved oxygen
- 2 increased aerobic respiration by decomposers
- 3 increased decomposition after death of producers
- 4 increased growth of producer organisms
- 5 reduction of amount of dissolved oxygen in water

Which sequence of processes is correct?

- A** 1 → 3 → 2 → 4 → 5
- B** 4 → 3 → 2 → 5 → 1
- C** 1 → 2 → 4 → 3 → 5
- D** 4 → 5 → 3 → 2 → 1

14 The diagrams show four different mixtures of gases.

Which diagram represents a mixture containing **only** elements?

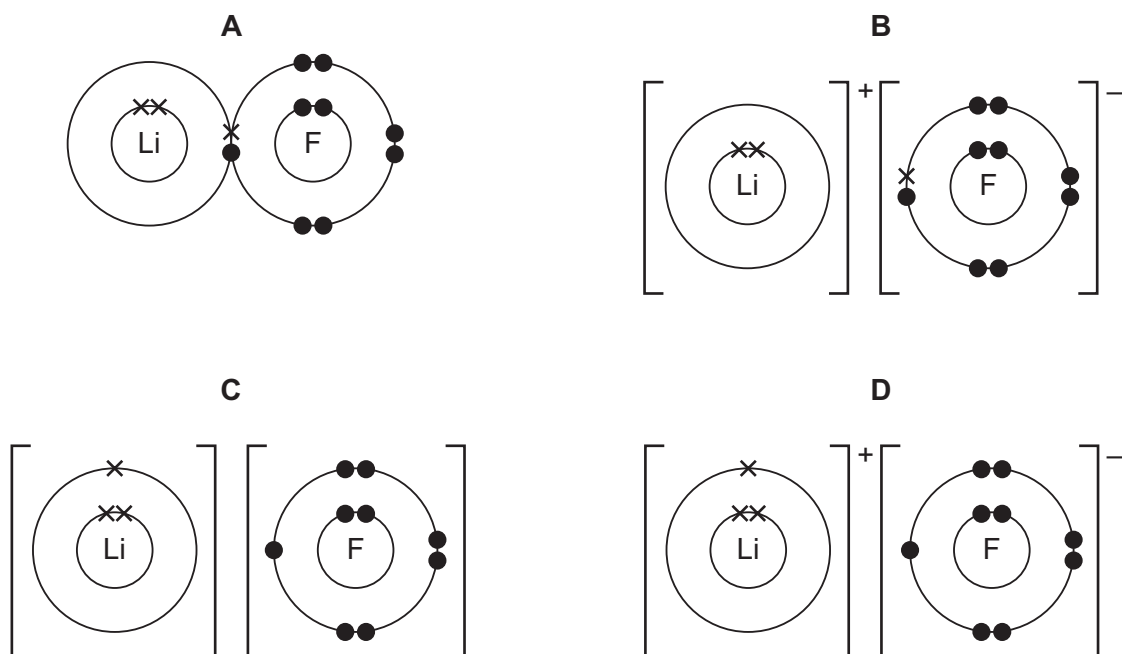


15 The nucleon number of an atom of chlorine is 35.

Which statement about this atom is correct?

- A** It contains the same number of neutrons as electrons.
- B** It contains the same number of protons as neutrons.
- C** It contains the same number of protons as electrons.
- D** The numbers of protons, neutrons and electrons are all different from each other.

16 Which dot-and-cross diagram represents lithium fluoride, LiF?



- 17 Aqueous sodium sulfate reacts with aqueous barium chloride to make barium sulfate and sodium chloride.

What is the ionic equation for this reaction?

- A  $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{aq})$   
 B  $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$   
 C  $\text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{NaCl}(\text{s})$   
 D  $\text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{NaCl}(\text{aq})$

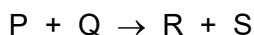
- 18 Dilute sulfuric acid is electrolysed using inert electrodes.

The concentration of two ions decreases during this process.

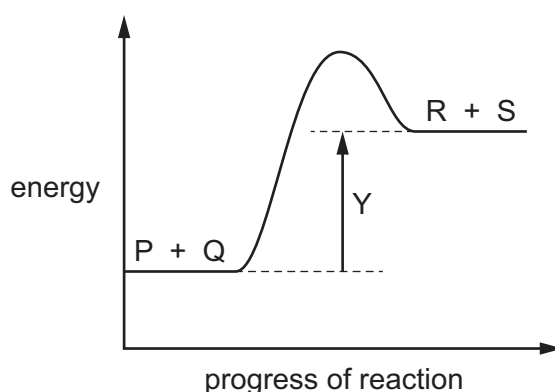
What are these ions?

- A hydrogen ions and oxide ions  
 B hydrogen ions and hydroxide ions  
 C hydroxide ions and sulfate ions  
 D oxide ions and sulfate ions

- 19 Substances P and Q react together.



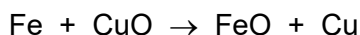
The energy level diagram for this reaction is shown.



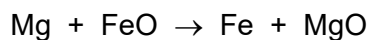
Which statement about this reaction is correct?

- A Arrow Y represents the activation energy.  
 B The energy given out forming the bonds in R and S is less than the energy used to break the bonds in P and Q.  
 C The reaction is exothermic.  
 D The temperature increases when P reacts with Q because R and S have more energy than P and Q.

- 20 Iron displaces copper from copper oxide.



Magnesium displaces iron from iron oxide.



Which statement about these reactions is correct?

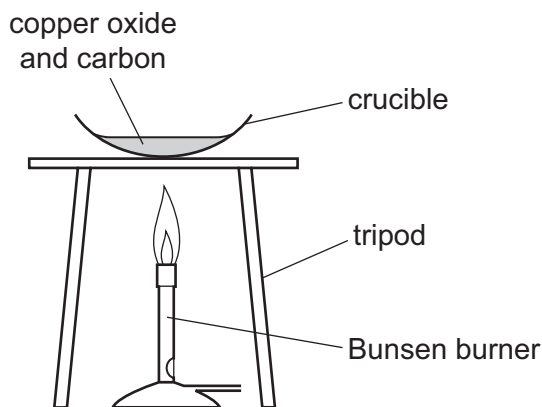
- A Copper oxide and iron oxide are being oxidised.
  - B Iron is a stronger oxidising agent than copper.
  - C Magnesium and iron are being reduced.
  - D Magnesium is a stronger reducing agent than iron.
- 21 Which two substances both react with dilute sulfuric acid to make the salt magnesium sulfate?
- A magnesium carbonate and magnesium chloride
  - B magnesium chloride and magnesium nitrate
  - C magnesium oxide and magnesium carbonate
  - D magnesium oxide and magnesium nitrate
- 22 The results of two tests on a white solid are shown.

|   | test                         | result                   |
|---|------------------------------|--------------------------|
| 1 | add aqueous sodium hydroxide | white precipitate formed |
| 2 | add dilute hydrochloric acid | colourless gas formed    |

What is the white solid?

- A iron(II) carbonate
  - B iron(II) chloride
  - C zinc carbonate
  - D zinc chloride
- 23 Which statement explains how a greater number of outer-shell electrons affects the metallic character of an element?
- A The element is more metallic because electrons are lost less easily.
  - B The element is more metallic because electrons are lost more easily.
  - C The element is less metallic because electrons are lost less easily.
  - D The element is less metallic because electrons are lost more easily.

24 Copper oxide is heated with carbon as shown.



Which statement about this experiment is correct?

- A A pink-brown solid is formed.
- B Carbon is placed underneath the copper oxide so that the air can react with the hot copper oxide.
- C Carbon reacts with the air to form carbon dioxide which then reacts with the copper oxide.
- D Copper is more reactive than carbon.

25 Some gases in air are listed.

- 1 carbon dioxide
- 2 oxygen
- 3 methane
- 4 sulfur dioxide

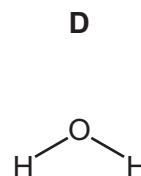
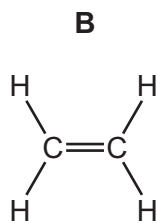
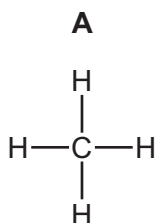
Which gases cause an enhanced greenhouse effect when their concentration in the air increases?

- A 1 and 2      B 1 and 3      C 2 and 4      D 3 and 4

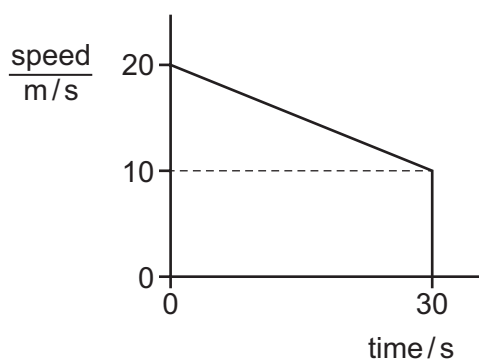
26 Which statement about all alkanes is correct?

- A They contain the same number of carbon atoms.
- B They have different chemical properties.
- C They have the same general formula.
- D They have the same melting point.

- 27 Which structure represents a molecule that is **not** formed during cracking of large alkane molecules?

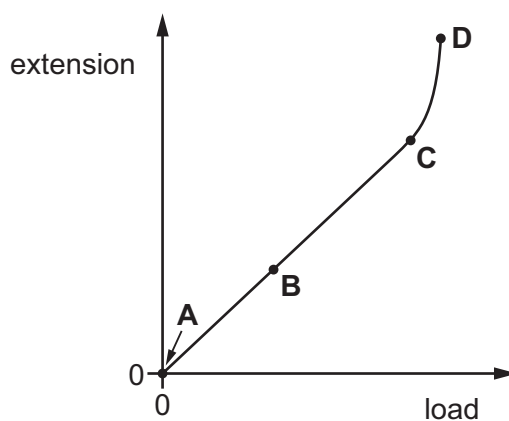


- 28 The diagram shows the speed–time graph for a moving object.



What is the distance travelled by the object in 30 s?

- A** 150 m      **B** 300 m      **C** 450 m      **D** 600 m
- 29 Which statement about mass and weight is correct?
- A** Mass and weight are different types of force.
- B** The mass of an object depends on the strength of the gravitational field in which it is placed.
- C** The mass of an object is the same on the Moon as it is on the Earth.
- D** The unit of weight is the kilogram.
- 30 The diagram shows an extension–load graph for a spring.
- Which labelled point shows the limit of proportionality for the spring?



- 31** A block of metal has a mass of 2.0 kg. The area of contact between the block and a horizontal surface is  $100 \text{ cm}^2$ .

The gravitational field strength is  $10 \text{ N/kg}$ .

What is the pressure on the surface due to the block?

- A**  $0.020 \text{ N/cm}^2$     **B**  $0.20 \text{ N/cm}^2$     **C**  $5.0 \text{ N/cm}^2$     **D**  $50 \text{ N/cm}^2$

- 32** An object has speed  $v$  and kinetic energy  $E$ .

What is the mass of the object?

- A**  $\frac{E}{v}$                       **B**  $\frac{2E}{v}$                       **C**  $\frac{E}{v^2}$                       **D**  $\frac{2E}{v^2}$

- 33** The generator in a power station is rotated by a turbine. Steam from boiling water rotates the turbine.

Which energy source is used to produce electricity in this way?

- A** hydroelectric energy  
**B** nuclear fission  
**C** tidal energy  
**D** wind energy

- 34** Which statement describes the molecules in a gas?

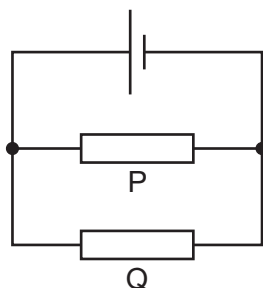
- A** They are close together and move about quickly.  
**B** They are close together and move about slowly.  
**C** They are far apart and move about quickly.  
**D** They are far apart and move about slowly.

- 35** A student investigates the rate of evaporation of water.

Which changes produce the greatest increase in the rate of evaporation of the water?

- A** doubling its temperature and doubling its surface area  
**B** doubling its temperature and halving its surface area  
**C** halving its temperature and doubling its surface area  
**D** halving its temperature and halving its surface area

- 36 Two resistors P and Q are connected in parallel to a cell, as shown.



The resistance of resistor P is greater than the resistance of resistor Q.

Which row gives the relationship between the currents in P and Q, and between the potential differences across P and Q?

|          | current          | potential difference (p.d.) |
|----------|------------------|-----------------------------|
| <b>A</b> | P greater than Q | P different to Q            |
| <b>B</b> | P greater than Q | P the same as Q             |
| <b>C</b> | Q greater than P | P different to Q            |
| <b>D</b> | Q greater than P | P the same as Q             |

- 37 A sound wave passes through air.

Which type of wave is a sound wave and in which direction do the air particles vibrate?

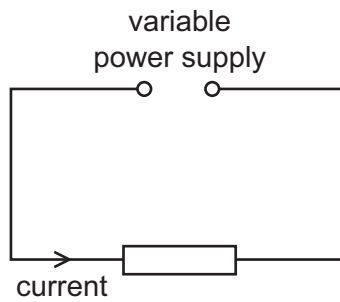
|          | type of wave | direction of vibration          |
|----------|--------------|---------------------------------|
| <b>A</b> | longitudinal | parallel to wave direction      |
| <b>B</b> | longitudinal | perpendicular to wave direction |
| <b>C</b> | transverse   | parallel to wave direction      |
| <b>D</b> | transverse   | perpendicular to wave direction |

- 38 The speed of light  $c$  in a vacuum is  $3.0 \times 10^8 \text{ m/s}$ .

Which row relates other speeds to  $c$ ?

|          | speed of light in glass | speed of infrared waves in a vacuum |
|----------|-------------------------|-------------------------------------|
| <b>A</b> | equal to $c$            | equal to $c$                        |
| <b>B</b> | equal to $c$            | different from $c$                  |
| <b>C</b> | different from $c$      | equal to $c$                        |
| <b>D</b> | different from $c$      | different from $c$                  |

- 39** A variable power supply is connected to a resistor and there is a current in the resistor.



The potential difference (p.d.) across the resistor is decreased.

The temperature of the resistor does not change.

What happens to the current in the resistor and what happens to the resistance of the resistor?

|          | current   | resistance     |
|----------|-----------|----------------|
| <b>A</b> | decreases | increases      |
| <b>B</b> | decreases | stays the same |
| <b>C</b> | increases | decreases      |
| <b>D</b> | increases | stays the same |

- 40** An electric heater has a label stating this information: 240 V, 2400 W, 10 A.

What is written on a fuse with a rating that is appropriate for use with this heater?

- A** 5 A                      **B** 13 A                      **C** 230 V                      **D** 250 V

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| Group                      |                             |                                                                                             |  |  |  |  |  |  |  |  |  |                                 |                             |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                            |                           |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|---------------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|----------------------------|---------------------------|
| I                          | II                          |                                                                                             |  |  |  |  |  |  |  |  |  | III                             | IV                          | V                            | VI                           | VII                          | VIII                         |                                |                               |                               |                             |                             |                             |                               |                              |                            |                           |
|                            |                             | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |  |  |  |  |  |  |  |  |  | 1<br>H<br>hydrogen<br>1         |                             |                              |                              |                              |                              |                                |                               |                               |                             |                             |                             |                               |                              |                            |                           |
| 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>—    | 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>— | 113<br>Nh<br>nihonium<br>—  | 114<br>Fl<br>flerovium<br>— | 115<br>Mc<br>moscovium<br>— | 116<br>Lv<br>livermorium<br>— | 117<br>Ts<br>tennessine<br>— | 118<br>Og<br>oganeson<br>— |                           |

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