



# Cambridge IGCSE™

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## CO-ORDINATED SCIENCES

0654/22

Paper 2 Multiple Choice (Extended)

February/March 2021

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)

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### 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.

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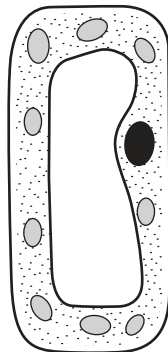
This document has **16** pages.



1 Which statement defines excretion?

- A the chemical reactions in cells that break down nutrient molecules and release energy for metabolism
- B the removal from organisms of the waste products of metabolism
- C the taking in of materials for energy, growth and development
- D the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses

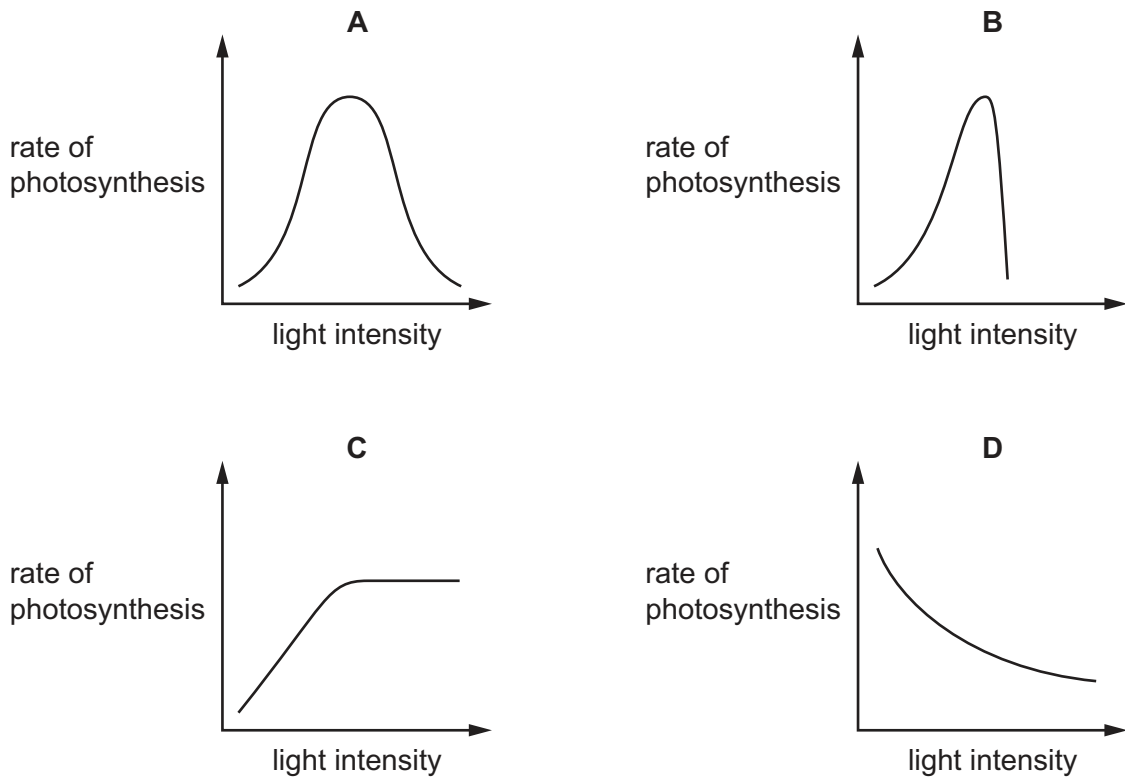
2 The diagram shows an incomplete plant cell.



Which structure is **not** shown?

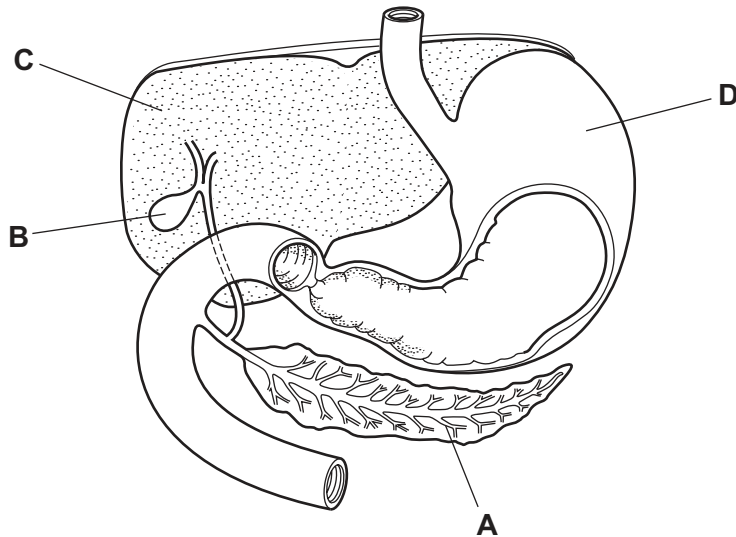
- A cell membrane
  - B cell wall
  - C chloroplast
  - D vacuole
- 3 What are the molecules that make up fats and oils?
- A amino acids and glycerol
  - B fatty acids and glycerol
  - C glucose and amino acids
  - D glucose and fatty acids
- 4 What are biological catalysts?
- A antibodies
  - B enzymes
  - C hormones
  - D platelets

5 Which graph shows the effect of increasing light intensity on the rate of photosynthesis?



6 The diagram shows part of the alimentary canal and associated organs.

Where is lipase produced?



7 In which weather conditions is the rate of transpiration fastest?

- A cold and dry
- B cold and wet
- C warm and dry
- D warm and wet

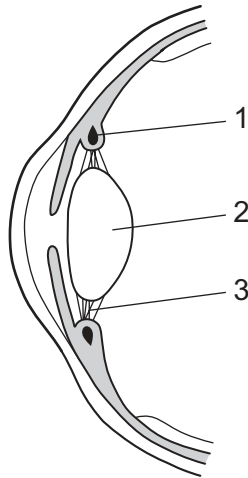
8 When a person was walking or running, the following measurements were taken.

| speed / km per hour | number of breaths per minute | volume of each breath / dm <sup>3</sup> |
|---------------------|------------------------------|---|
| 4                   | 16                           | 1                                       |
| 6                   | 18                           | 2                                       |
| 8                   | 20                           | 3                                       |

How many dm<sup>3</sup> of air did the person breathe per minute when running at 6 km per hour?

- A 18
- B 36
- C 60
- D 108

9 The diagram shows structures in a section through the front of the eye.



When reading a book, how are the labelled structures involved in focusing the eye?

|   | 1         | 2       | 3        |
|---|-----------|---------|----------|
| A | contracts | thicker | slackens |
| B | contracts | thinner | tightens |
| C | relaxes   | thicker | tightens |
| D | relaxes   | thinner | slackens |

10 Which features are adaptations of wind-pollinated flowers?

- 1 anthers exposed to the wind
- 2 produce heavy sticky pollen
- 3 produce large quantities of pollen
- 4 brightly coloured petals
- 5 produce nectar

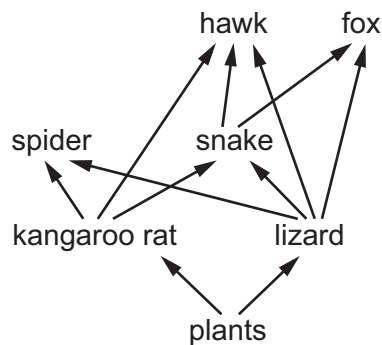
**A** 1, 2 and 3      **B** 3, 4 and 5      **C** 1 and 3 only      **D** 4 and 5 only

11 Selective breeding is used to improve crop plants.

What does it involve?

- A** artificial selection
- B** asexual reproduction
- C** ionising radiation
- D** natural selection

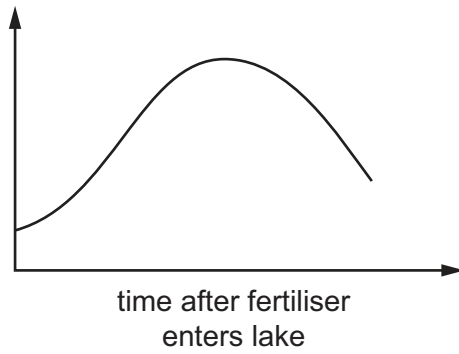
12 The diagram shows a food web.



How many organisms act as secondary consumers in this food web?

**A** 2                      **B** 3                      **C** 4                      **D** 6

13 The graph shows changes during eutrophication.



What could be the label for the vertical (y) axis?

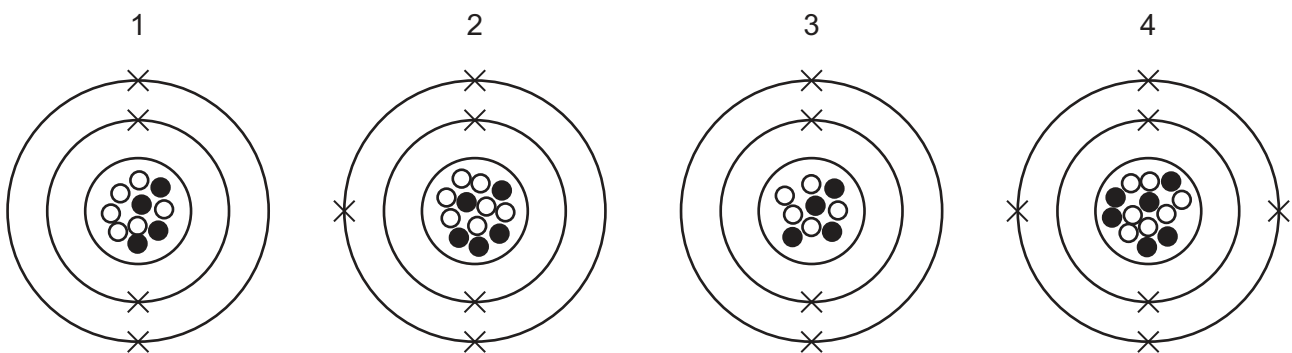
- 1 growth of producers
- 2 number of aerobic bacteria
- 3 rate of decomposition

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

14 Which process is used to separate a mixture of coloured compounds?

- A** chromatography
- B** distillation
- C** evaporation
- D** filtration

15 The electronic structures of four isotopes are shown.



key  
 ● proton  
 ○ neutron  
 × electron

Which isotopes have the same chemical properties?

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

16 What is the mass of hydrogen in 51 g of ammonia,  $\text{NH}_3$ ?

- A 3g                      B 9g                      C 14g                      D 17g

17 Molten lead(II) bromide is electrolysed.

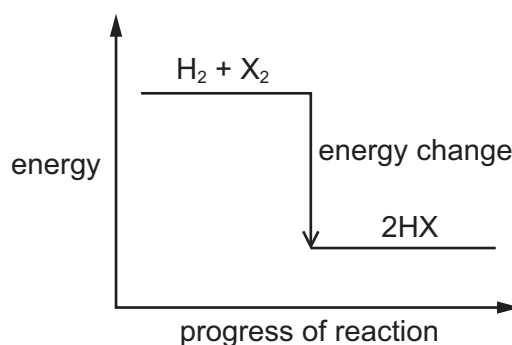
Which equation represents the reaction at the cathode?

- A  $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$   
 B  $\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$   
 C  $\text{Pb}^{2+} \rightarrow \text{Pb} + 2\text{e}^-$   
 D  $\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$

18 The diagram shows the energy change for the reactions between hydrogen and the halogens.

The reaction is  $\text{H}_2 + \text{X}_2 \rightarrow 2\text{HX}$ .

The size of the energy change is different for each halogen.



The diagram shows that the reactions are .....1..... .

The most reactive halogen is .....2..... and therefore the energy change for this element is .....3..... .

Which words complete gaps 1, 2 and 3?

|          | 1           | 2        | 3        |
|----------|-------------|----------|----------|
| <b>A</b> | endothermic | fluorine | least    |
| <b>B</b> | endothermic | iodine   | least    |
| <b>C</b> | exothermic  | fluorine | greatest |
| <b>D</b> | exothermic  | iodine   | greatest |

19 In which equation is the underlined substance acting as an oxidising agent?

- A  $\text{CuO} + \underline{\text{H}_2} \rightarrow \text{Cu} + \text{H}_2\text{O}$   
B  $\text{CuSO}_4 + \underline{\text{Mg}} \rightarrow \text{MgSO}_4 + \text{Cu}$   
C  $\text{H}_2 + \underline{\text{Cl}_2} \rightarrow 2\text{HCl}$   
D  $\underline{\text{Zn}} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

20 A label from a packet of indigestion tablets is shown.

|                       |        |
|-----------------------|--------|
| Each tablet contains: |        |
| magnesium carbonate   | 120 mg |
| magnesium hydroxide   | 15 mg  |
| magnesium oxide       | 62 mg  |
| magnesium sulfate     | 47 mg  |

Which substance does **not** neutralise stomach acid?

- A magnesium carbonate  
B magnesium hydroxide  
C magnesium oxide  
D magnesium sulfate

21 Substance X is insoluble in water.

It reacts with dilute nitric acid to produce solution Y and a gas which turns limewater milky.

A white precipitate is formed when aqueous sodium hydroxide is added to solution Y. This precipitate remains when excess sodium hydroxide is added.

What is substance X?

- A calcium carbonate  
B calcium chloride  
C zinc carbonate  
D zinc chloride



22 Astatine is below iodine in Group VII of the Periodic Table.

Which statements about astatine are correct?

- 1 It is monoatomic.
- 2 It is a solid at room temperature.
- 3 It is lighter in colour than iodine.
- 4 It does not react with aqueous potassium iodide.

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

23 Which elements in the Periodic Table form coloured compounds?

- A** Group I metals
- B** halogens
- C** noble gases
- D** transition metals

24 Part of the reactivity series is shown.

aluminium  
(carbon)  
iron  
lead  
copper  
gold

Which statement is correct?

- A** Aluminium can be extracted by heating its oxide with carbon.
- B** Gold forms an oxide which cannot be reduced by heating with aluminium.
- C** Iron cannot be extracted by heating its oxide with carbon.
- D** Lead can be extracted by heating its oxide with carbon.

25 Which statement about the Haber process is correct?

- A** All of the raw materials are obtained from the air.
- B** It requires a catalyst.
- C** It uses a low pressure and a high temperature.
- D** Sulfuric acid is produced in the process.

26 Naphtha is obtained from petroleum.

What is a use for naphtha?

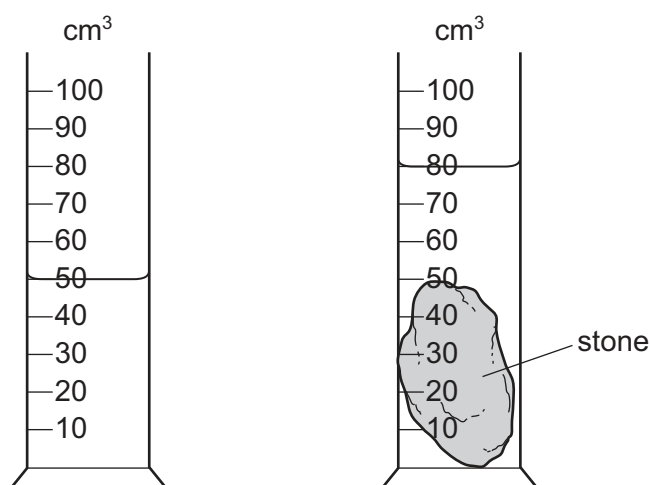
- A cooking
- B making chemicals
- C heating
- D making roads

27 Ethanol is manufactured by reacting ethene with steam in the presence of a catalyst.

Which type of reaction occurs?

- A addition
- B oxidation
- C polymerisation
- D reduction

28 A stone of mass 60g is placed in a measuring cylinder containing water. The water level in the measuring cylinder rises as shown.

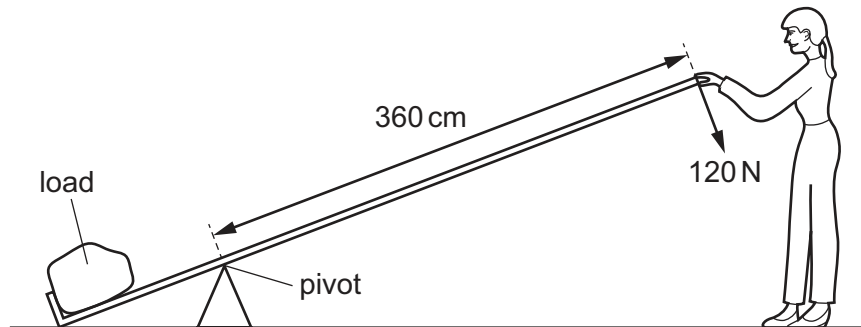


What is the density of the stone?

- A 0.50g/cm<sup>3</sup>
- B 0.75g/cm<sup>3</sup>
- C 1.3g/cm<sup>3</sup>
- D 2.0g/cm<sup>3</sup>

- 29 A scientist uses a lever to lift a heavy load.

She applies a force of 120 N at a distance of 360 cm from a pivot.



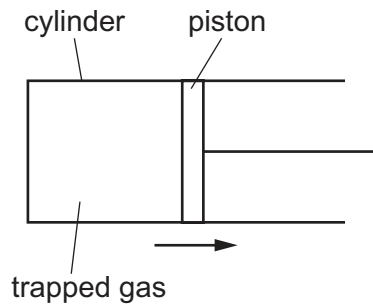
What is the moment about the pivot of the force applied by the scientist?

- A** 3.0 Nm      **B** 33.3 Nm      **C** 432 Nm      **D** 43 200 Nm
- 30 A crane lifts a load of mass 300 kg through a height of 20 m in 1.0 minute. The gravitational field strength  $g$  is 10 N/kg.
- What is the average power output of the crane during this task?
- A** 600 W      **B** 1000 W      **C** 36 000 W      **D** 60 000 W
- 31 In a room, hot air above a heater rises and is replaced by cool air that falls.

What is the name of this process, and how does the density of the hot air compare with the density of the cool air?

|          | process    | density of hot air    |
|----------|------------|-----------------------|
| <b>A</b> | conduction | greater than cool air |
| <b>B</b> | conduction | less than cool air    |
| <b>C</b> | convection | greater than cool air |
| <b>D</b> | convection | less than cool air    |

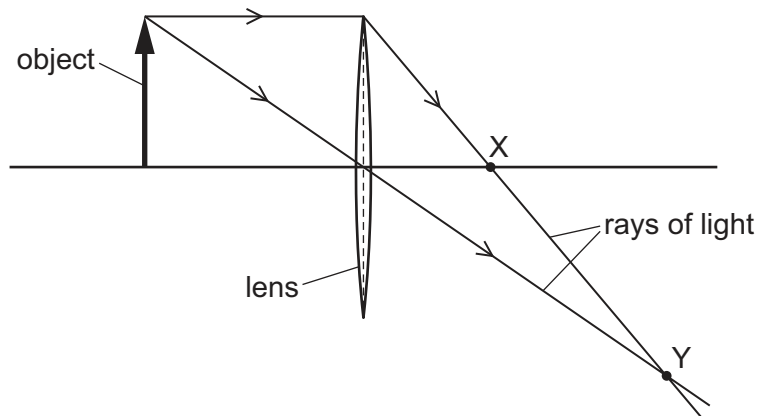
- 32 A fixed mass of gas is trapped in a cylinder by a piston, as shown. The volume of the gas is increased at constant temperature by moving the piston to the right, as shown.



What effect does this have on the average speed of the molecules and on how many collisions are made by the molecules with the piston each second?

|          | average speed of molecules | number of collisions each second |
|----------|----------------------------|----------------------------------|
| <b>A</b> | increases                  | decreases                        |
| <b>B</b> | increases                  | increases                        |
| <b>C</b> | unchanged                  | decreases                        |
| <b>D</b> | unchanged                  | increases                        |

- 33 The diagram shows two rays of light that have passed from an object through a converging lens.



Which labelled point X or Y is a principal focus of the lens, and how does the size of the image compare with the size of the object?

|          | principal focus | size of image       |
|----------|-----------------|---------------------|
| <b>A</b> | X               | larger than object  |
| <b>B</b> | X               | smaller than object |
| <b>C</b> | Y               | larger than object  |
| <b>D</b> | Y               | smaller than object |

34 Sound travels at different speeds in water, in steel and in air.

Each row in the table gives the three speeds at room temperature.

Which row gives the speeds in the correct columns?

|          | <u>speed of sound in water</u><br>m/s | <u>speed of sound in steel</u><br>m/s | <u>speed of sound in air</u><br>m/s |
|----------|---------------------------------------|---------------------------------------|-------------------------------------|
| <b>A</b> | 300                                   | 1500                                  | 4500                                |
| <b>B</b> | 300                                   | 4500                                  | 1500                                |
| <b>C</b> | 1500                                  | 4500                                  | 300                                 |
| <b>D</b> | 4500                                  | 1500                                  | 300                                 |

35 What is meant by an electric field?

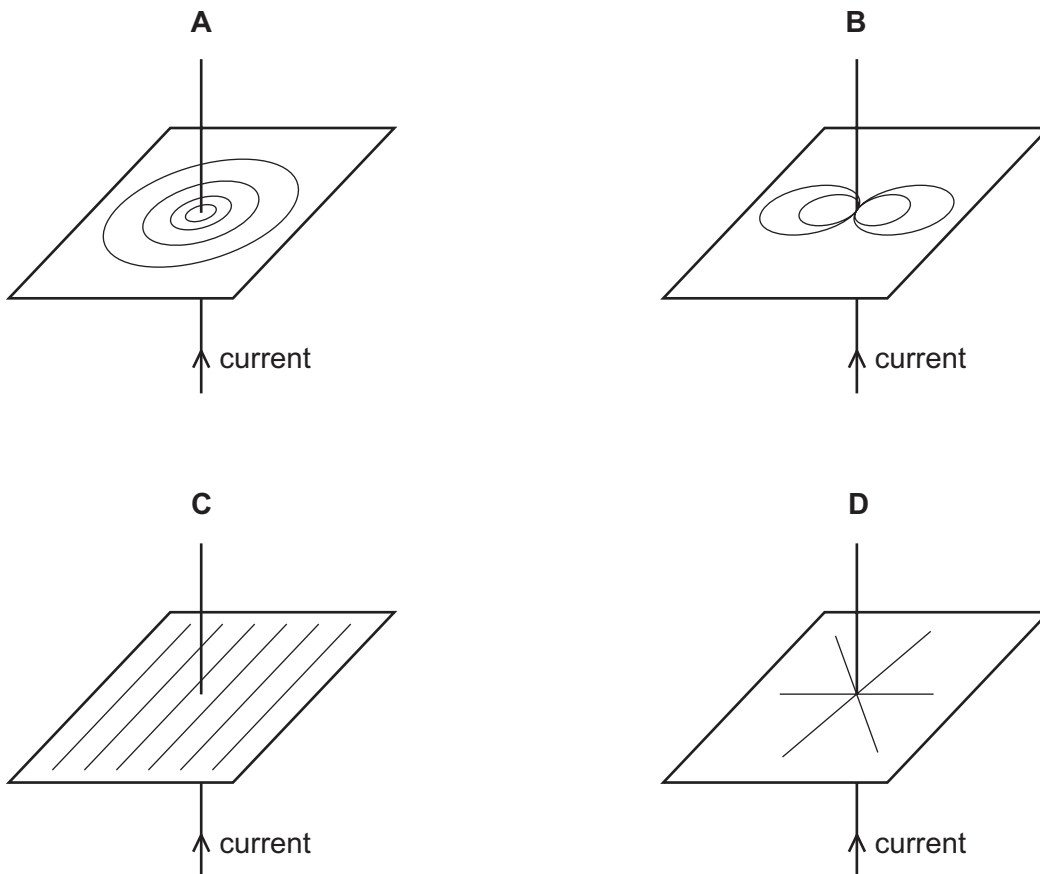
- A** a region in which a charge experiences a force
- B** a region in which a current experiences a force
- C** a region in which a magnetic pole experiences a force
- D** a region in which a mass experiences a force

36 The electromotive force (e.m.f.) of a battery is 2.0 V.

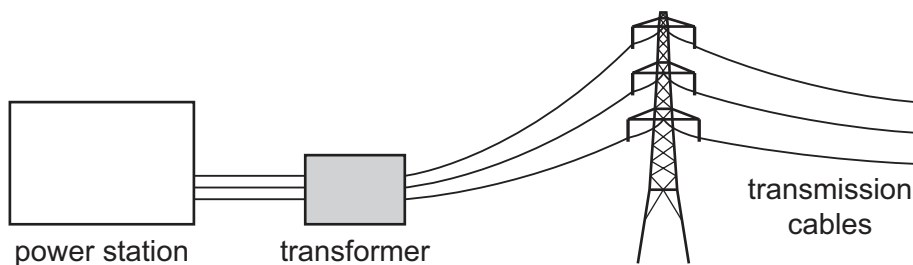
Which statement is correct?

- A** The battery supplies 0.50 J of energy for every 1.0 C of charge driven around the circuit.
- B** The battery supplies 0.50 J of energy for every 2.0 C of charge driven around the circuit.
- C** The battery supplies 2.0 J of energy for every 1.0 C of charge driven around the circuit.
- D** The battery supplies 2.0 J of energy for every 2.0 C of charge driven around the circuit.

37 Which diagram shows the pattern of the magnetic field due to a current in a straight wire?



38 Electrical energy from a power station is transmitted over a large distance. A 100% efficient transformer is used near to the power station. This transformer reduces the amount of energy that is wasted thermally in the transmission cables.



How does the transformer reduce the amount of energy that is wasted?

- A It decreases the power transmitted so the current and the voltage are both larger.
- B It decreases the power transmitted so the current and the voltage are both smaller.
- C It increases the current so the voltage is smaller.
- D It increases the voltage so the current is smaller.

39 The table compares an atom of carbon-13 and an atom of nitrogen-14.

|                    | carbon-13 | nitrogen-14 |
|--------------------|-----------|-------------|
| nucleon number $A$ | 13        | 14          |
| proton number $Z$  | 6         | 7           |

What do the neutral atom of carbon-13 and the neutral atom of nitrogen-14 have the same number of?

- A electrons
- B ions
- C neutrons
- D protons

40  $\alpha$ ,  $\beta$  and  $\gamma$  radiation can all penetrate materials and ionise atoms.

Which row compares the different types of radiation?

|          | least penetrating | least ionising |
|----------|-------------------|----------------|
| <b>A</b> | $\alpha$          | $\beta$        |
| <b>B</b> | $\alpha$          | $\gamma$       |
| <b>C</b> | $\gamma$          | $\alpha$       |
| <b>D</b> | $\gamma$          | $\beta$        |

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The Periodic Table of Elements

|                                   |                                    | Group  |  |                                    |                                     |                                    |                                     |                                     |                                       |                                      |                                      |                                    |                                      |                                    |                                     |                                  |                                  |
|-----------------------------------|------------------------------------|--|--|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------------------------|----------------------------------|----------------------------------|
| I                                 | II                                 | III  | IV                                     | V                                  | VI                                  | VII                                | VIII                                |                                     |                                       |                                      |                                      |                                    |                                      |                                    |                                     |                                  |                                  |
| 3<br><b>Li</b><br>lithium<br>7    | 4<br><b>Be</b><br>beryllium<br>9   | <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> <b>Key</b><br/>                     atomic number<br/>                     atomic symbol<br/>                     name<br/>                     relative atomic mass                 </div> |  |                                    |                                     |                                    |                                     |                                     |                                       |                                      |                                      | 2<br><b>He</b><br>helium<br>4      |                                      |                                    |                                     |                                  |                                  |
| 11<br><b>Na</b><br>sodium<br>23   | 12<br><b>Mg</b><br>magnesium<br>24 |  |  |                                    |                                     |                                    |                                     |                                     |                                       |                                      |                                      | 5<br><b>B</b><br>boron<br>11       | 6<br><b>C</b><br>carbon<br>12        | 7<br><b>N</b><br>nitrogen<br>14    | 8<br><b>O</b><br>oxygen<br>16       | 9<br><b>F</b><br>fluorine<br>19  | 10<br><b>Ne</b><br>neon<br>20    |
| 19<br><b>K</b><br>potassium<br>39 | 20<br><b>Ca</b><br>calcium<br>40   | 21<br><b>Sc</b><br>scandium<br>45  | 22<br><b>Ti</b><br>titanium<br>48      | 23<br><b>V</b><br>vanadium<br>51   | 24<br><b>Cr</b><br>chromium<br>52   | 25<br><b>Mn</b><br>manganese<br>55 | 26<br><b>Fe</b><br>iron<br>56       | 27<br><b>Co</b><br>cobalt<br>59     | 28<br><b>Ni</b><br>nickel<br>59       | 29<br><b>Cu</b><br>copper<br>64      | 30<br><b>Zn</b><br>zinc<br>65        | 31<br><b>Ga</b><br>gallium<br>70   | 32<br><b>Ge</b><br>germanium<br>73   | 33<br><b>As</b><br>arsenic<br>75   | 34<br><b>Se</b><br>selenium<br>79   | 35<br><b>Br</b><br>bromine<br>80 | 36<br><b>Kr</b><br>krypton<br>84 |
| 37<br><b>Rb</b><br>rubidium<br>85 | 38<br><b>Sr</b><br>strontium<br>88 | 39<br><b>Y</b><br>yttrium<br>89  | 40<br><b>Zr</b><br>zirconium<br>91     | 41<br><b>Nb</b><br>niobium<br>93   | 42<br><b>Mo</b><br>molybdenum<br>96 | 43<br><b>Tc</b><br>technetium<br>— | 44<br><b>Ru</b><br>ruthenium<br>101 | 45<br><b>Rh</b><br>rhodium<br>103   | 46<br><b>Pd</b><br>palladium<br>106   | 47<br><b>Ag</b><br>silver<br>108     | 48<br><b>Cd</b><br>cadmium<br>112    | 49<br><b>In</b><br>indium<br>115   | 50<br><b>Sn</b><br>tin<br>119        | 51<br><b>Sb</b><br>antimony<br>122 | 52<br><b>Te</b><br>tellurium<br>128 | 53<br><b>I</b><br>iodine<br>127  | 54<br><b>Xe</b><br>xenon<br>131  |
| 55<br><b>Cs</b><br>caesium<br>133 | 56<br><b>Ba</b><br>barium<br>137   | 57–71<br>lanthanoids   | 72<br><b>Hf</b><br>hafnium<br>178      | 73<br><b>Ta</b><br>tantalum<br>181 | 74<br><b>W</b><br>tungsten<br>184   | 75<br><b>Re</b><br>rhenium<br>186  | 76<br><b>Os</b><br>osmium<br>190    | 77<br><b>Ir</b><br>iridium<br>192   | 78<br><b>Pt</b><br>platinum<br>195    | 79<br><b>Au</b><br>gold<br>197       | 80<br><b>Hg</b><br>mercury<br>201    | 81<br><b>Tl</b><br>thallium<br>204 | 82<br><b>Pb</b><br>lead<br>207       | 83<br><b>Bi</b><br>bismuth<br>209  | 84<br><b>Po</b><br>polonium<br>—    | 85<br><b>At</b><br>astatine<br>— | 86<br><b>Rn</b><br>radon<br>—    |
| 87<br><b>Fr</b><br>francium<br>—  | 88<br><b>Ra</b><br>radium<br>—     | 89–103<br>actinoids  | 104<br><b>Rf</b><br>rutherfordium<br>— | 105<br><b>Db</b><br>dubnium<br>—   | 106<br><b>Sg</b><br>seaborgium<br>— | 107<br><b>Bh</b><br>bohrium<br>—   | 108<br><b>Hs</b><br>hassium<br>—    | 109<br><b>Mt</b><br>meitnerium<br>— | 110<br><b>Ds</b><br>darmstadtium<br>— | 111<br><b>Rg</b><br>roentgenium<br>— | 112<br><b>Cn</b><br>copernicium<br>— | 114<br><b>Fl</b><br>flerovium<br>— | 116<br><b>Lv</b><br>livermorium<br>— | —                                  | —                                   | —                                | —                                |

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