Centre name: ..... Date: .....

Candidate name: .....

AQA Combined Science: Trilogy (8464)

Practice Paper

Higher Tier

Time allowed: 60 minutes **Total marks:** 19

Instructions

- Answer all questions in the spaces provided.
- Show all your working. Marks may be awarded for correct working even if the answer is incorrect.
- The marks for each question are shown in brackets.

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1 .

[1 mark]

In the mid-19th century, Gregor Mendel suggested that inherited characteristics are determined by 'units' passed on to offspring unchanged.

Tick (✓) **one** box to identify the scientific discovery made in the **late 19th century** that provided the first physical evidence supporting Mendel's model of inheritance.

The observation of how chromosomes behave during cell division ☐

The determination of the double-helix structure of DNA ☐

The discovery of the chemical structure of base pairs ☐

The mapping of specific genes onto genetic inheritance webs ☐

2 .

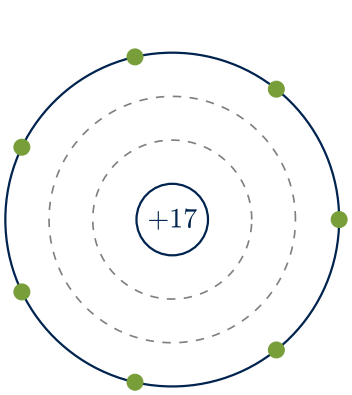
[4 marks]

The diagram shows the simplified atomic structures of chlorine and bromine, which are both Group 7 elements.

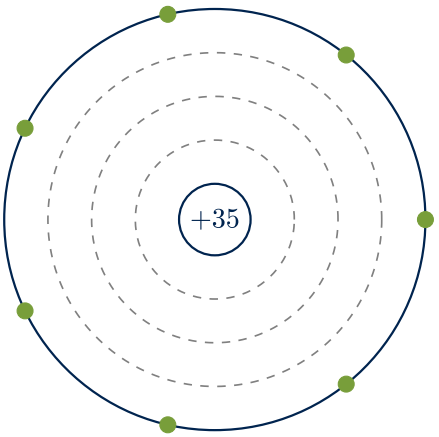
Explain why chlorine is more reactive than bromine.

In your answer, refer to:

- the number of energy levels (shells) and shielding
- the attraction between the nucleus and the outermost energy level
- how easily an outer electron is gained.



Chlorine atom



Bromine atom

3 .

[1 mark]

A student tests a sample of groundwater to confirm the presence of sulfate ions, $\mathrm{SO_4^{2-}}$.

They add a few drops of dilute hydrochloric acid to the sample, followed by barium chloride solution. A white precipitate forms.

Which statement explains why dilute hydrochloric acid is added before the barium chloride solution?

A To react with and remove any carbonate impurities that would also produce a white precipitate. ☐

B To act as a catalyst to increase the rate of precipitation of barium sulfate. ☐

C To provide chloride ions that are required to react with the sulfate ions. ☐

D To acidify the solution to make the barium sulfate precipitate more soluble. ☐

4 .

[2 marks]

An engineer designs a new mechanical prosthetic knee joint.

Figure 1 shows a vector diagram of two forces acting on the joint pivot during a stride. Table 1 shows information about these force vectors.

Table 1

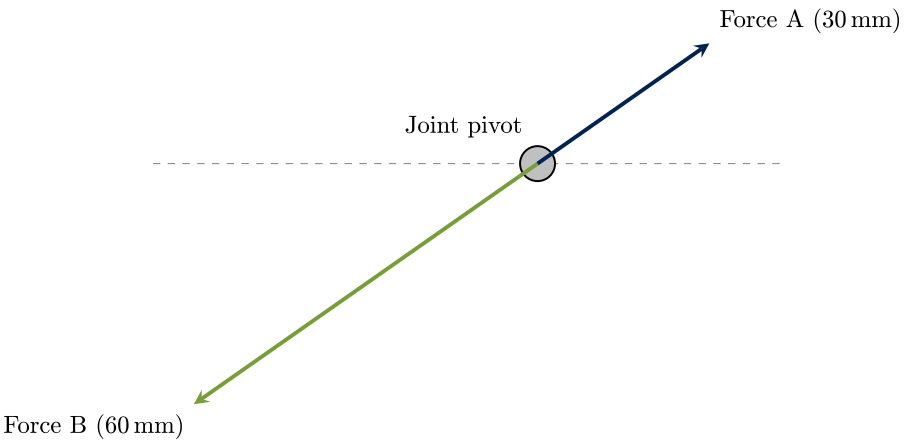
| Force vector | Source of force | Length of arrow in Figure 1 |

| :--- | :--- | :--- |

| **Force A** | Thigh muscle pulling on joint | 30 mm |

| **Force B** | Ground pushing up on joint | 60 mm |

Tick **two** boxes to identify the correct statements about how these vector arrows represent the forces.



Force vector	Source of force	Length of arrow in Figure 1
Force A	Thigh muscle pulling on joint	30 mm
Force B	Ground pushing up on joint	60 mm

The magnitude of Force B is twice the magnitude of Force A. ☐

The direction of the arrow for Force A shows the direction of the thigh muscle's force. ☐

Force A is a scalar quantity because its arrow is shorter than Force B. ☐

The distance between the two arrowheads represents the displacement of the joint pivot. ☐

The width of each arrow represents the contact area inside the joint. ☐

5 .

[1 mark]

In a car engine, burning fossil fuels produces several atmospheric pollutants. One of these pollutants is nitrogen dioxide (NO_2).

Which statement explains how nitrogen dioxide is formed in a car engine?

A Nitrogen gas and oxygen gas from the air react together at the high temperatures reached inside the engine. ☐

B Nitrogen impurities present inside the liquid fuel react with oxygen from the air during combustion. ☐

C The catalytic converter in the exhaust system oxidises nitrogen gas from the air into nitrogen dioxide. ☐

D Incomplete combustion of the fuel molecules releases trapped nitrogen oxides directly into the air. ☐

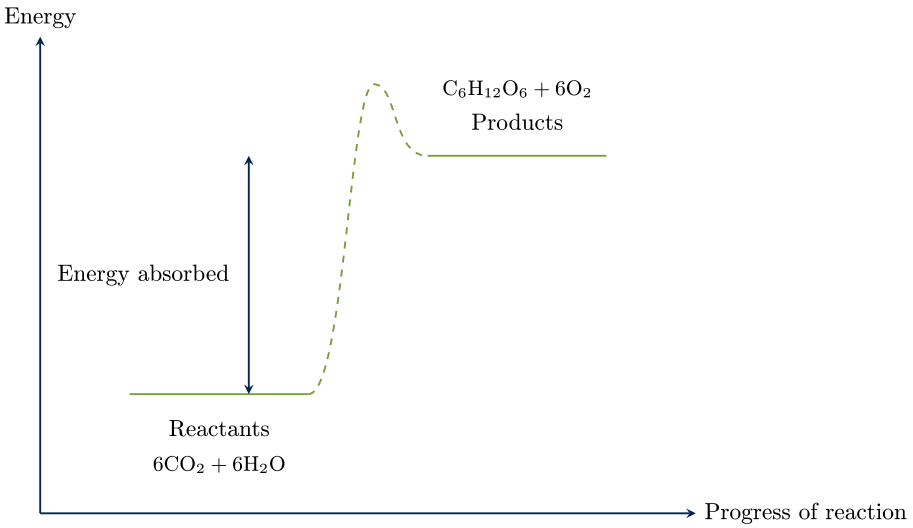
6 . **[6 marks]**

A student models the energy pathway of photosynthesis using the reaction profile diagram below.

Justify why photosynthesis is classified as an endothermic chemical reaction.

In your answer, refer to:

- the relative energy levels of the reactants and products shown in the diagram
- the roles of chloroplasts and light
- the balanced symbol equation for the reaction.



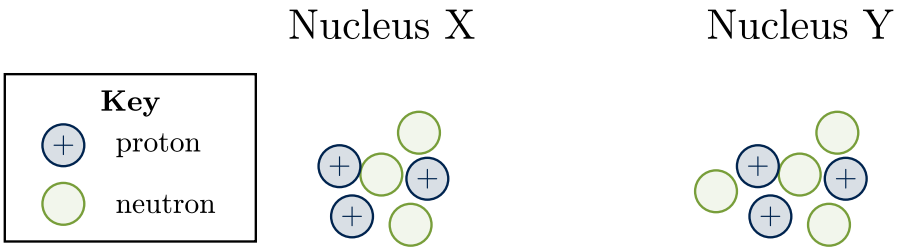
7 .

[2 marks]

Figure 1 shows diagrams of the nuclei of two atoms, **X** and **Y**.

Explain why atom **X** and atom **Y** are isotopes of the same element.

Refer to the specific subatomic particles shown in Figure 1 in your explanation.



8 .

[2 marks]

The transmission cables of the National Grid have electrical resistance. Explain the effect of using a step-up transformer on the rate of energy transfer to the thermal store of these cables.

END OF QUESTIONS