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Wednesday 15 June 2022 – Morning

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/04 Combined Science (Foundation Tier)

Time allowed: 1 hour 45 minutes

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You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9-1) Combined Science B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

J 2 6 0 0 4

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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Answer **all** the questions.

1 The energy needs of the UK are met by a wide range of energy resources.

(a) Which two energy resources are burned for heating?

Tick (✓) **two** boxes.

- Biofuel ☐
- Fossil fuels ☐
- Hydroelectricity ☐
- Nuclear fuel ☐
- The Sun ☐
- Wind ☐

[2]

(b) Complete the sentences to describe how fossil fuel power stations generate electricity.

Use words from the list.

You can use each word once, more than once or not at all.

gas **hydroelectric** **transformer** **turbine** **water** **wind**

In coal and ..... power stations ..... is heated to produce steam. The steam turns a ..... which makes a generator rotate.

[3]

(c) The table compares the ways in which the main energy resources are used to generate electricity.

For each row, tick (✓) **all** the statements that are true about the method used to generate electricity from each energy resource in the table.

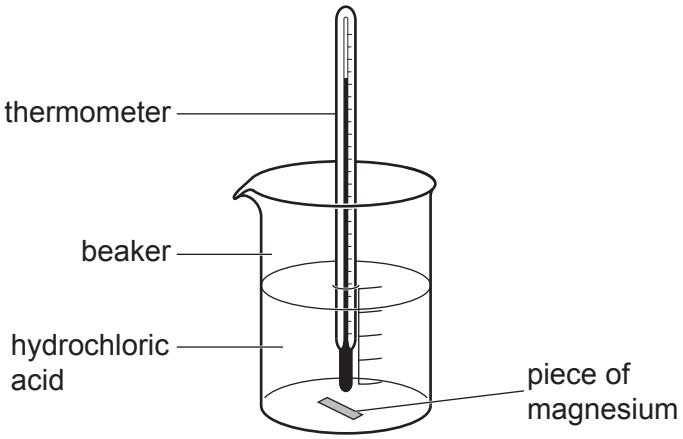
	Statement		
Energy resource used to generate electricity	Has a boiler to make steam	Has a turbine to operate the generator	Does not release carbon dioxide whilst generating electricity
Nuclear Power			
The Sun			
Wind			

[3]

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2 Jack is investigating the change in temperature when a piece of magnesium is added to hydrochloric acid.

He uses the equipment in the diagram.



(a) Jack's results are in the table.

Repeat	Temperature before adding magnesium (°C)	Temperature after adding magnesium (°C)	Increase in temperature (°C)
1	26	31	5
2	24	30	6
3	24	31	7
4	25	30	5
5	23	27	4

(i) Give **one** reason why Jack repeated the experiment.

.....

..... **[1]**

(ii) Calculate the mean increase in temperature for Jack's results.

Give your answer as a **whole number**.

Mean increase = ...°C **[3]**

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(b) (i) Which word describes the type of reaction Jack has investigated?

Tick (✓) **one** box.

Combustion ☐

Endothermic ☐

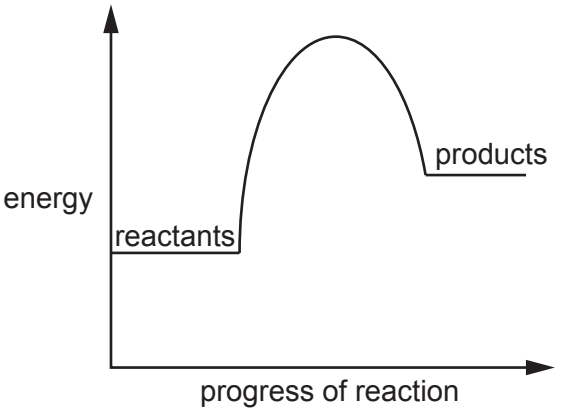
Exothermic ☐

Neutralisation ☐

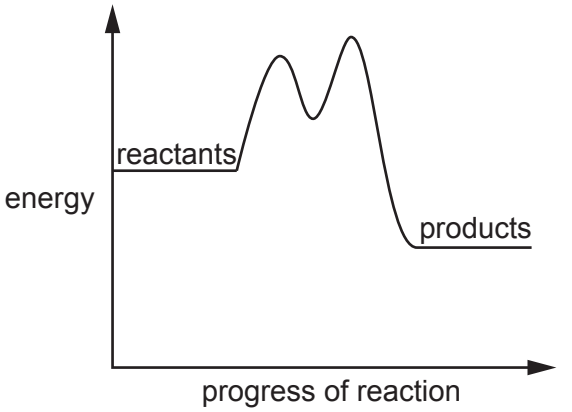
[1]

(ii) Jack draws the reaction profile for his investigation.

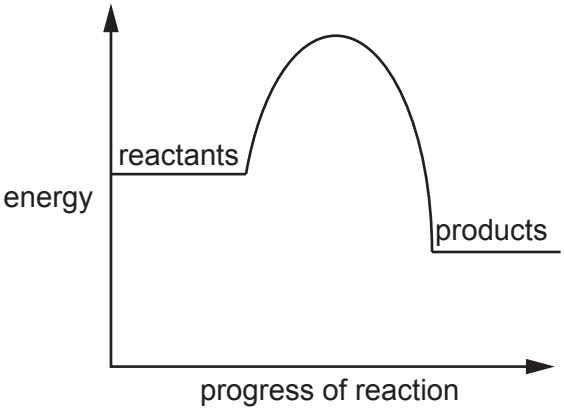
Tick (✓) the correct diagram.



A ☐



B ☐

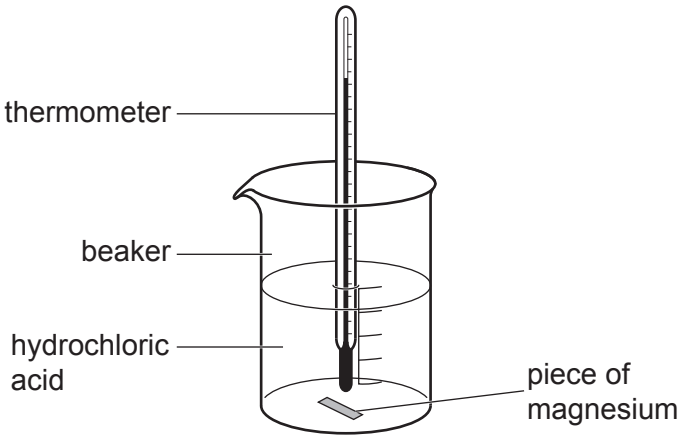


C ☐

[1]

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Jack thinks he could improve his method to make the temperature change data more accurate.



(c) Draw **one** line from an improvement Jack could make to the correct explanation, to make the temperature change data more **accurate**.

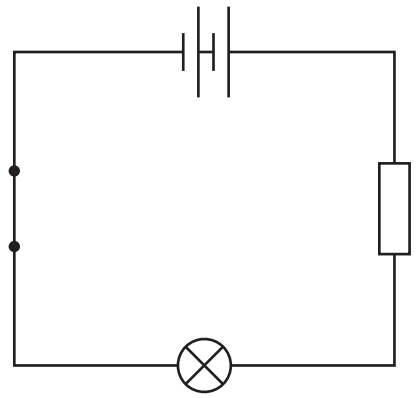
Improvement	Explanation
Change the concentration of the acid	To get a broader range of data
Insulate the beaker	To change the rate of reaction
Use a different type of metal	To reduce heat loss

[2]

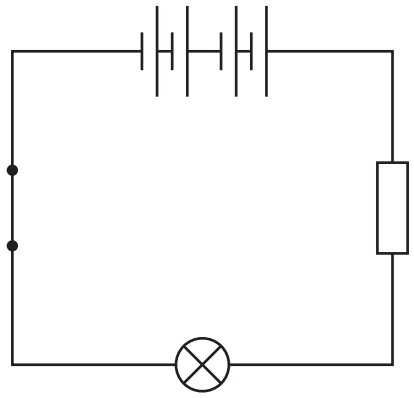
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3 Mia is investigating circuits.

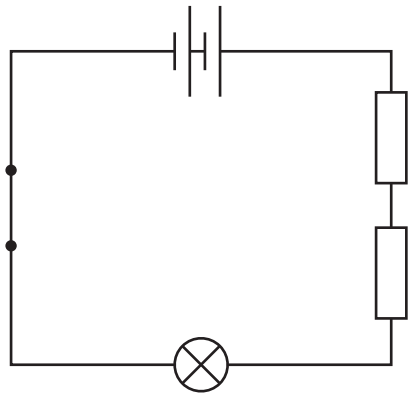
She has built the circuit in the diagram.



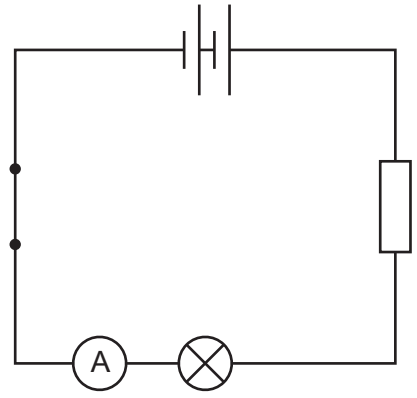
(a) Mia wants to increase the potential difference across the bulb. Here are three possible circuits she could make.



A



B



C

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All the resistors in each circuit are identical.

Which circuit, **A**, **B** or **C**, will increase the potential difference across the bulb?

Explain why.

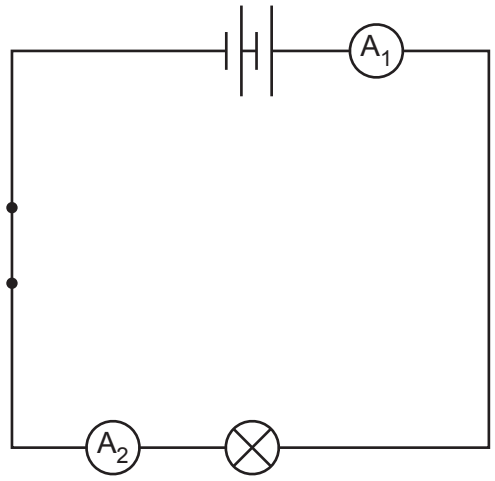
Circuit .....

Explanation .....

.....

..... **[2]**

(b) Mia builds the circuit in the diagram to investigate current in the circuit.



Mia thinks the reading on ammeter A_1 in the circuit in the diagram will be greater than the reading on A_2 because it is closer to the battery.

Explain why Mia is wrong.

.....

.....

.....

..... **[2]**

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(c) (i) In a circuit, you can measure current, potential difference and resistance.

Draw one line from each circuit measurement to the unit it is measured in.

Measurement	Unit
current	amp
potential difference	ohm
resistance	volt

[2]

(ii) Mia's circuit contains a 3.0 V battery and has a total resistance of 24 Ω.

Calculate the current.

Use the equation: current (A) = potential difference (V) ÷ resistance (Ω)

Current = ... A **[2]**

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4 This question is about genes and inheritance.

(a) Draw one line from each genetic term to its correct definition.

Genetic Term	Definition
Alleles	Only one copy of this genetic variant is needed to have the feature it produces.
Dominant	The entire genetic material of an organism.
Gamete	The two versions of a gene in a pair of chromosomes.
Genome	A sex cell used in sexual reproduction.

[3]

(b)* Sara breeds rats. Some rats have an inherited genetic condition that means they lack pigment in their skin and hair, so their hair is white. They are called albinos.



Sara breeds a brown female rat and a brown male rat.

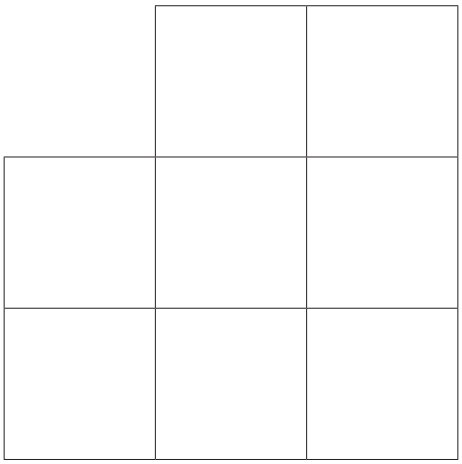
Both brown rats have a heterozygous genotype, **Bb**.
B = brown hair
b = white hair

Her rats have had several offspring, but none of them has been albino. Sara thinks that her rats could have an albino baby.

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Explain why Sara is correct.

Use the Punnet square.



.....

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..... **[6]**

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5 **(a)** The table gives some information about three sugars that plants make.

Sugar	Formula	Relative Formula Mass (RFM)
Glucose	$C_6H_{12}O_6$	180
Fructose	$C_6H_{12}O_6$	180
Sucrose	$C_{12}H_{22}O_{11}$	342

Glucose and fructose react to make sucrose and water, as shown:

glucose + fructose → sucrose + water

The relative formula mass of water is 18.

Explain how this reaction demonstrates the conservation of mass.

Use data from the table and the **Data Sheet** to support your answer.

.....

.....

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.....

.....

..... **[3]**

(b) Plants use glucose in aerobic respiration.

Where does aerobic respiration take place in plant cells?

Tick **one** (✓) box.

chloroplast ☐

mitochondria ☐

nucleus ☐

ribosome ☐

[1]

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(c) Respiration produces carbon dioxide. To test for carbon dioxide we use limewater.

The limewater turns cloudy because calcium carbonate forms.

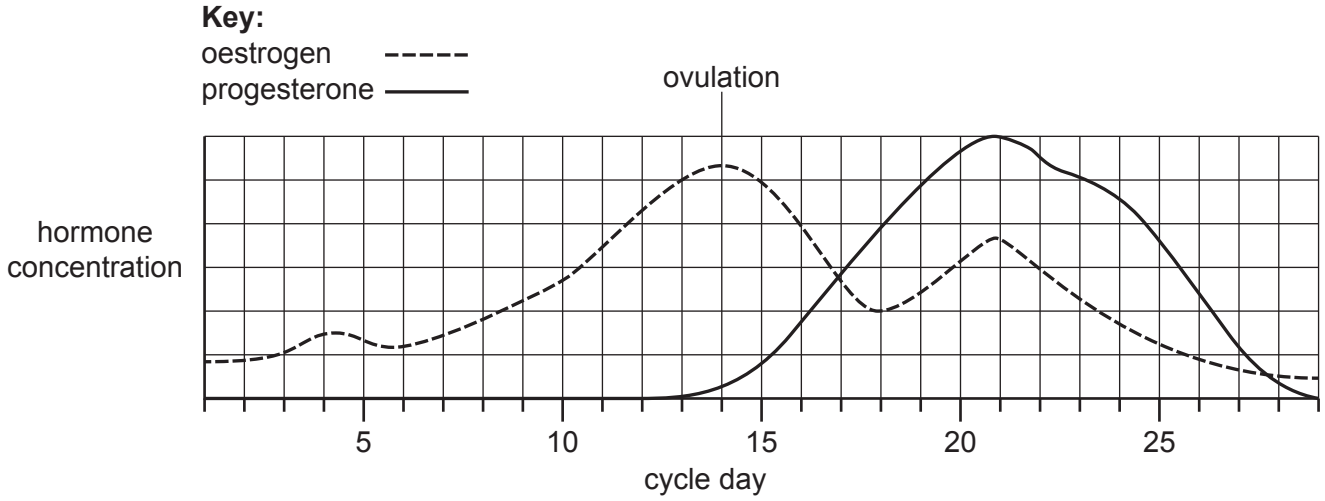
Calculate the percentage by mass of calcium in calcium carbonate, $CaCO_3$.

Element	Relative Atomic Mass
Carbon (C)	12
Oxygen (O)	16
Calcium (Ca)	40

Percentage = ... % **[4]**

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6 **(a)** The graph shows the concentrations of female hormones during one complete menstrual cycle.



(i) Compare the levels of oestrogen and progesterone in the menstrual cycle up to ovulation.

.....

.....

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.....

.....

..... **[3]**

(ii) On which cycle day does this female ovulate?

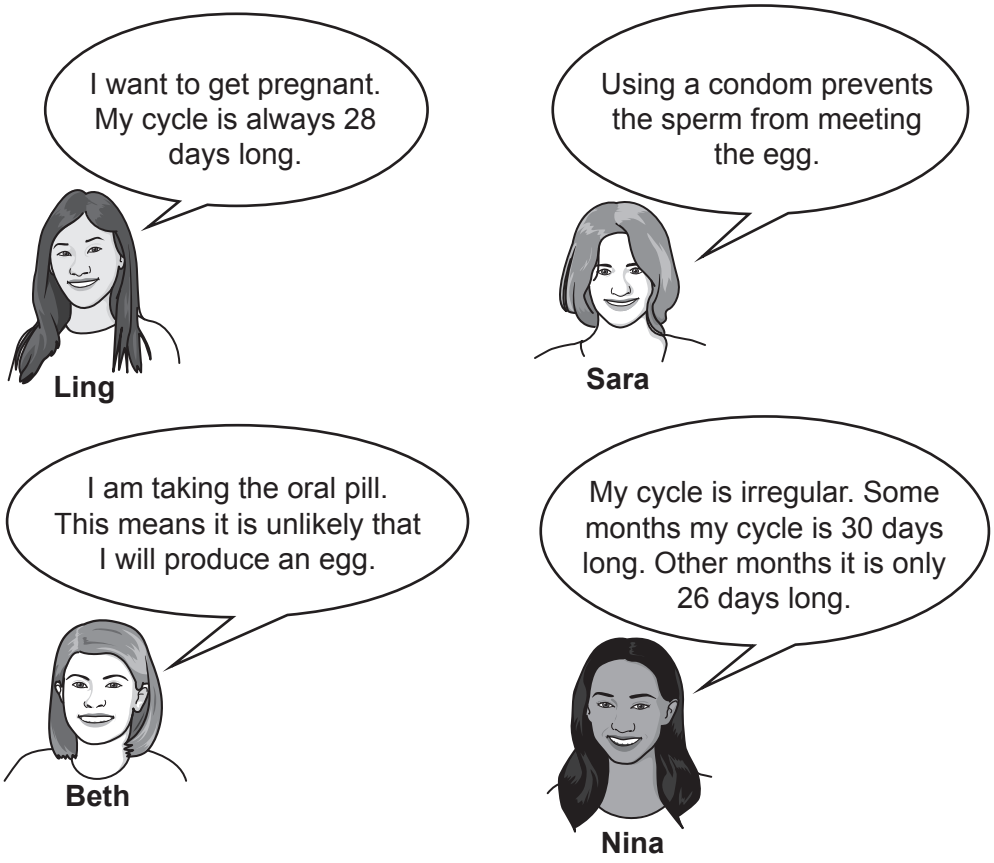
Day ..... **[1]**

(iii) On which cycle day does the progesterone level become higher than the oestrogen level?

Day ..... **[1]**

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(b) Some people are talking about female hormones and the menstrual cycle.



(i) Which two people are talking about contraception?

..... **[1]**

(ii) Who might find it hard to predict when they are ovulating?

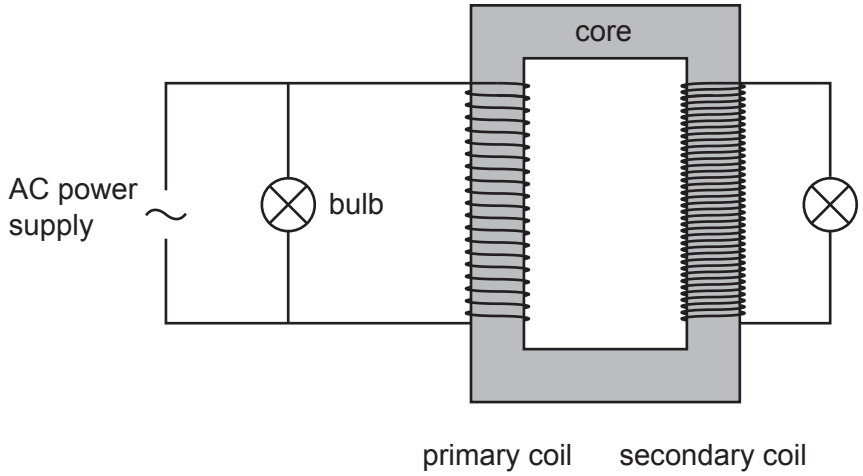
..... **[1]**

(iii) Who is preventing ovulation?

..... **[1]**

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7 Eve is investigating transformers.



(a) The power in the primary coil is equal to the power in the secondary coil.

State in what unit is power measured.

Unit of power = ... **[1]**

(b) Eve's circuit has a current of 1.5 A in the primary coil and a potential difference of 2.5 V across the primary coil.

A potential difference of 6 V is induced in the secondary coil.

She uses the equation:

potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil

Calculate the current in the secondary coil.

Current = ... A **[3]**

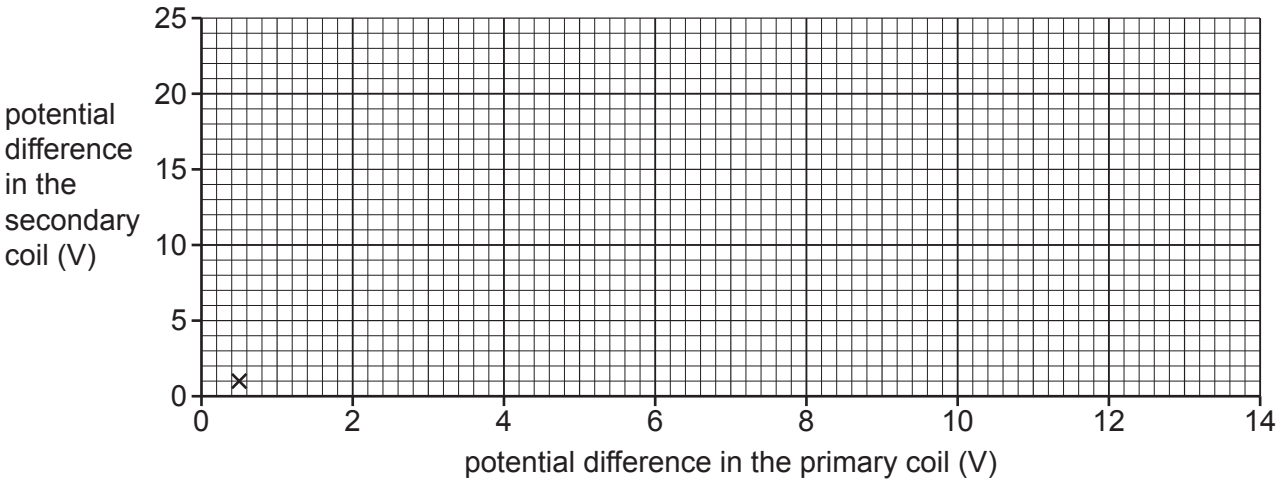
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(c) Eve does experiments with five different potential differences in the primary coil and records the potential differences in the secondary coil for each one.

Her results are in the table.

Potential difference in the primary coil (V)	Potential difference in the secondary coil (V)
0.5	1.0
2.0	4.0
6.0	12.5
10.0	20.0
12.0	23.0

(i) Complete the graph of Eve's results by plotting the data points **and** drawing a line of best fit. The first point has been plotted for you.



[3]

(ii) Describe the relationship shown by the graph.

.....

..... **[2]**

(d) Transformers are used in the transmission of electrical power.
Eve uses her data to explain why transmitting power at higher voltages is a more efficient way to transfer electrical energy.

Complete the sentences.

Put a (ring) around each correct option.

As the potential difference across the secondary coil increases,

the current in the secondary coil **decreases / increases / stays the same**.

This **reduces / stops / increases** energy loss in electrical power transmission.

[2]

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8 Sundip observed her teacher reacting five different metals with water and dilute hydrochloric acid.

(a) Suggest **one** safety precaution the teacher should have taken when demonstrating these reactions.

..... **[1]**

(b) The table shows Sundip's observations.

Metal	Reaction with water	Reaction with dilute hydrochloric acid
A	lots of bubbles and fizzing	fizzing and caught fire
B	no reaction	no reaction
C	no reaction	a few bubbles formed
D	caught fire	explosion
E	one bubble formed	lots of bubbles formed

(i) Write the letters of the metals in the boxes to show the correct order of reactivity.

The first one has been done for you.

least reactive ⟶ most reactive

B				

[3]

(ii) Sundip predicts that the bubbles given off by these reactions are hydrogen.

To test for this she blows out a splint and places it at the top of the test tube used for each reaction.

Will this test show whether the gas is hydrogen? Explain your answer.

.....

.....

.....

..... **[2]**

(c) Sodium (Na) is a metal that reacts vigorously with hydrochloric acid (HC*l*) to give off hydrogen (H_2).

Complete the balanced symbol equation for the reaction of sodium with hydrochloric acid.

..... Na + ... HC*l* ⟶ ..... NaC*l* + H_2

[3]

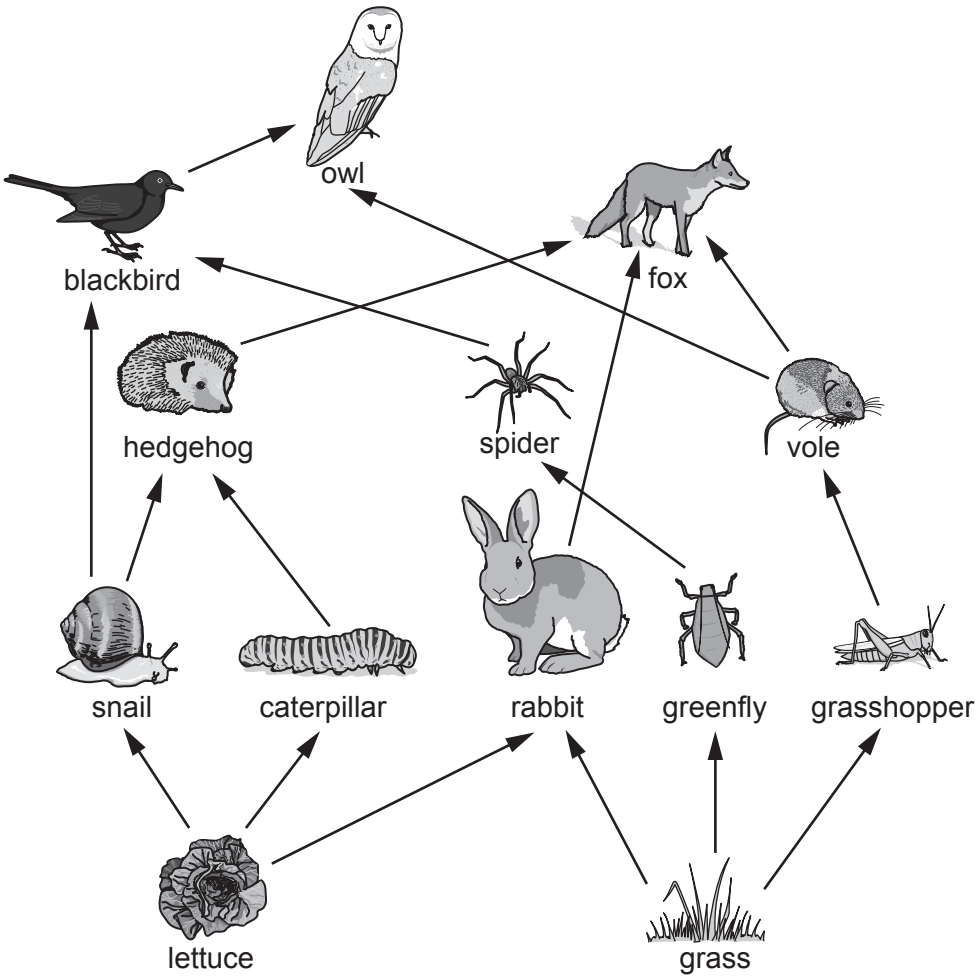
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9 The diagram shows a food web from a garden.



(a) **(i)** Which **two** organisms from the list below are secondary consumers in the food web diagram?

Tick (✓) **two** boxes.

- Greenfly ☐
- Hedgehog ☐
- Lettuce ☐
- Owl ☐
- Rabbit ☐
- Spider ☐

[1]

(ii) How many organisms are there in the **longest** food chain in the food web diagram?

..... **[1]**

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(iii) A disease reduced the number of caterpillars in the garden. What could happen to the number of snails in the garden? Explain your answer.

Number of snails .....

.....

Explanation .....

..... **[2]**

(b) One food chain from the garden food web is

grass → grasshopper → vole → fox

On average the transfer of biomass between organisms is 10% efficient.

The biomass of **grass** in the vole's food chain is 37.5 kg.

Calculate the expected biomass of **voles** in the food chain.

Expected biomass of voles = ... kg **[2]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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