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H

Wednesday 15 June 2022 – Morning

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

J260/08 Combined Science (Higher Tier)

Time allowed: 1 hour 45 minutes

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

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 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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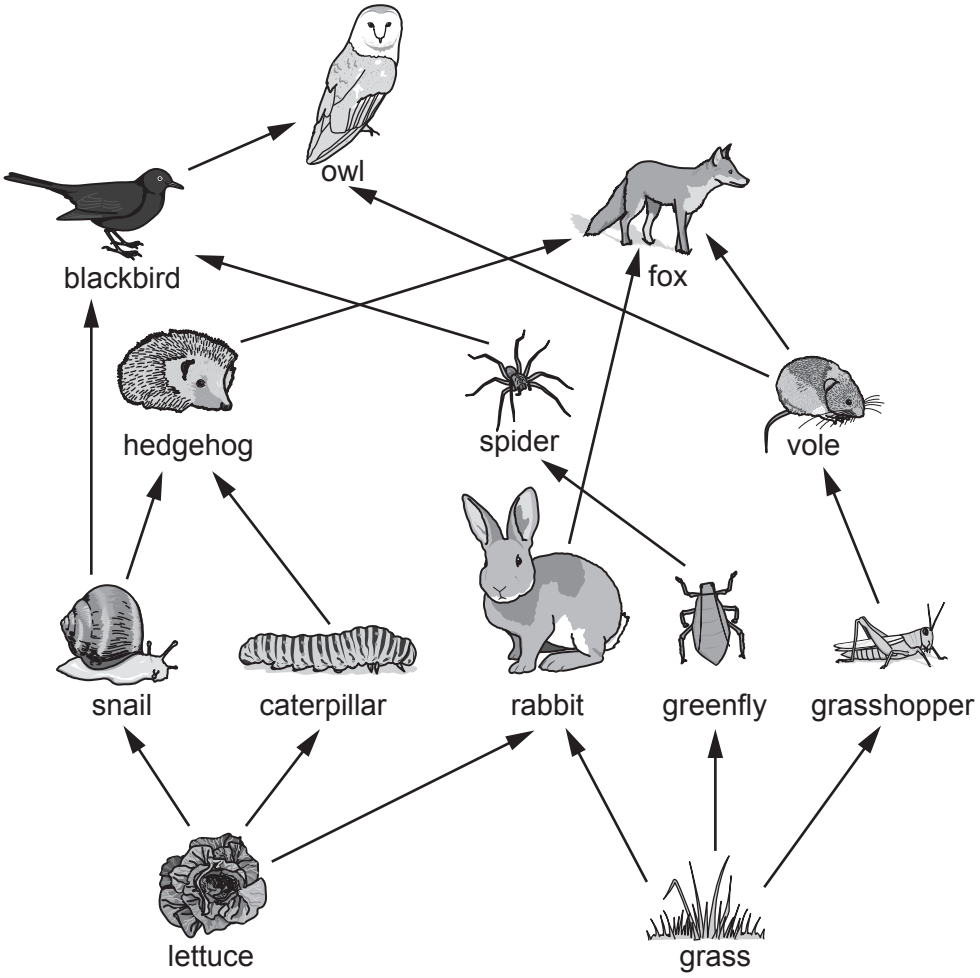
2 The diagram shows a food web from a garden.



(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]**

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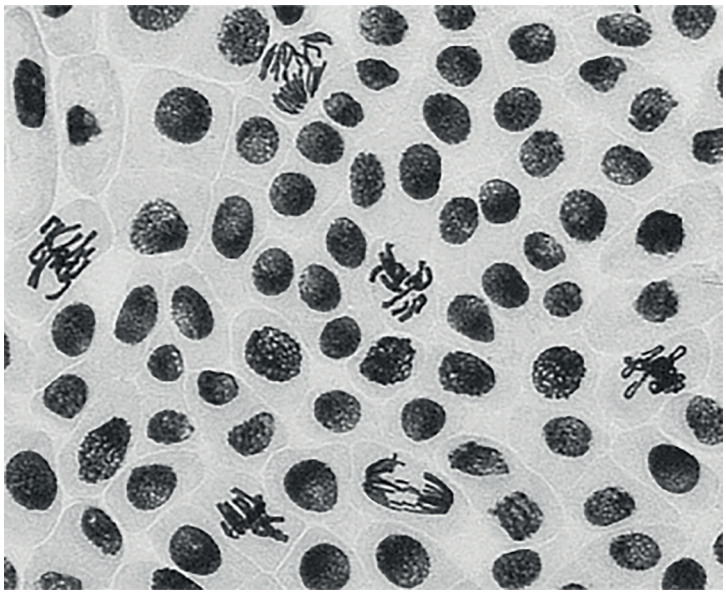
3 **(a)** James is looking at cells taken from the root tips of broad beans under a light microscope.

The cells are shown in the image.



(i) James counts 76 cells in the image.

Calculate the percentage of cells undergoing mitosis in James' image.

Percentage = ... % **[3]**

(ii) Suggest why James is looking at the cells in the root **tips** of the broad bean roots.

.....

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

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(iii) Mitosis is the process of producing new cells so the broad bean plant can grow.

Draw **one** line from each word to its correct description about mitosis and growth.

Word	Description
Differentiation	Cells in the bean plant that can form any type of cell.
Interphase	A group of bean cells that have the same function.
Meristem cells	The stage in the cell cycle before the bean cells begin mitosis.
Tissue	The process of newly formed bean cells becoming root hair cells.

[3]

(b) Meiosis is another form of cell division.

Complete the sentences to explain the role of meiosis.

Use the words and numbers.

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

cells **gametes** **genes** **nucleus** **23**

once **tissues** **twice** **46**

Meiosis is a process where the cells divide ..... .

The cells produced are called ..... . In humans these cells have

..... chromosomes in preparation for fertilisation.

[3]

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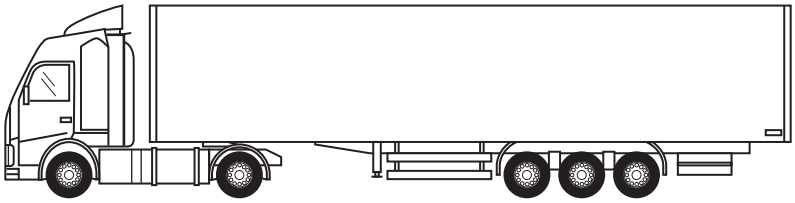
4* The picture shows a goods lorry.



When the lorry is empty, it has a mass of 1.45×10^4 kg.

The lorry can carry a maximum load of 2.95×10^4 kg.

The lorry is travelling at a velocity of 25 m/s on a motorway.

Explain why the stopping distance of the lorry is different when the lorry is empty compared to when it is fully loaded.

Include calculations in your answer.

Use the equation

momentum (kg m/s) = mass (kg) × velocity (m/s)

and ideas about change in momentum in your answer.

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

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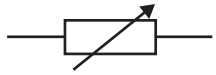
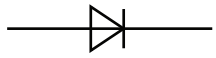
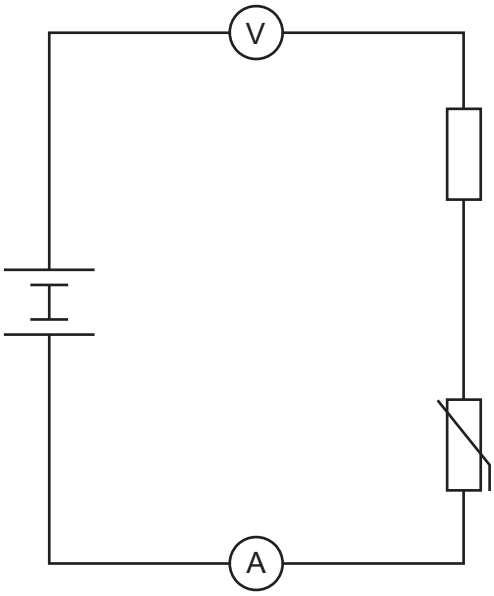
5 **(a)** **(i)** Draw lines to connect each electrical component to its correct symbol.

Electrical Component	**Symbol**
Diode	
Light dependent resistor (LDR)	
Thermistor	
Variable resistor	

[3]

(ii) Sarah is planning to make a series circuit to investigate the effect of changing the temperature of a thermistor on the current and potential difference in the circuit.

The diagram shows the circuit Sarah plans to use.



Describe **two** improvements she needs to make to the circuit to get valid results.

1 .....

.....

2 .....

.....

[2]

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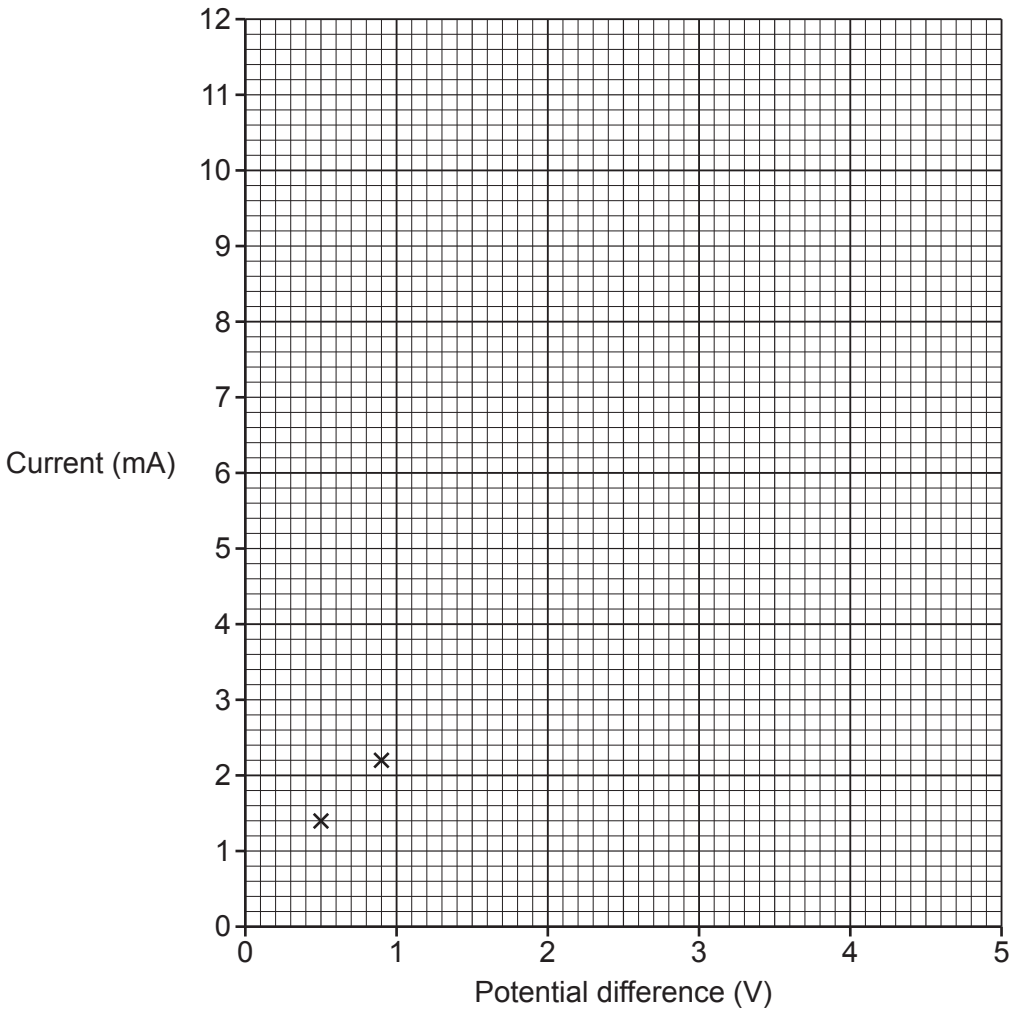
Sarah's results at a constant room temperature can be seen in the table.

Potential difference (V)	Current (mA)
0.5	1.4
0.9	2.2
1.6	3.4
2.1	4.3
3.1	7.1
3.8	8.4
4.5	10.9

(iii) Plot Sarah's results from the table **and** draw a line of best fit. The first two have been plotted for you.



[3]

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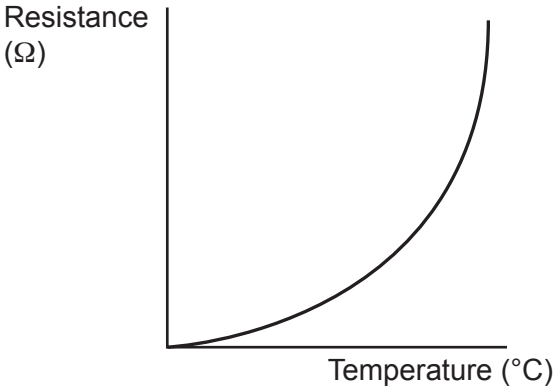
(b) Sarah repeated the experiment at different temperatures. She heated the thermistor in a water bath to increase the temperature.

Which of these graphs shows how the resistance of the thermistor changes as the temperature increases?

Tick (✓) **one** box.



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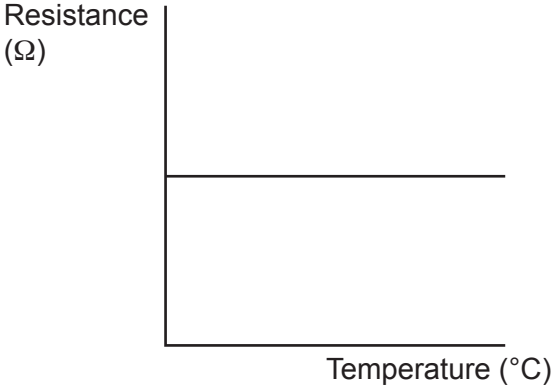

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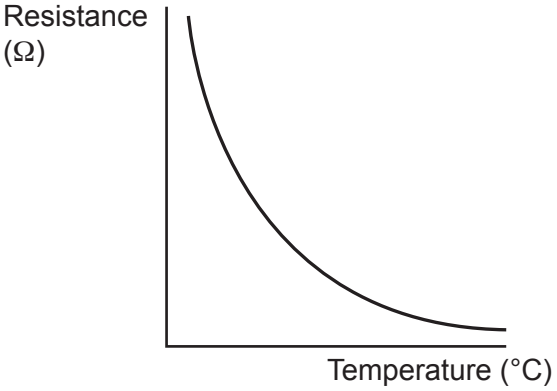

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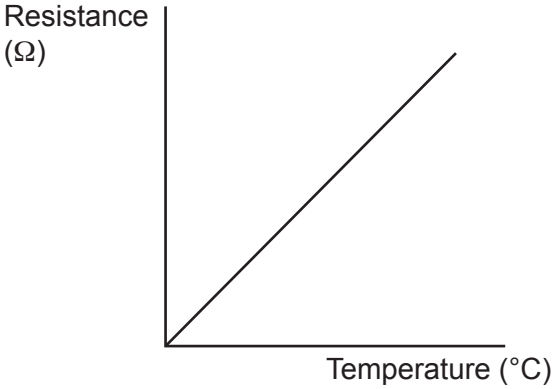

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[1]

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6 **(a)** Amir is planning an electrolysis investigation.

(i) Which **two** substances could be separated by electrolysis?

Tick (✓) **two** boxes.

Diamond ☐

Graphite ☐

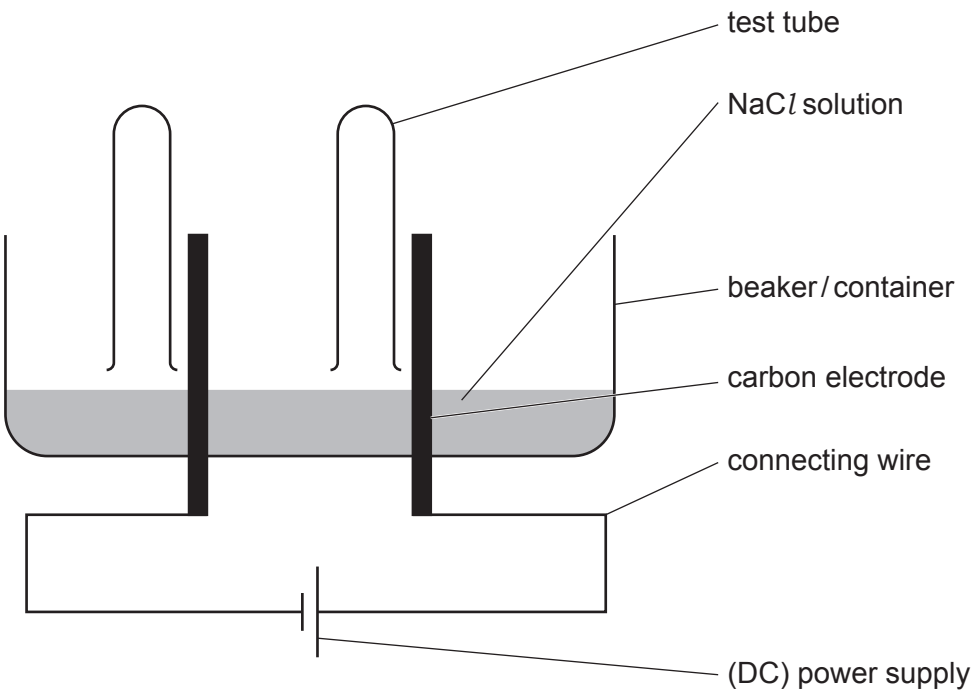
Lead bromide ☐

Potassium chloride ☐

Silicon dioxide ☐

[2]

(ii) Amir uses a sodium chloride solution and wants to collect the gases given off at the electrodes. The diagram shows the equipment he plans to use.



Give **two** improvements Amir could make to his equipment.

1 .....

.....

2 .....

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

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(iii) Name the gas formed at each electrode during the electrolysis of sodium chloride solution.

Anode .....

Cathode .....

[2]

(b) During the electrolysis of a molten ionic compound the reaction taking place at each of the electrodes is either oxidation or reduction.

Write the balanced half equation for the reduction reaction in the electrolysis of **molten** sodium chloride.

$2Na^+$ + ... $\rightarrow$ ..... **[2]**

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7 Scientists have discovered that breast cancer can be inherited. They have identified two alleles that can increase the risk of developing breast cancer. These two alleles are BRCA1 and BRCA2.

The table shows results from studies of women in five different countries looking at the link between BRCA alleles and breast cancer.

Country	**Proportion of women with BRCA1 allele (%)**	**Proportion of women with BRCA2 allele (%)**	**Proportion of women with BRCA alleles who developed breast cancer (%)**
Australia	54.5	45.5	55.4
Finland	49.5	50.5	56.3
Iceland	0.0	100.0	82.2
Italy	59.9	40.1	58.7
UK	56.1	43.9	48.9

(a) (i) There were 1212 women in the Australian study.

Calculate the number of women with BRCA alleles in the Australian study who developed breast cancer.

Use the data in the table.

Number of women ..... **[2]**

(ii) Which country has the highest proportion of women with cancer in the study?

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

(iii) A student looks at the data and draws the conclusion that roughly the same percentage of women have the BRCA1 allele as those who have the BRCA2 allele.

Explain why the student is not correct.

.....

.....

.....

.....

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

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(b) Genetic testing can be used to determine if someone has inherited BRCA alleles.

Suggest **two** ways that genetic testing for BRCA alleles can be used to reduce the incidence of breast cancer.

1 .....

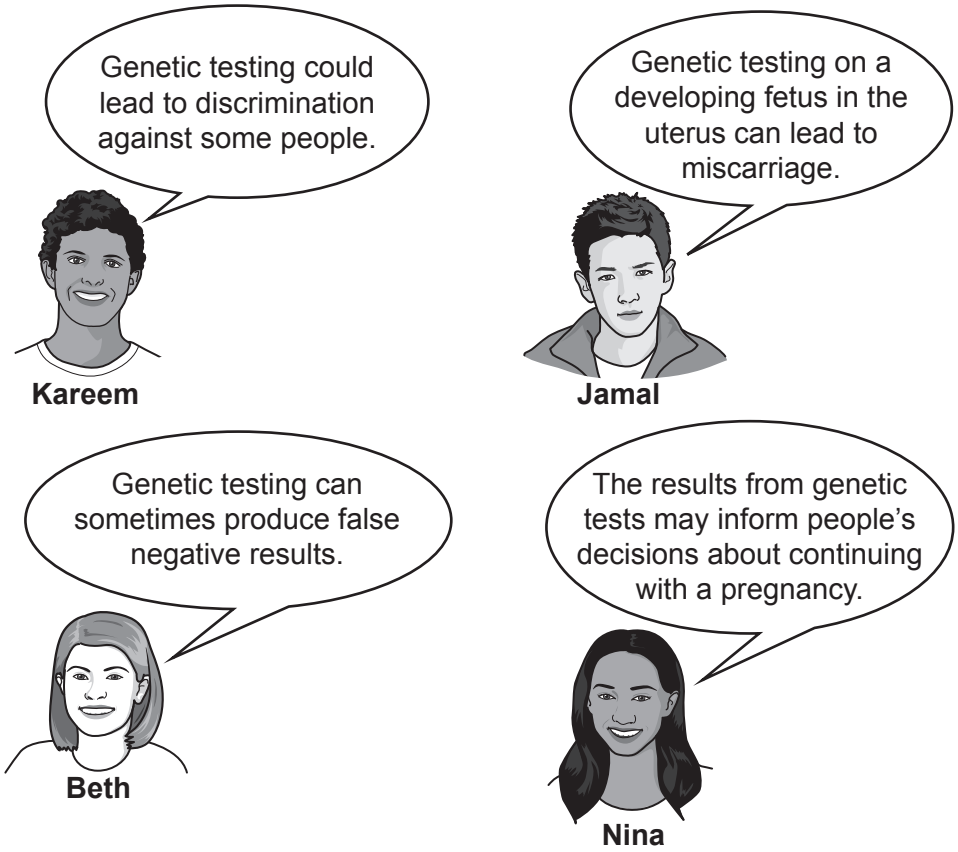
.....

2 .....

.....

[2]

(c) Some students are talking about genetic testing.



(i) Which student is discussing the reliability of genetic testing?

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

(ii) Which student is talking about a medical risk of genetic testing?

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

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8 The table shows some information about four nanoparticles.

Nanoparticle	**Formula**	**Diameter (nm)**	**Surface area to volume ratio**	**Use**
Silicon dioxide	SiO_2	70	0.09	Added to plastics
Titanium dioxide	TiO_2	20	0.30	Used in sunscreens
Silver oxide	Ag_2O	15	0.40	Used as an industrial catalyst
Gold	Au	50	0.12	Used to deliver drugs to cells

(a) Gold nanoparticles can be assumed to be spheres.

(i) Calculate the surface area of a gold nanoparticle.

Use information from the table and the equation:

surface area of a sphere = $4\pi r^2$

Use π = 3.14

Give the correct **unit** for your answer.

Surface area of a gold nanoparticle = ... unit = ... **[3]**

(ii) Which statement would be a reason to use gold nanoparticles to deliver drugs to cells in the human body?

Tick (✓) **one** box.

Gold is very valuable ☐

Gold has the smallest diameter ☐

Gold is very unreactive ☐

Gold only contains one element ☐

[1]

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(b) Explain why silver oxide nanoparticles make an effective catalyst.

Use information from the table to support your answer.

.....

.....

.....

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

(c) Suggest why titanium dioxide nanoparticles might be a risk to marine ecosystems. Use information from the table and your own knowledge to support your answer.

.....

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..... **[4]**

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9 The table gives some information about three radioactive isotopes.

Element	Isotope	Half life	Type of emission
Carbon	$^{14}_{6}C$	5.73×10^{3} years	β
Phosphorus	$^{32}_{15}P$	1.43×10^{1} days	β
Uranium	$^{234}_{92}U$	2.45×10^{5} years	α

(a) Complete the nuclear equation for the decay of the uranium isotope into an isotope of thorium (Th).

$$^{234}_{92}U \rightarrow \begin{matrix} \ldots\ldots\ldots \\ \\ \ldots\ldots\ldots \end{matrix} Th + \ldots\ldots\ldots$$

[3]

(b) **(i)** A woolly mammoth was discovered in a melting glacier.

The net decline of $^{14}_{6}C$ emission of the mammoth was recorded as 1/4.

Calculate how long ago the woolly mammoth died.

Use information from the table.

..... years ago **[3]**

(ii) Suggest **one** reason why the value calculated in **(b)(i)** is likely to be **inaccurate**.

.....

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

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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