



OUNDLE

School

13+ Academic Scholarship 2026

Science

Time allowed: 90 minutes

Name: _____

Instructions

- There are **THREE** sections. You should attempt the questions in all sections. You are advised to spend no more than 30 minutes on each section.
- There is a Periodic Table on the first page for your use. Important equations that you might need are printed in the relevant section of the question paper.
- Graphs should be drawn in **pencil**.
- Calculators **are** allowed.
- Answer on the paper. Marks can be gained from showing your working in selected questions.
- There is additional space, if you need it, at the end of the paper
- You are expected to write clearly and accurately throughout each of your answers.
- The maximum number of marks for this paper is 90.

The Periodic Table of the Elements

1	2	Key										3	4	5	6	7	0	
		relative atomic mass atomic symbol atomic (proton) number																
7	9											11	12	14	16	19		
Li lithium 3	Be beryllium 4											B boron 5	C carbon 6	N nitrogen 7	O oxygen 8	F fluorine 9		
23	24											27	28	31	32	35.5		
Na sodium 11	Mg magnesium 12											Al aluminum 13	Si silicon 14	P phosphorus 15	S sulfur 16	Cl chlorine 17		
39	40											70	73	75	79	80		
K potassium 19	Ca calcium 20											Ga gallium 31	Ge germanium 32	As arsenic 33	Se selenium 34	Br bromine 35		
85	88											115	119	122	128	127		
Rb rubidium 37	Sr strontium 38											In indium 49	Sn tin 50	Sb antimony 51	Te tellurium 52	I iodine 53		
133	137											204	207	209	[209]	[210]		
Cs caesium 55	Ba barium 56											Tl thallium 81	Pb lead 82	Bi bismuth 83	Po polonium 84	At astatine 85		
[223]	[226]											[272]	[271]	[268]	[277]	[264]	[266]	
Fr francium 87	Ra radium 88											Rg roentgenium 111	Ds darmstadtium 110	Mt meitnerium 109	Hs hassium 108	Bh bohrium 107	Sg seaborgium 106	
Elements with atomic numbers 112-116 have been reported but not fully authenticated																		

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

SECTION ONE: CHEMISTRY

[30 marks]

1. This question tests your understanding of states of matter.

a. Complete the table below.

Process	Change of state seen	Change in energy of particles	Change in arrangement of particles
Melting		Increase	
	Gas to liquid		Particles become closer together
	Solid to gas		
Condensing			

[5 marks]

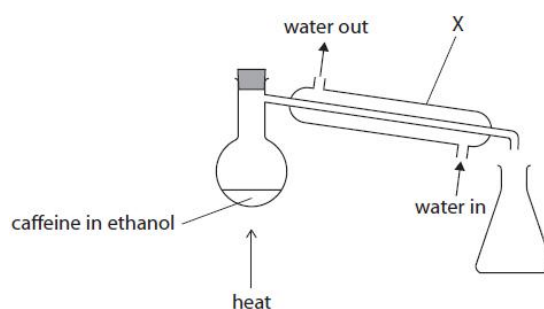
b. Which of these is a physical change?

Circle the appropriate letter.

- A Melting wax
- B Burning wood
- C Neutralising an acid
- D Rusting iron

[1 mark]

- c. A mixture of caffeine and ethanol can be separated using this apparatus:



Name this technique.

[1 mark]

- d. The table shows the melting and boiling points of different gases at room temperature.

Substance	Melting Point / °C	Boiling Point / °C
Ammonia	-77	-33
Oxygen	-218	-183
Helium	-272	-269
Nitrogen	-210	-196

- i. A mixture of ammonia, oxygen, helium and nitrogen were cooled down.

Which gas(es) would be liquids at -190 °C?

[1 mark]

ii. Elias makes the following statement:

“For a substance to freeze, it has to be cold”.

Using your knowledge and giving an example, **decide** whether this statement is correct?

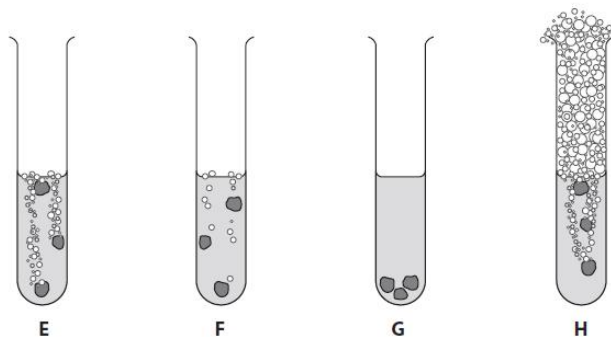
[2 marks]

[Total: 10 marks]

2. This question is about metals and compounds of metals

Three equal sized pieces of the metals E, F, G and H are put into separate test tubes containing equal volumes of dilute sulfuric acid.

The results in the figure below show the test tubes after half a minute.



- a. **Arrange** the metals **E**, **F**, **G** and **H** in order of reactivity.

Metal	
	Most reactive
	Least reactive

[1 mark]

- b. The bubbles that form are hydrogen.

Describe the test that would confirm the gas is hydrogen.

[2 marks]

- c. A piece of zinc was placed into a beaker of copper sulfate. After a short period of time, zinc sulfate and copper were produced.

Describe two observations that would be made during this reaction.

[2 marks]

- d. Lithium is a very reactive metal. It is stored under oil.

Suggest a reason why lithium is stored under oil.

[1 mark]

- e. A piece of lithium was cleaned of its oil and placed in a trough of water. Upon contact with the water, it began to fizz and move around on the surface of the water.

When some universal indicator was placed into the water it turned blue, showing that the water was now alkaline. Alkaline solutions contained hydroxide ions, OH^- . Lithium hydroxide, LiOH , is produced in this reaction.

Write a balanced symbol equation for the reaction of lithium with water.

In your equation, you should **include state symbols**.

[3 marks]

- f. Read the following passage carefully.

Because atoms are very small, chemists use the concept of 'a mole'.

A mole is a very large number which allows chemists to scale up from the atomic level.

Although it is a very large number, it is possible to have a fraction of a mole, or number of moles of a substance. You can think of it like a dozen eggs, half a dozen eggs, etc.

The relationship between mass (in grams) and a mole is as follows:

Mass (in grams) = number of moles of substance $\times$ mass of one mole

- i. A student weights out 50g of calcium carbonate.

Calcium carbonate reacts with hydrochloric acid to form carbon dioxide gas.



The mass of one mole of calcium carbonate is 100g.

The mass of one mole of carbon dioxide is 44g.

What mass of mass of carbon dioxide is produced in this reaction?

You are encouraged to show your working.

[3 marks]

[Total: 12 marks]

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3. This question is about how atoms bond to one another.

The chemistry of carbon based compounds is known as Organic Chemistry.

Organic chemists have a certain way of showing how carbon atoms bond to one another and to other atoms. One way is to use 'displayed formulae'.

a. The displayed formula of pentane, an organic compound is shown below.

Pentane has five carbon, C, atoms and each is joined to a number of hydrogen, H, atoms.

As you can see, every carbon atoms forms four chemical bonds (represented by a line) to neighbouring atoms.

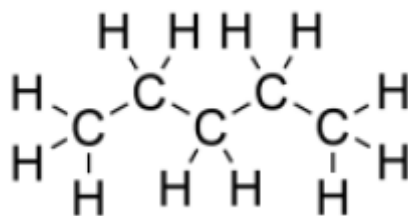


Fig: displayed formula of pentane

What is the chemical formula of this compound?

[1 mark]

- b. For more complex molecules, organic chemists use 'skeletal formulae'.

The skeletal formula of pentane is.

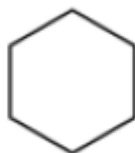


Fig. skeletal formula of pentane

In skeletal formula representation hydrogen atoms that are bonded to carbon atoms are not drawn in and the bonds between these carbon and hydrogen atoms are not drawn in either. All other bonds and atoms are shown.

Carbon atoms themselves are represented as vertices on the line.

- i. How many carbon and hydrogen atoms are in this structure represented by a skeletal formula.

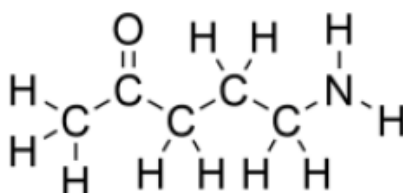


Number of carbon atoms: _____

Number of hydrogen atoms: _____

[2 marks]

- ii. Draw the skeletal representation of this structure.



[3 marks]

- c. Read the following passage carefully.

When a metal and non-metal bond together they use something called 'ionic bonding'. An example of an ionic compound is sodium chloride. It is made of sodium 'ions' and chloride ions'.

The formula of the compound is derived from considering the charges on the individual ions.

Sodium ions have a +1 charge. Chloride ions have a -1 charge. Because, overall, sodium chloride has no charge, it has a ratio of one of each ion, so the charges cancel each other out.

The formula of sodium chloride is NaCl.

Magnesium chloride is made up of magnesium 'ions', which have a +2 charge, and chloride ions', which have a -1 charge.

The formula of magnesium chloride is MgCl₂.

Calcium nitride is produced when calcium is burned in a nitrogen atmosphere. A nitride ion has -3 charge.

What is the formula of calcium nitride?

[2 mark]

[Total: 8 marks]

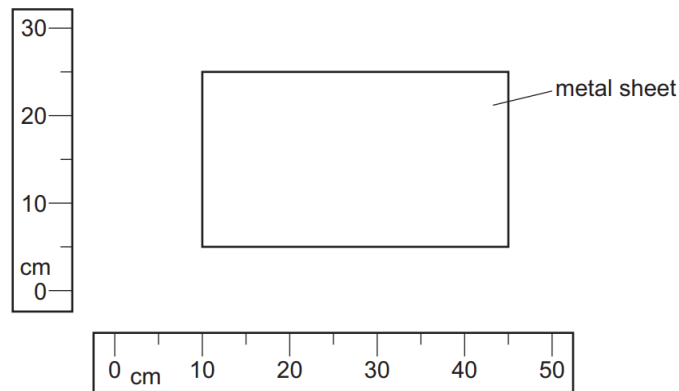
SECTION TWO: PHYSICS

[30 marks]

You may find these equations and data useful

- Distance = speed $\times$ time
- Weight = mass $\times$ g
- Voltage = current $\times$ resistance
- Moment = force $\times$ perpendicular distance from the pivot
- Force = mass $\times$ acceleration
- Charge = current $\times$ time
- Frequency of electromagnetic radiation (Hz) = speed of light (m/s) / wavelength (m)
- Force = pressure $\times$ area

1. The diagram shows a rectangular sheet close to two rulers

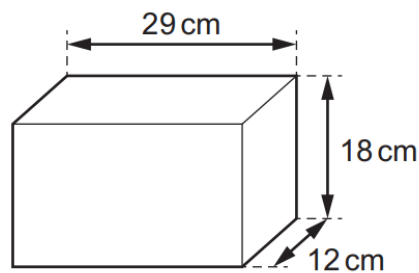


What is the area of the metal sheet?

Area = _____

[1 mark]

2. A concrete building block has the dimensions shown.



The mass of the block is 15,000g.

In kg/m^3 , what is the density of the block?

You are encouraged to show your working.

Density = _____

[3 marks]

3. A student wants to compare the conduction of thermal energy through rods made of iron, copper, glass and aluminium.

Each rod is coated with wax. Figure 3.1 shows the equipment that the student uses.

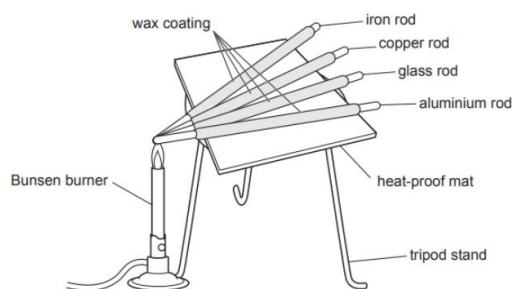


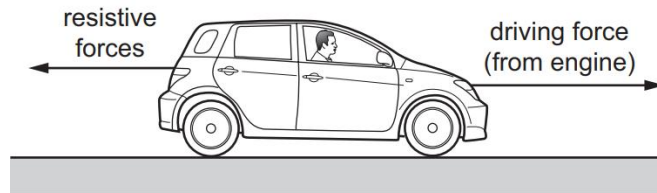
Figure 3.1

Describe how the student can compare the conduction of thermal energy through the rods in Figure 3.1.

[2 marks]

4. A car is driven from rest on a long straight road. The car engine exerts a constant driving force.

The diagram shows the horizontal forces acting on the car. The resistive forces are proportional to the speed of the car.



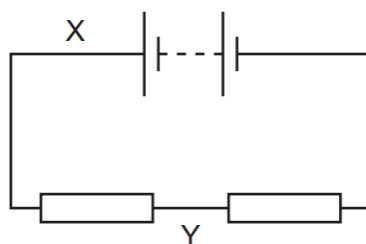
Explain why does the car eventually reach a maximum speed?

[2 marks]

5. The diagram shows a circuit containing two identical resistors connected to a battery.

The current is measured at X and at Y.

Steven is going to build the circuit and measure the current.



- a) **State** the arrangement of the resistors in the circuit.

[1 mark]

- b) **State** what device he should use to measure the current.

[1 mark]

- c) **Explain** what relationship you would expect to see between the current at point X and the current at point Y

[2 marks]

[Total: 4 marks]

6. A rocket travels with an average speed of 6 km/s for 2 minutes.

What is the distance travelled by the rocket in meters?

You are encouraged to show your working.

Distance = _____

[2 marks]

7. An elephant of mass 4,500kg stands with all four feet on the floor.

The average pressure on the floor due to an elephants foot in contact with it is

34,000 N/m².

Calculate the area of each foot of the elephant?

You are encouraged to show your working.

Area = _____

[4 marks]

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8. Read the following passage carefully.

Betelgeuse is a star in the constellation Orion.

It is normally the tenth-brightest star in the night sky.

The mass of the Sun is often represented by the symbol $M_{\odot}$ in astronomy.

Betelgeuse has a mass of $12M_{\odot}$, and when it eventually goes supernova (sometime within the next $\sim 100,000$ years), it is expected to release about 2×10^{44} J of kinetic energy.



Despite this, Betelgeuse is very distant, around 8×10^{18} m from Earth, so although the explosion will be bright enough to cast shadows at night and be visible during the day, it will not pose any danger to us.

- a) If $M_{\odot} = 1.99 \times 10^{30}$ kg and 88% of the star's mass is ejected during the supernova, calculate the mass of the hot stellar core that remains.

You are encouraged to show your working.

mass = _____ kg

[2 marks]

b) The speed of light is $c = 3.0 \times 10^8$ m/s.

If we were to *see* Betelgeuse go supernova tomorrow, how long ago (in years) would the explosion actually have taken place?

You are encouraged to show your working.

time = _____ years

[3 marks]

[Total: 5 marks]

9. This question is about a ‘ticking’ clock.

A grandfather clock keeps time using the physics of a swinging pendulum.

The pendulum’s steady back-and-forth motion is controlled by its length.

A longer pendulum swings more slowly, and a shorter one swings faster.



Maddie carries out an experiment to measure the time taken for one complete swing of a simple pendulum.

a) **Explain** why Maddie didn’t measure one single swing.

[1 mark]

- b) The pendulum consists of a small mass attached to a thin string, as shown in the figure below.

The string has a length of **0.50 m**, and the mass used is **60 g**.

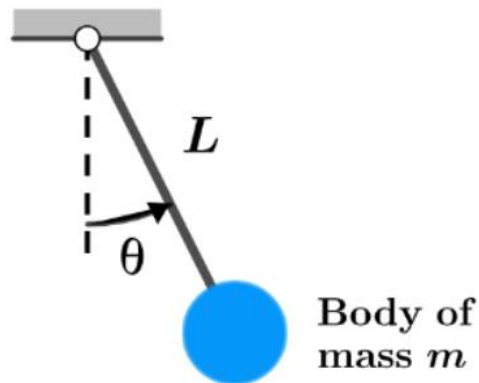


Fig. Pendulum

One swing is defined as the time taken for the mass *starting* from the highest point on the right to *returning* to the highest point on the right.

A student wants to measure the time it takes for one swing.

They measure 20 swings in a time of 28s.

- i) Calculate the time it takes for one swing.

[1 mark]

- ii) Maddie is told during her physics lesson that the time taken, t , for one swing is proportional to the square root of the length of the string.

The equation below shows this, where k is a constant.

$$t = k\sqrt{L}$$

What length of string does Maddie need to use if she wanted a time period twice as long as the original swing?

You are encouraged to show your working.

Hint: You do not need to know the original time period of the swing to work out this answer.

[2 marks]

- c) Maddie wants to design a pendulum that swings 60 times in 1 minute. What length of pendulum should she use.

Give you answer to the nearest mm.

You are encouraged to show your working.

[3 marks]

[Total: 7 marks]

SECTION THREE: BIOLOGY

[30 marks]

1. Which of the following is a characteristic of all living organisms?
 - A) Photosynthesis
 - B) Respiration
 - C) Sexual reproduction
 - D) Producing seeds

2. Which kingdom contains organisms that are multicellular and heterotrophic?
 - A) Plantae
 - B) Animalia
 - C) Fungi
 - D) Protista

3. Which of these organisms is a prokaryote?
 - A) Amoeba
 - B) Bacterium
 - C) Yeast
 - D) Algae

4. Which feature is common to all fungi?
 - A) Chlorophyll in cells
 - B) Chitin in cell walls
 - C) Photosynthesis
 - D) Glycogen storage

5. Viruses differ from living organisms because they:
 - A) Have DNA or RNA
 - B) Can reproduce independently
 - C) Are made of cells
 - D) Do not require a host

6. Which elements are present in carbohydrates?
- A) Carbon, Hydrogen, Oxygen
 - B) Carbon, Hydrogen, Nitrogen
 - C) Carbon, Oxygen, Nitrogen
 - D) Carbon, Hydrogen, Sulfur
7. Proteins are made up of:
- A) Simple sugars
 - B) Amino acids
 - C) Fatty acids and glycerol
 - D) Nucleotides
8. Lipids are composed of:
- A) Amino acids
 - B) Simple sugars
 - C) Fatty acids and glycerol
 - D) Glucose molecules
9. Starch and glycogen are examples of:
- A) Monosaccharides
 - B) Disaccharides
 - C) Polysaccharides
 - D) Proteins
10. Which of the following correctly describes the basic units of carbohydrates?
- A) Amino acids
 - B) Simple sugars
 - C) Fatty acids
 - D) Glycerol

[Total: 10 marks]

11. This question is about cells and transport.

a. Complete the table below

	Contains genetic information
Mitochondria	
	Controls the movement of substances into and out of the cell

[3 marks]

b. A student investigated the effect of salt concentration on pieces of potato.

This is the method that they used.

1. Cut three pieces of potato of the same size.
2. Record the mass of each potato piece.
3. Add 150 cm³ of 0.4 mol/dm³ salt solution to a beaker.
4. Place each potato piece into the beaker.
5. After 30 minutes, remove each potato piece and dry the surface with a paper towel.
6. Record the mass of each potato piece
7. Repeat steps 1 to 6 using different concentrations of salt solution

i. What is the independent variable in this investigation?

[1 mark]

- ii. Suggest why the student dried the surface of each potato piece with a paper towel in Step 5.

[1 mark]

- iii. The student calculated the percentage change in mass of each potato piece.

For one potato piece:

- the starting mass was 2.5 g
- the end mass was 2.7 g

Calculate the percentage increase in mass of the potato piece.
You are encouraged to show your working.

Percentage increase in mass = _____%

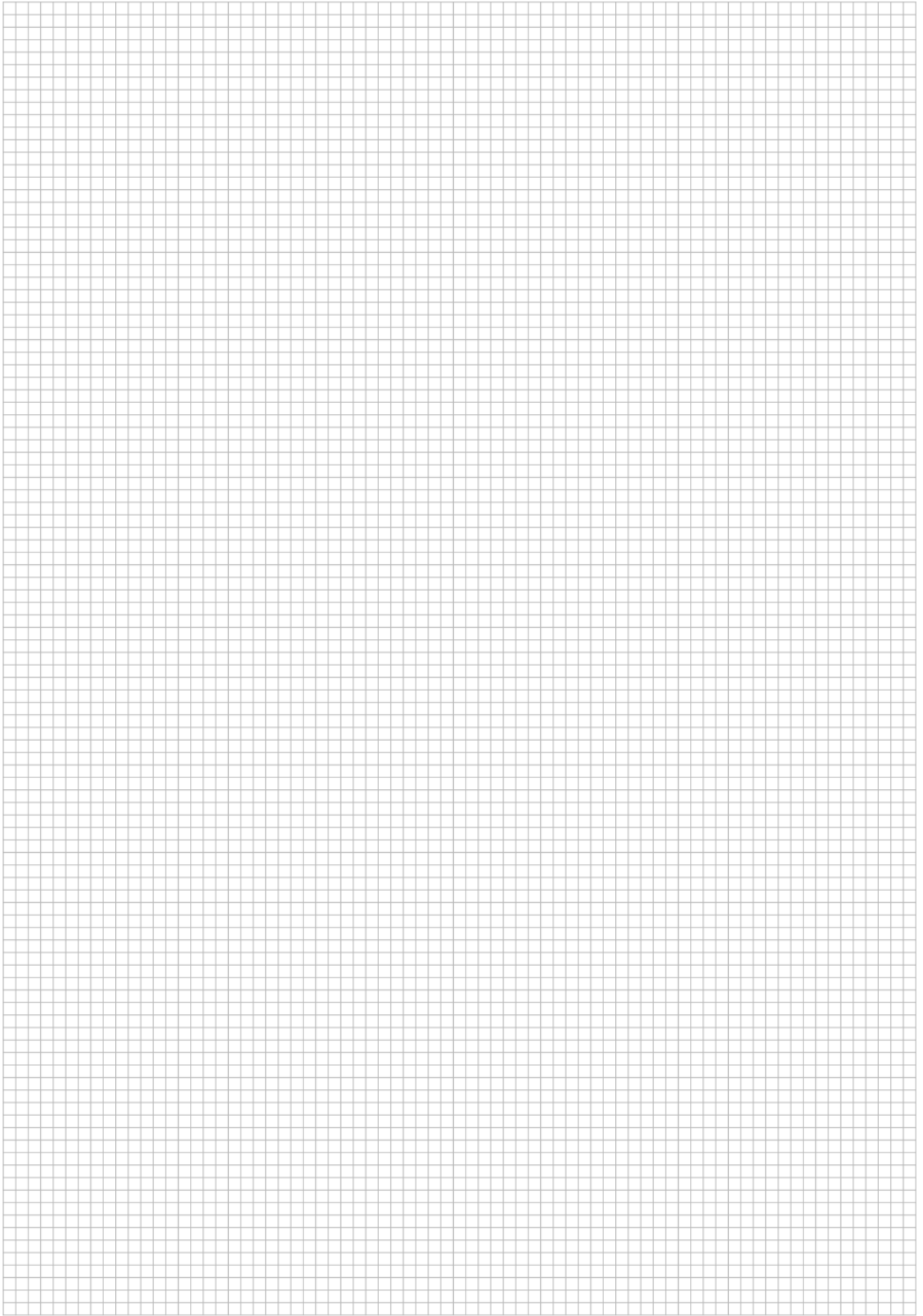
[2 marks]

- iv. The student used the results from each potato piece to calculate the mean percentage change in mass at each concentration.

The table below shows the results.

Concentration of salt solution in mol/dm³	Mean percentage (%) change in mass
0.0	9.8
0.1	9.5
0.2	7.0
0.3	0.4
0.4	-1.4

Plot the data as an appropriate graph on the provided graph paper on the next page.



[4 marks]

- c. Using your data, state what concentration of salt solution was equal to the concentration of the solution inside the potato pieces.

Concentration = _____ mol/dm³

[1 mark]

- d. Explain why the potato pieces in the 0.4 mol/dm³ salt solution decreased in mass.

[3 marks]

[Total: 15 marks]

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12. This question is all about cricket(s).

Crickets are small arthropods, insects, that are very similar to grasshoppers.



- a. Crickets make a noise or 'sing' by rubbing their wings together.

This attracts a mate.

Unfortunately, the noise also attracts a type of fly.

The fly lays eggs on the cricket.

The eggs hatch and the maggots burrow into the cricket and feed on it, eventually killing it.

Choose the appropriate word from the list below to **describe** the maggots in this feeding relationship.

competitor host parasite partner prey

Answer: _____

[1 mark]

- b. Scientists found that some crickets on an island had a gene that made them silent.

The scientists found that after a few years most crickets on the island were silent.

However, there were still a number of crickets on the island that could 'sing'.

Using your knowledge of natural selection, **explain** why most of the crickets are now silent and why scientists think that this could lead to the formation of a new species.

[illegible]

[4 marks]

[Total: 5 marks]

END OF EXAMINATION

[illegible]

[illegible]

[illegible]

[illegible]