2024.S26

2024J057C1EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle Final Examination 2024

Science

Common Level

Monday 10 June Morning 9:30 – 11:30

360 marks

Examination Number

Date of Birth

For example, 3rd February 2005 is entered as 03 02 05

Centre Stamp

Instructions

Write your Examination Number and your Date of Birth in the boxes on the front cover.

There are two sections in this examination paper.

Section A	150 marks	10 questions
Section B	210 marks	7 questions

Answer **all** parts of **all** questions.

You may ask the superintendent for a copy of the *Formulae and Tables* booklet. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

Not all the questions carry equal marks. The number of marks for each question is stated at the top of the question.

Write your answers in the spaces provided in this booklet. You are not required to use all of the space provided. There is extra space at the end of Section A and at the back of the booklet. Label any extra work clearly with the question number and part.

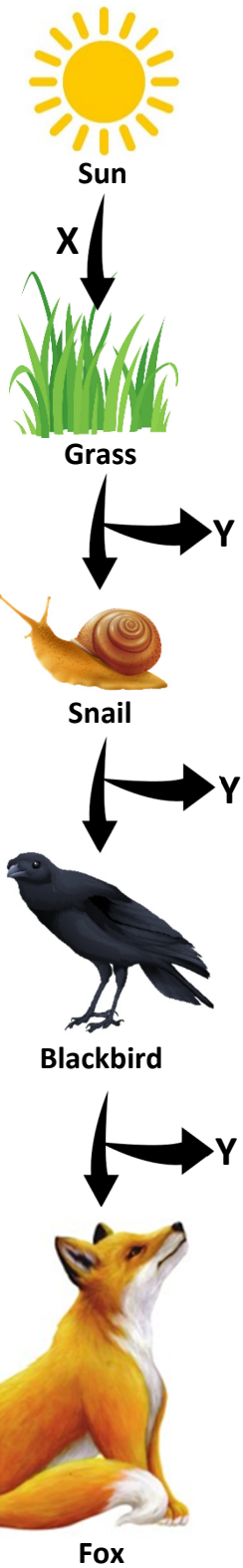
This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write your answers in blue or black pen. You may use pencil for graphs and diagrams only.

Section A — 150 marks

Question 1 **(15 marks)**

The diagram shows a grassland food chain. The black arrows indicate the movement of energy through the food chain.



Answer questions **(a)** to **(d)** by putting a tick (✓) in the correct box.

(a) Identify the producer (organism that makes its own food) in the food chain.

Grass ☐ Snail ☐ Blackbird ☐ Fox ☐

(b) Identify the secondary consumer in the food chain.

Grass ☐ Snail ☐ Blackbird ☐ Fox ☐

(c) Energy is converted from one form to another at arrow **X**.
Identify this energy conversion.

Heat energy to kinetic energy ☐

Chemical energy to kinetic energy ☐

Solar energy to chemical energy ☐

Sound energy to chemical energy ☐

(d) Organisms release energy to their environment.
What form of energy is released to the environment at arrow **Y**?

Solar ☐

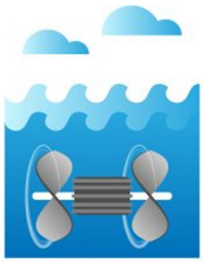
Heat ☐

Nuclear ☐

(e) Suggest a reason why food chains rarely have more than four trophic (feeding) levels.

Question 2 **(15 marks)**

The images below show sources used by humans to generate electricity.



Water

Coal

Oil

Wind

Sun

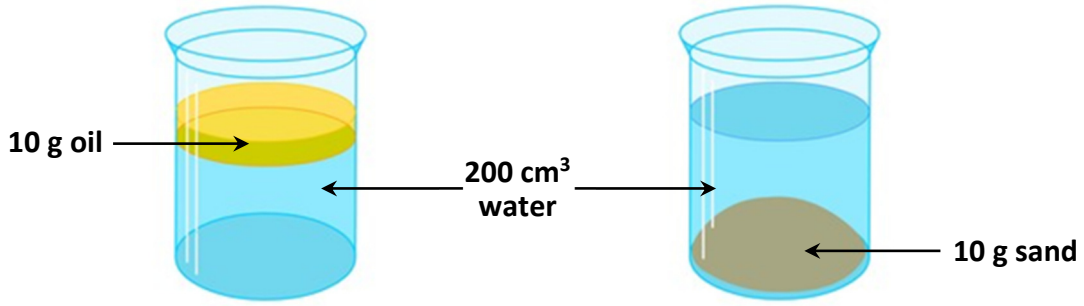
(a) Classify each of the sources as renewable or non-renewable by putting a tick (✓) in the correct column.

Source	Renewable	Non-renewable
Water		
Coal		
Oil		
Wind		
Sun		

(b) "Energy producers face ethical issues in the way energy is extracted and/or produced." Do you agree with this statement? Justify your answer.

Question 3 **(15 marks)**

A student set up the experiment shown below to compare the densities of oil and sand with the density of water. The contents of both beakers were stirred and left to stand for five minutes. The diagram below shows the results of the investigation after five minutes had passed.



(a) Which substance, oil or sand, was more dense than water? Justify your answer.

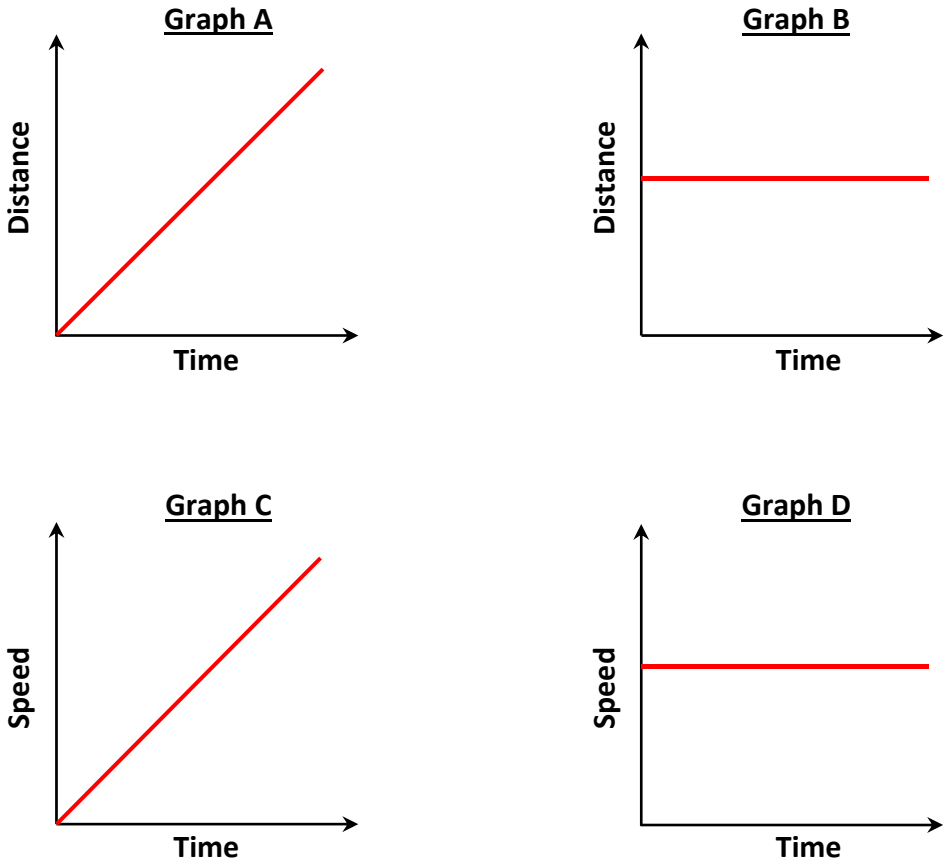
(b) Oil is insoluble in water.
What evidence is there in the diagram to support this statement?

(c) In the space below, draw a **labelled** diagram of a separation technique that could be used to separate the sand from the water.

Labelled diagram:

Question 4 **(15 marks)**

The four graphs below (**A**, **B**, **C** and **D**) describe the motion of four different objects.



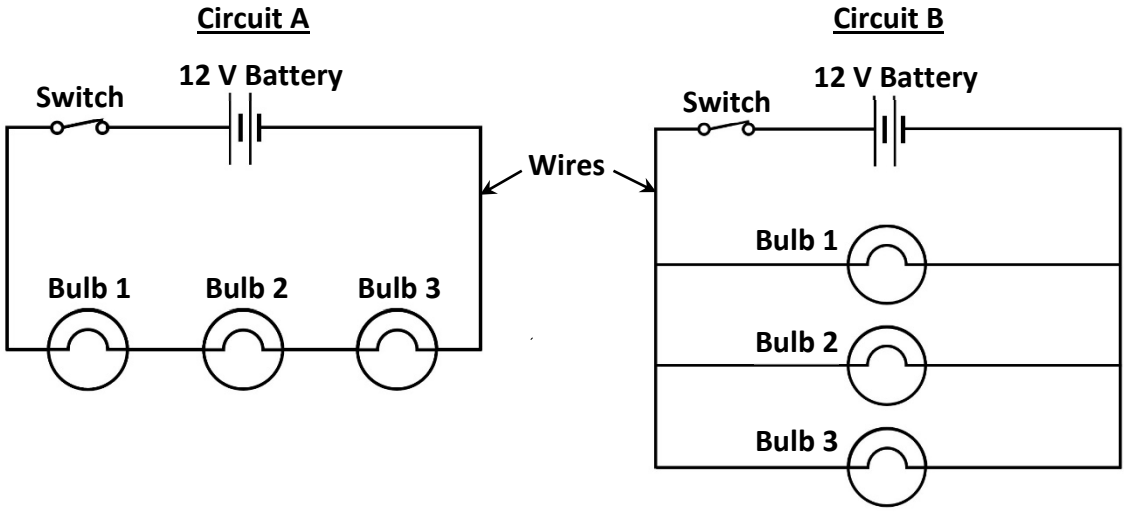
Use the statements below to describe the motion of the object in each of the four graphs.
(Note that one of the statements should be used twice.)

1. The object did not move.
2. The object moved with constant speed.
3. The object accelerated.

Graph	Statement
A	
B	
C	
D	

Question 5 **(15 marks)**

Examine the circuit diagrams **A** and **B** below and answer the questions that follow.
All of the bulbs have the same resistance.



(a) In circuit **A**, what would happen if bulb **1** 'blew' or failed? Put a tick (✓) in the correct box.

Bulbs 2 and 3 would go out. ☐

Bulbs 2 and 3 would shine with the same brightness as before. ☐

Bulbs 2 and 3 would shine less brightly. ☐

Bulbs 2 and 3 would shine more brightly. ☐

(b) In circuit **B**, what would happen if bulb **1** 'blew' or failed? Put a tick (✓) in the correct box.

Bulbs 2 and 3 would go out. ☐

Bulbs 2 and 3 would shine with the same brightness as before. ☐

Bulbs 2 and 3 would shine less brightly. ☐

Bulbs 2 and 3 would shine more brightly. ☐

(c) In circuit **A**, a voltmeter was used to measure the potential difference (voltage) across bulb **1**. What reading would you expect to see on the voltmeter? Put a tick (✓) in the correct box.

0 volts ☐ 3 volts ☐ 4 volts ☐ 12 volts ☐

(d) In circuit **B**, a voltmeter was used to measure the potential difference (voltage) across bulb **1**. What reading would you expect to see on the voltmeter? Put a tick (✓) in the correct box.

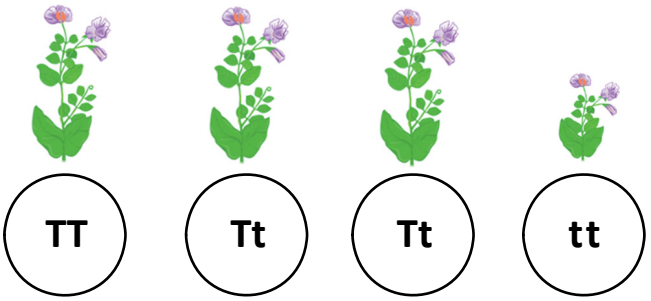
0 volts ☐ 3 volts ☐ 4 volts ☐ 12 volts ☐

Question 6 **(15 marks)**

Gregor Mendel is considered the father of genetics. He studied how characteristics are inherited by experimenting with pea plants.

In their cells, pea plants contain two versions (alleles) of the gene for height. The alleles can be represented by the letters **T** and **t**.
The possible pairs of alleles are **TT** (tall), **Tt** (tall) and **tt** (dwarf). These are called genotypes.

The table below illustrates a genetic cross between two tall pea plants. The table is incomplete. Study the table and answer the questions that follow.

	Parent 1 – Tall Plant	**Parent 2 – Tall Plant**
Parent genotype	**Tt**	**?**
Gametes produced	**T** or **t**	**?** or **?**
Offspring genotype	 **TT** **Tt** **Tt** **tt**	

Answer the following questions by putting a tick (✓) in the correct box.

(a) What is the ratio of **tall** plants to **dwarf** plants in the offspring of this cross?

1:3 ☐ 3:1 ☐ 1:1 ☐

(b) Which of the following are the possible genotypes of the gametes produced by parent **2**?

T or T ☐ T or t ☐ t or t ☐

(c) Which of the following is the genotype of parent **2**?

TT ☐ Tt ☐ tt ☐

(d) Which version (allele) of the gene for height is dominant?

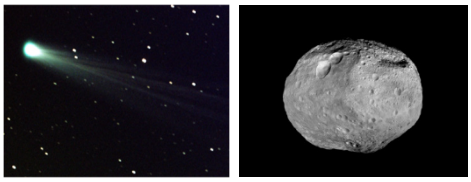
T ☐ t ☐

(e) Which type of reproduction is illustrated above?

Sexual ☐ Asexual ☐

Question 7 **(15 marks)**

Comets and asteroids are objects found in our solar system. Some of the properties of comets and asteroids are listed in the table below. Each property is true for either a comet, an asteroid, or both.
Write the word '**comet**' or '**asteroid**' or '**both**' in the table next to each property.



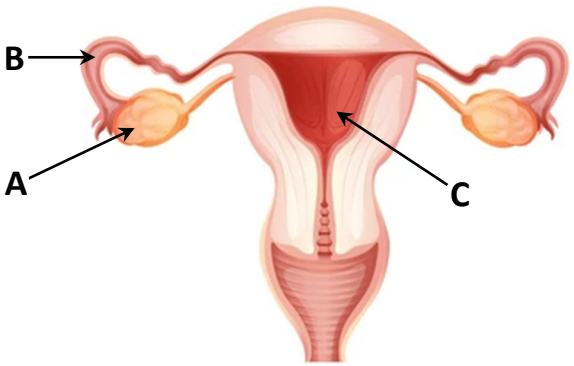
Comet **Asteroid**

Property	**Comet** or **asteroid** or **both**
Usually contains ice	
Mostly located in a belt between Mars and Jupiter	
Forms a tail when it passes through the inner solar system	
Often found in orbit around the Sun	
Usually located in the outer solar system	

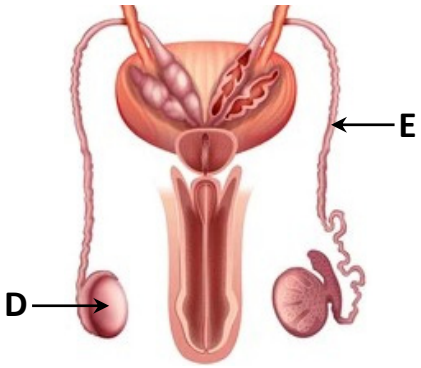
Question 8 **(15 marks)**

The diagrams below show the reproductive systems of a human female and a human male.

Female



Male



Complete the table by matching the words in the list below to the letters in the diagram.

Uterus **Sperm duct** **Ovary** **Testis** **Fallopian tube**

Letter	**Part of reproductive system**
A	
B	
C	
D	
E	

Question 9 **(15 marks)**

Electrical appliances use electrical energy to perform a specific function.
The electric kettle in the picture has an electrical power of 2300 W.

(a) Which of the following sentences describes electrical power?
Put a tick (✓) in the correct box.

A force that slows down the flow of current.	☐
The rate at which electrical energy is used in an electric circuit.	☐
The rate of movement of electrical charge through an electric circuit.	☐

(b) The potential difference (voltage) across the kettle is 230 V.
What is the current flowing through the kettle? Put a tick (✓) in the correct box.

0.1 A ☐ 10 A ☐ 100 A ☐

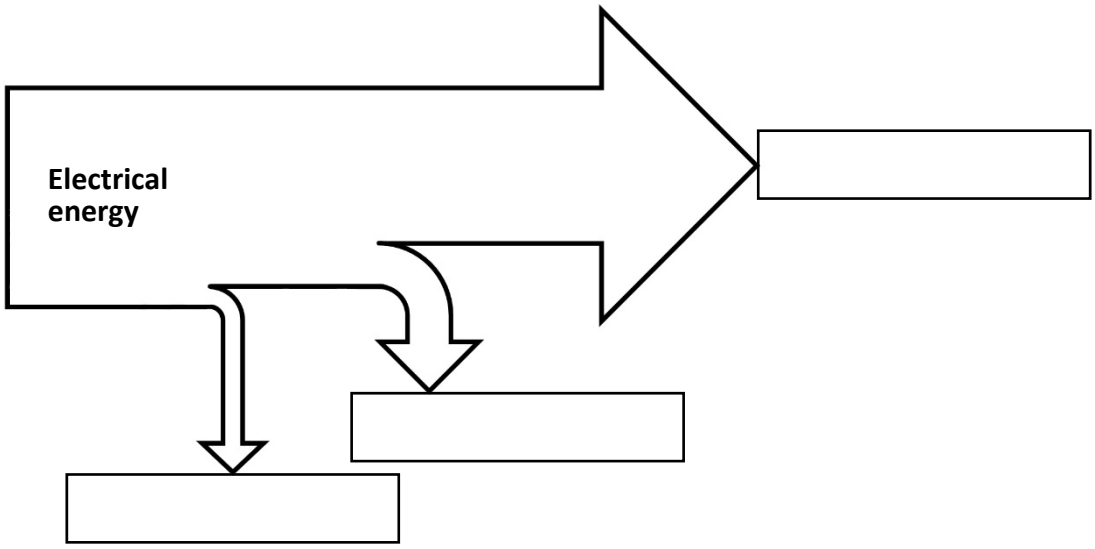
(c) Calculate the resistance of the kettle. Include the unit for your answer.

Calculation:

Electrical energy is converted to other forms of energy when a kettle is in use.
The kettle in the image above is energy efficient.

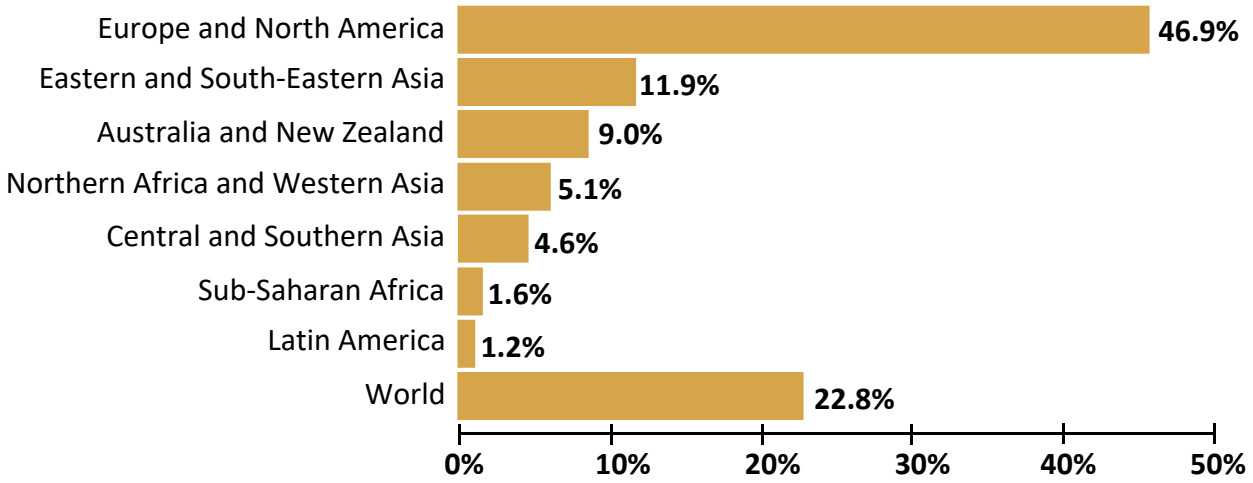
(d) Three forms of energy are listed below.
Use these words to label the Sankey diagram for the kettle.

Heat **Sound** **Light**



Question 10 **(15 marks)**

When electronic equipment is discarded, it is called 'e-waste'. This waste contains both valuable and hazardous materials. Not all countries process e-waste correctly. The majority of the world's electronic waste is not being managed safely.
The chart below shows the e-waste collection rates for different regions in 2019.



Adapted from "*The Sustainable Development Goals Report*", The United Nations

(a) Name the region (or regions) that had the highest rate of e-waste collection in 2019.

(b) What was the e-waste collection rate for the world in 2019?

(c) Suggest one way a country could improve e-waste collection rates.

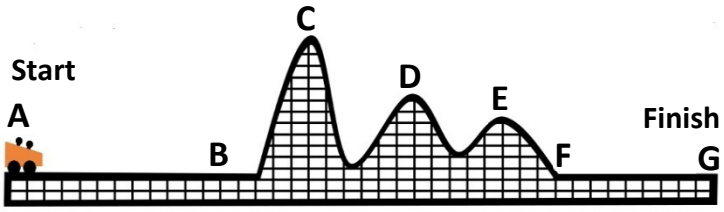
(d) Would you consider the above data a reliable source of information regarding e-waste disposal? Justify your answer.

Additional writing space for **Section A**.
Label all work clearly with the question number and part.

Section B — 210 marks

Question 11 **(30 marks)**

The diagram shows a rollercoaster car at the start of its track. The letters **A** to **G** indicate the position of the car at certain stages during its journey along the track.

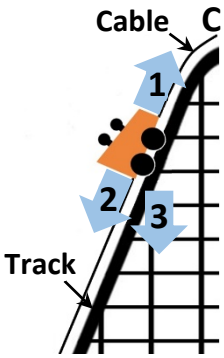


The car is stationary (not moving) at point **A**. It takes 10 seconds for the car to reach point **B**. As the car passes point **B** it is travelling at a speed of 2.5 m/s.

(a) Calculate the acceleration of the car between points **A** and **B**. Include the unit for your answer.

Calculation:

After the car passes point **B**, it is pulled upwards by a cable towards point **C** as shown in the diagram.
The blue arrows indicate three forces (**1**, **2** and **3**) acting on the car as it is being pulled upwards.



(b) Match each of the words from the following list with the correct force.

Weight **Friction** **Tension**

Arrow	1	2	3
Force			

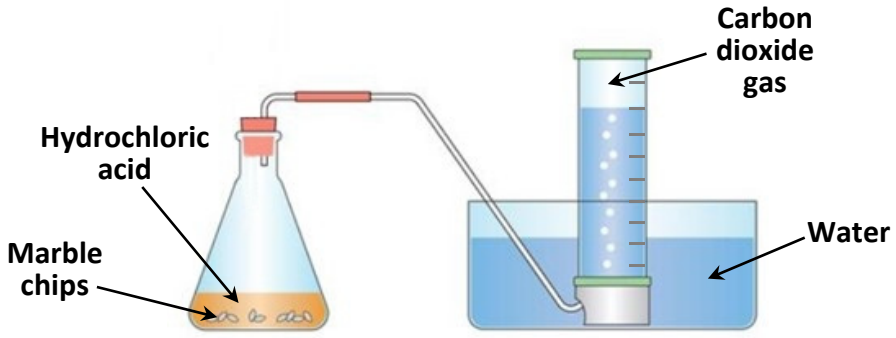
(c) Which letter represents the point on the track when the car has the most potential energy? Justify your answer.

(d) On the rollercoaster drawn above, the hills decrease in height from the start of the track to the finish point. Suggest a reason why.

Question 12 **(30 marks)**

Carbon dioxide gas can be produced in the laboratory by reacting hydrochloric acid with marble chips (calcium carbonate).

Three students were asked to measure the total volume of carbon dioxide gas produced when an excess of marble chips was reacted with 100 cm^3 of dilute hydrochloric acid. Each student set up the apparatus shown in the diagram. They each repeated the investigation three times. Their results are shown in the table below.



	Run 1	Run 2	Run 3
Student 1	220 cm^3	210 cm^3	230 cm^3
Student 2	240 cm^3	240 cm^3	240 cm^3
Student 3	220 cm^3	220 cm^3	220 cm^3

The correct total volume of gas that should have been collected was **240 cm^3**.

Answer questions **(a)**, **(b)** and **(c)** by putting a tick (✓) in the correct box.

(a) Which student collected data that were precise but not accurate?

Student 1 ☐ Student 2 ☐ Student 3 ☐

(b) Which student collected data that were neither accurate nor precise?

Student 1 ☐ Student 2 ☐ Student 3 ☐

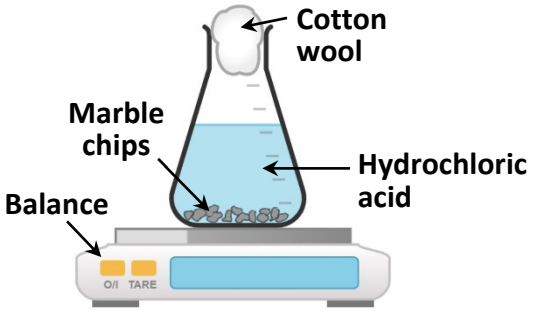
(c) Which student collected data that were both accurate and precise?

Student 1 ☐ Student 2 ☐ Student 3 ☐

The students carried out a second investigation.

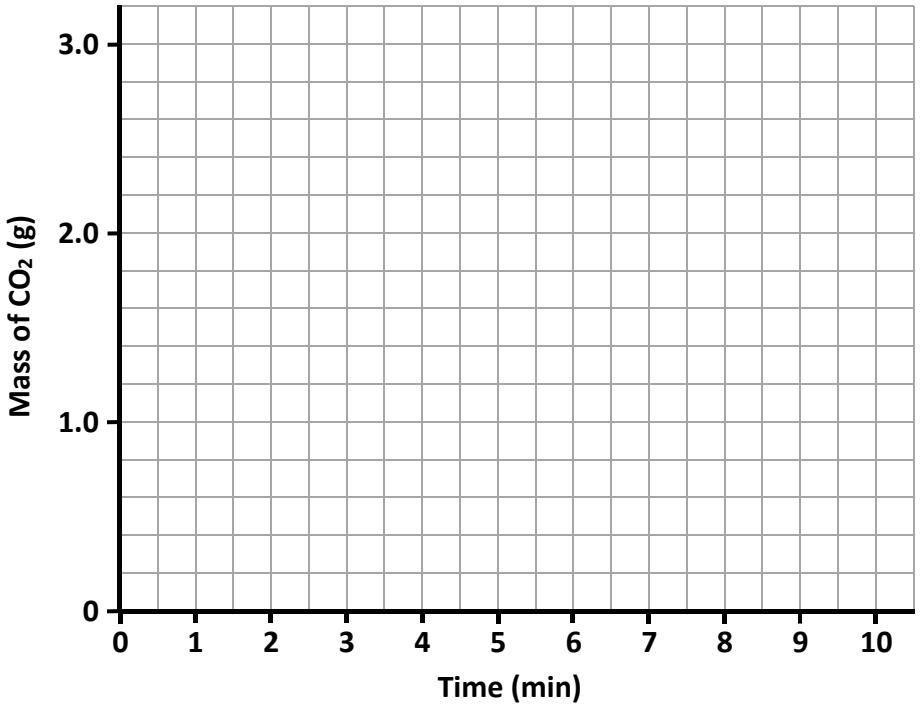
This time they measured the mass of carbon dioxide produced at regular intervals using the apparatus on the right.

The data collected by the students are shown below.



Time (min)	0	1	2	3	4	5	6	7	8	9	10
Mass of CO_2 (g)	0	0.8	1.4	2.0	2.4	2.6	2.8	2.9	3.0	3.0	3.0

(d) In the space below, draw a line graph of the students' results.



(e) At what time was the reaction complete?

(f) On your graph above, draw a dashed line (- - - - - -) to show the result you would expect if the above investigation was repeated exactly as before, but using smaller marble chips of the same total mass.

Question 13 **(30 marks)**

A group of scientists carried out an investigation to see if cress seeds would grow at the same rate in lunar soil (soil from the Moon) compared to Earth soil.

Five cress seeds were planted in lunar soil and five cress seeds were planted in Earth soil.

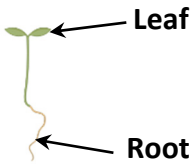
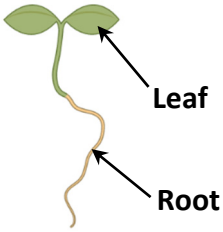
(a) Write a suitable hypothesis for this investigation.

(b) Identify the variable changed by the scientists during the investigation.

(c) Name one variable the scientists should have kept constant during the investigation.

(d) Explain why five cress seeds were used instead of just one.

The growth of the seedlings was monitored over a number of days. The table below shows the results for the investigation on days 6 and 16 after the experiment was set up.

	Cress grown in lunar soil	Cress grown in Earth soil
Day 6		
Day 16		

(e) Do the results support your hypothesis you wrote in part **(a)**? Justify your answer.

In 2019, a robotic spacecraft landed on the Moon carrying an experiment using cress. The cress was placed in a tin with silkworms, soil and water. The organisms in the tin had access to sunlight through a tube. The cress produced oxygen for the silkworms and the silkworms produced carbon dioxide for the cress.

(f) **(i)** What name is given to the relationship between organisms where they rely on each other for survival? Put a tick (✓) in the correct box.

Competition ☐ Adaptation ☐ Interdependence ☐

(ii) Name the biological process carried out by the cress that produced oxygen for the silkworms.

(iii) Name two factors that could have affected the rate of this biological process in the above experiment.

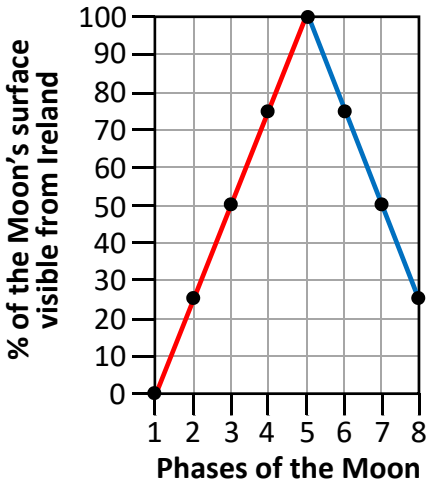
Question 14 **(30 marks)**

As the Moon orbits the Earth, the percentage of the Moon's surface visible from Earth changes. These changes are called the phases of the Moon.

The graph below shows the percentage (%) of the surface of the Moon visible from Ireland during eight consecutive phases of the Moon.

The image below represents the appearance of the Moon as seen from Ireland during phase **3**.

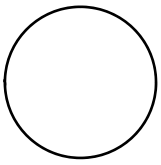
Examine the graph and the image and answer the questions that follow.



The Moon as seen during phase 3

(a) The phases of the Moon are 'waxing' when the portion of the Moon visible from Earth increases over time.
Which line (red or blue) represents the phases of the Moon that are waxing?

(b) In the circle on the right, shade in the part of the Moon that would appear dark when seen from Ireland during phase **7**.



(c) Which of the Moon phases from **1** to **8** represents the phase of the Moon when a total solar eclipse (an eclipse of the Sun) might occur on Earth?

(d) Explain why total solar eclipses only occur when the Earth and the Sun are on opposite sides of the Moon.

The table below shows the distance of the Moon from Earth on different days during a month of the year. The percentage (%) of the Moon visible from Earth is also shown.

Date	Approximate distance of the Moon from Earth ($\times 10^3$ km)	% of the Moon visible from Earth
8	393	10
12	404	44
16	396	81
20	377	100
24	368	80
28	371	47

(e) A total lunar eclipse (an eclipse of the Moon) occurred during this month.
On which date did it occur?

(f) When the Moon is visible, it is because light from the Sun reflects off its surface towards Earth. On which date did it take the least amount of time for the light to reach Earth from the Moon? Justify your answer.

(g) Does the data in the table suggest that the Moon travels in a regular circular path around the Earth? Justify your answer.

Question 15 **(30 marks)**

Two groups of students carried out a quadrat survey of a field. They identified five different plants. The groups also calculated the percentage (%) frequency of each of these plants. Group **A** took one quadrat sample. Group **B** took five quadrat samples. The results for both groups are shown below.

Group A

Plant type	Daisy	Plantain	Dandelion	Buttercup	Grass
Quadrat 1	✓	✓	✓	✓	✓
% Frequency	100	100	100	100	100

Group B

Plant type	Daisy	Plantain	Dandelion	Buttercup	Grass
Quadrat 1	×	✓	×	✓	✓
Quadrat 2	✓	×	✓	✓	✓
Quadrat 3	×	✓	×	✓	✓
Quadrat 4	✓	✓	✓	✓	✓
Quadrat 5	✓	✓	×	×	✓
% Frequency	60	80		80	100

(a) How could the students have identified any unknown plants?

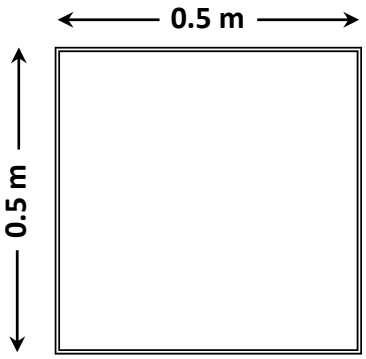
(b) Which group, **A** or **B**, carried out a better survey? Justify your answer.

(c) Calculate the percentage (%) frequency of dandelion for the results obtained by group **B**.

Calculation:

(d) Is percentage (%) frequency an example of qualitative or quantitative data? Explain your answer.

The size of the quadrat used by the students was 0.5 m × 0.5 m.



(e) Calculate the area of the quadrat in m^2.

Calculation:

(f) On further investigation of the field, group **B** identified a plant called 'ragwort'. On average there were two ragwort plants in every quadrat they surveyed. If the area of the field was 3500 m^2, calculate the total number of ragwort plants in the field.

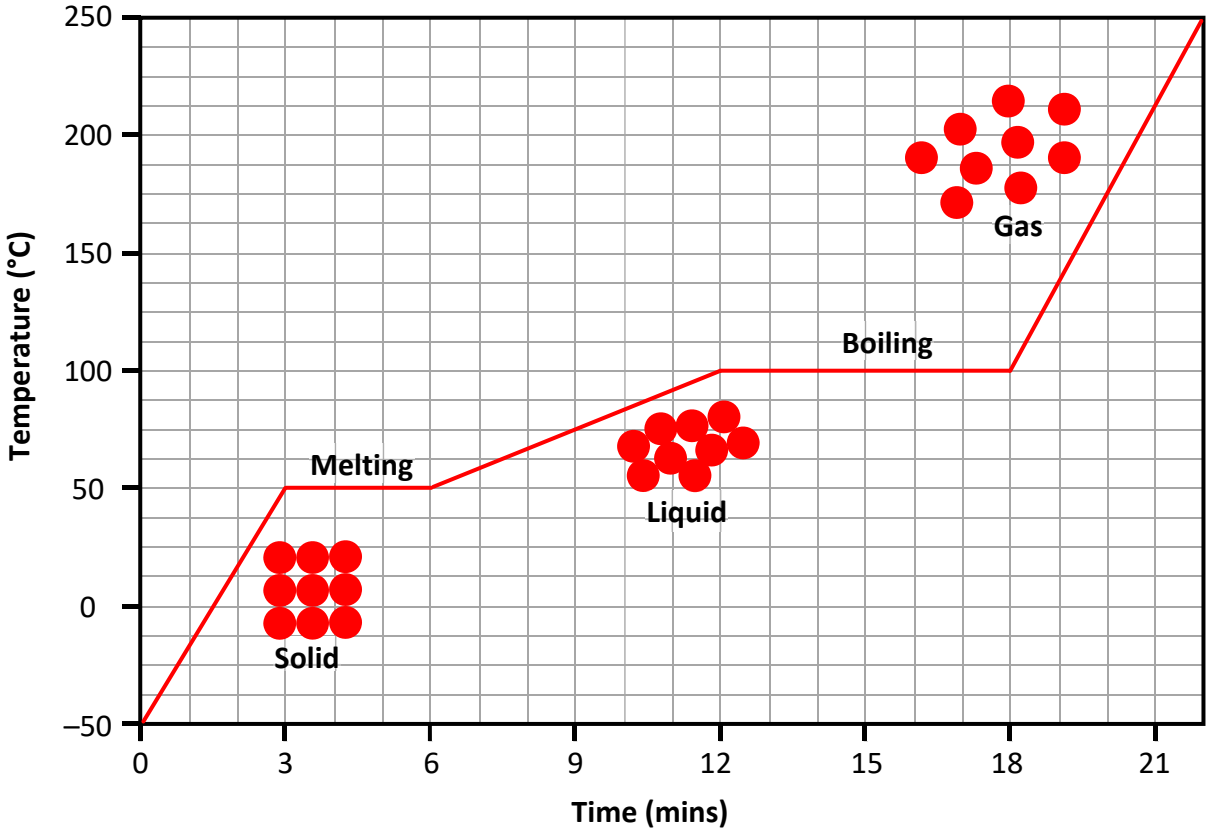
Calculation:

Question 16 **(30 marks)**

Matter exists as solids, liquids and gases. Substance **X** is a solid at –50 °C. A sample of substance **X** was heated at a constant rate. The time taken for substance **X** to change from a solid to a liquid to a gas was measured.

The graph below shows the results obtained.

Examine the graph and answer the questions that follow.



Answer questions **(a)**, **(b)** and **(c)** by putting a tick (✓) in the correct box.

(a) In which state does substance **X** have the highest temperature?

Solid ☐ Liquid ☐ Gas ☐

(b) In which state does substance **X** have a fixed volume and shape?

Solid ☐ Liquid ☐ Gas ☐

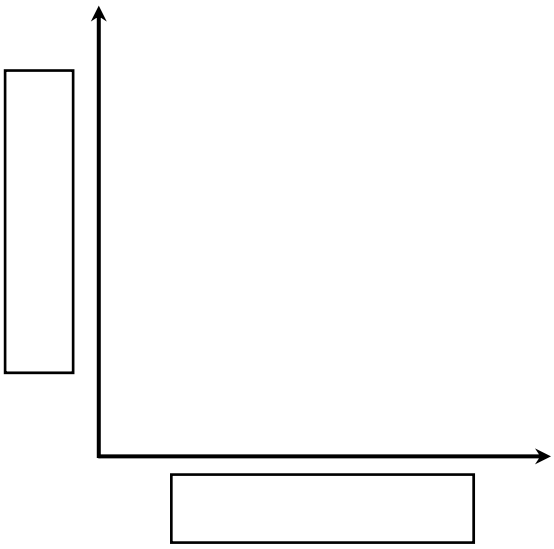
(c) In which state does substance **X** have a fixed volume but variable shape?

Solid ☐ Liquid ☐ Gas ☐

(d) At what temperature does substance **X** change from a solid to a liquid?

(e) How long did it take substance **X** to completely evaporate (change from a liquid to a gas) after it reached its boiling point?

(f) Melting and boiling are examples of endothermic processes.
In the space below, draw an energy profile diagram for an endothermic process.
Label both axes.



(g) Which one of the following statements correctly describes what happens to the particles in substance **X** as the temperature increases? Put a tick (✓) in the correct box.

The energy of the particles increases and they move closer together.	☐
The energy of the particles decreases and they move closer together.	☐
The energy of the particles increases and they move further apart.	☐
The energy of the particles decreases and they move further apart.	☐

(h) State one way of converting substance **X** from a gas back to a liquid.

Question 17 **(30 marks)**

Read the following passage, taken from a NASA website, and answer the questions that follow.

Carbon is the backbone of life on Earth. We are made of carbon, we eat carbon, and our economies, homes and means of transport are built on carbon. We need carbon, but that need is linked with one of the most serious problems facing us today: global climate change. Most of Earth's carbon is stored in rocks. The rest is in the ocean, in the biosphere and in fossil fuels. These are referred to as 'carbon reservoirs'.

Carbon flows between each reservoir in an exchange called the 'carbon cycle'. Any process that moves carbon out of one reservoir puts more carbon into other reservoirs. Processes that put carbon gases into the atmosphere result in warmer temperatures on Earth.

All the carbon on the planet Venus has entered its atmosphere. On Earth, the carbon cycle maintains a balance that prevents all the carbon from being stored in one reservoir only. This balance helps keep Earth's temperature relatively stable. **earthobservatory.nasa.gov**

(a) **(i)** Explain why carbon is 'the backbone of life on Earth'.

(ii) Where is most of Earth's carbon stored?

(b) Several processes are involved in the transfer of carbon from one reservoir to another. Some of these carbon transfer processes are listed below.

Combustion **Dissolving** **Weathering** **Decomposition**

(i) The table below refers to carbon transfer processes. In each case, carbon is transferred from reservoir **A** to reservoir **B**. Use the words in the list above to identify the carbon transfer process in each case. (The first one is completed for you.)

Reservoir A	Reservoir B	Carbon transfer process
Atmosphere	Ocean water	Dissolving
Fossil fuel	Atmosphere	
Land plants	Soil	
Limestone	Ocean or fresh water	

(ii) Name a biological process, other than decomposition, which adds carbon dioxide to the atmosphere.

(c) The passage refers to the planet Venus.
The table below compares Earth and Venus.

	Earth	**Venus**
Diameter (km)	12 756	12 104
Approximate distance to the Sun ($\times 10^6$ km)	151	108
Time to orbit the Sun (Earth days)	365	225
Mass (kg)	5.97×10^{24}	4.87×10^{24}
Density (kg/m^3)	5.52	5.24
Average surface temperature (°C)	14	460
Liquid water present	Yes	No
Composition of atmosphere	78% nitrogen, 21% oxygen, 0.04% carbon dioxide	96% carbon dioxide, 3.5% nitrogen

(i) Venus is often called 'Earth's planetary twin'.
State two pieces of evidence from the table to support this.

(ii) The atmosphere on Venus has a very high percentage of carbon dioxide compared to Earth.
Using the data in the table, suggest one reason why.

Additional writing space for **Section B**.
Label all work clearly with the question number and part.

Acknowledgements

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Junior Cycle Final Examination – Common Level

Science

Monday 10 June

Morning 9:30 – 11:30