

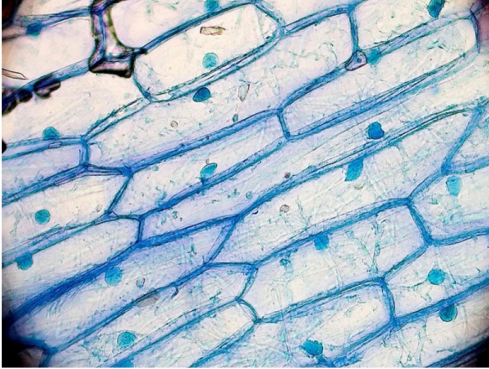
## Question 1

**Question 1**

**(15 marks)**

The pictures below show cells from an onion (plant cells) and from the human cheek (animal cells).

**Onion (plant cells)**



**Human cheek (animal cells)**



**N**

**N**

- (a) For each picture, draw an arrow from the letter **N** written below the picture to the nucleus of a cell.
- (b) The names of some of the other parts of cells are listed below.

**Cytoplasm**

**Cell membrane**

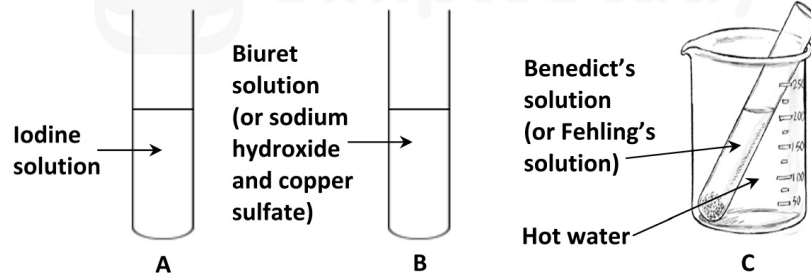
**Cell wall**

Use the words in the list to complete the table to name each cell part described.

Description of cell part	Name
Controls the movement of substances in and out of cells	
Found in plant cells only	
All of the material inside a cell, except for the nucleus	

**Question 2**

- (c) A group of students were given an unknown sample of food. They placed equal volumes of the sample into three test tubes and carried out various food tests as shown in the diagrams. (15)



The results were recorded in the table as shown.

RESULTS	
Test tube	Final colour
A	Red-brown
B	Purple
C	Blue

- (i) Based on the findings, which food type did the sample contain? \_\_\_\_\_
- (ii) Which test tube contained this food type? \_\_\_\_\_
- (iii) Why was a hot water bath used for test tube C?  
\_\_\_\_\_

- (iv) Describe how the students could carry out a control experiment for this investigation. A labelled diagram may help your answer.

\_\_\_\_\_

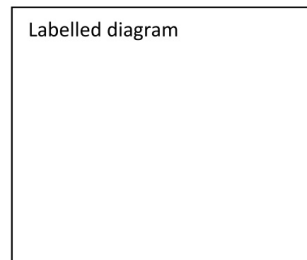
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



- (v) Describe how to test a food sample for the presence of fat.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

FOR  
examiner  
use only

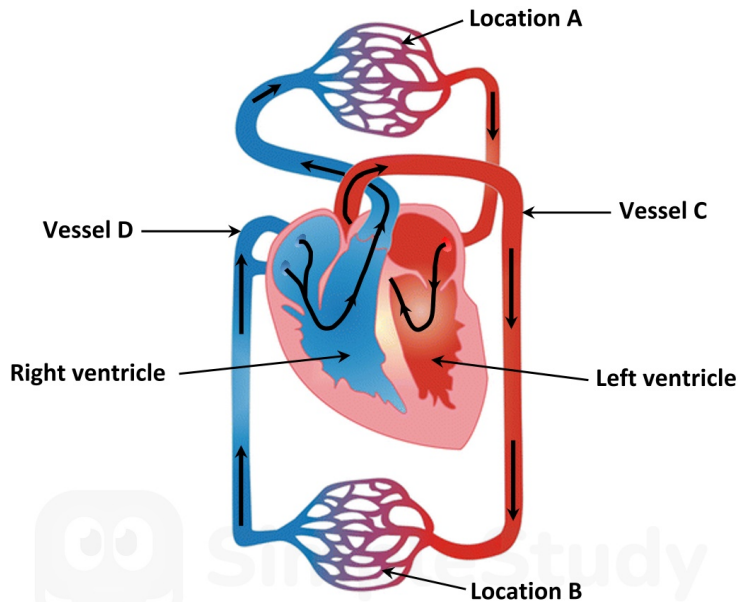
(1) | (2)

### Question 3

**Question 10**

**(15 marks)**

The diagram shows the human heart and some of the blood vessels of the circulatory system. The arrows indicate the direction in which the blood flows as it travels around the body.



- (a) The table below lists statements about the diagram. Indicate if each statement is true or false by putting a tick (✓) in the correct column.

Statement	True	False
The blood in vessel <b>C</b> is deoxygenated.		
The organs found at location <b>A</b> are part of the respiratory system.		
Carbon dioxide leaves the blood at location <b>B</b> .		
Vessel <b>D</b> is a vein.		

- (b) Vessel **C** has thicker walls than vessel **D**. Explain why.

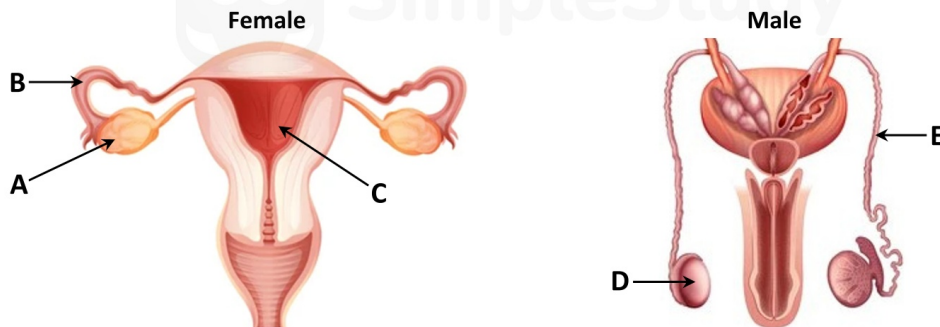



Question 5

Question 8

(15 marks)

The diagrams below show the reproductive systems of a human female and a human 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 6

### Question 4

(15 marks)

The passage below is about the three states of matter.  
The following five words are missing from the passage:

chemical

conservation

evaporation

melting

physical

Write the missing words in the spaces provided.

There are three states of matter: solid, liquid and gas. When a solid is heated it turns into a liquid – this change of state is called \_\_\_\_\_. When a liquid is heated it turns into a gas – this change of state is called \_\_\_\_\_.

Liquid water freezes to become solid ice; this is an example of a \_\_\_\_\_ change. However, when electricity is passed through liquid water it is converted into its elements, hydrogen and oxygen; this is an example of a \_\_\_\_\_ change.

When liquid water freezes, the mass of the ice formed is the same as the mass of the liquid water. This is an example of \_\_\_\_\_ of mass.

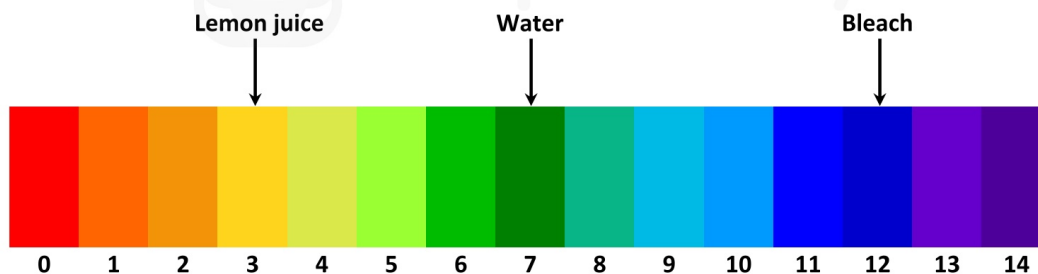


## Question 7

### Question 6

(15 marks)

The diagram below shows the pH of some common household substances.



- (a) Classify each of the substances in the diagram as acidic *or* basic *or* neutral.

Substance	Acidic <i>or</i> Basic <i>or</i> Neutral
Lemon juice	
Water	
Bleach	

- (b) Some insect stings are acidic and some are basic.

A type of cream can be used to treat (by neutralisation) some insect stings. One of the ingredients in the cream is sodium bicarbonate, which is a base.

Which type of sting (acidic *or* basic) could this cream be used to treat?



- (c) Identify one product from the list below which is commonly formed when an acid and a base react.

Water

Oxygen

Hydrogen

## Question 8

### Question 10

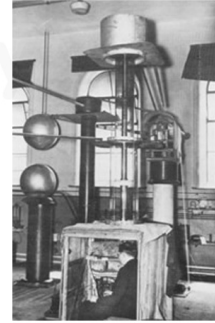
(15 marks)

In 1932, the Irish physicist Ernest Walton and the English physicist John Cockroft produced the first artificial splitting of a nucleus by bombarding atoms of lithium with high speed protons.

Walton and Cockroft showed that mass is converted into energy when a nucleus is split. This was the first experimental proof of Albert Einstein's famous equation,  $E = mc^2$ .

The photograph shows Walton carrying out this experiment.

For their work, Walton and Cockroft won the Nobel Prize in physics in 1951.



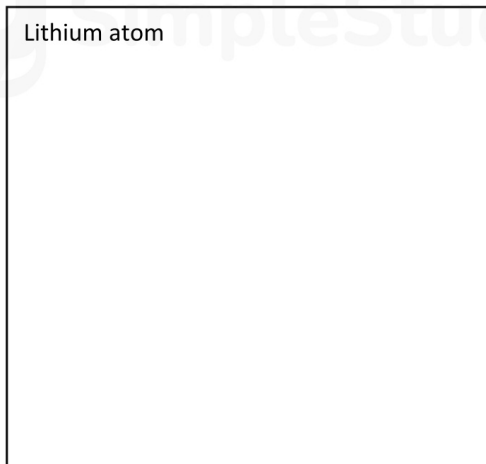
(a) Protons are one type of particle found in the nucleus of an atom.

(i) Name the other type of particle found in the nucleus of an atom.

(ii) Compare the charge of the proton with the charge of the other particle you have named.

(b) In the space below, draw a labelled diagram of an atom of lithium showing the positions of the nucleus and the electrons.



The work of Walton and Cockroft saw the dawn of the nuclear age.

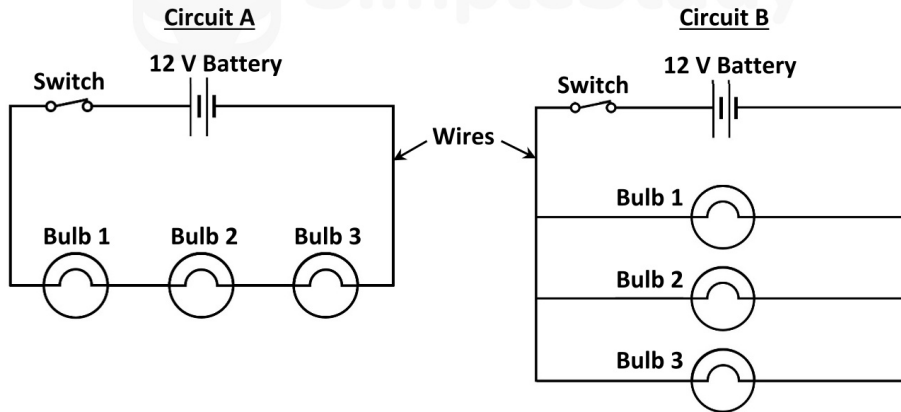
(c) State one advantage of using nuclear power to generate electricity.

## Question 9

### 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 10

### 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.



Comet



Asteroid

Write the word 'comet' or 'asteroid' or 'both' in the table next to each property.

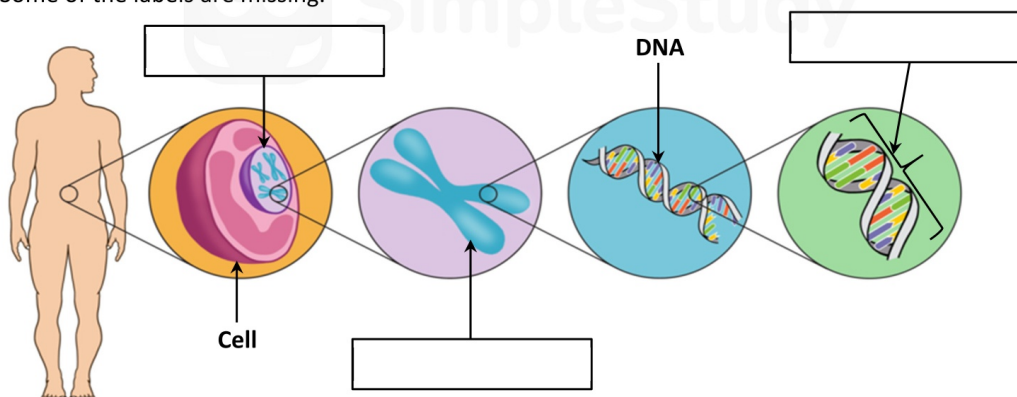
Property	Comet or asteroid or both
Usually contains ice	
Mostly located in a belt between Mars and Jupiter	
Forms a tail when it passes through the inner solar system	
Often found in orbit around the Sun	
Usually located in the outer solar system	

## Question 11

### Question 12

(30 marks)

The diagram illustrates the organisation of genetic information within human cells. Some of the labels are missing.



- (a) Use each of the words listed below to complete the labels on the diagram above.

**Chromosome**

**Nucleus**

**Gene**

- (b) Name an instrument which could be used in the laboratory to view human cells.

A normal human brain cell contains 46 chromosomes.

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

- (c) How many chromosomes are present in a human sperm cell?

23

46

69

92

- (d) The sperm cell fertilises an egg cell. How many chromosomes should be present in the resulting zygote?

23

46

69

92

- (e) Coat colour in a breed of dog is controlled by a single gene. There are two possible versions (alleles) of this gene – black coat (**B**) and white coat (**b**). The gene for black coat is dominant to the gene for white coat.

In their cells, dogs contain two versions of the gene for coat colour. Possible pairs are **BB** (black), **Bb** (black) and **bb** (white).

The table below illustrates a genetic cross between a male dog with genotype **Bb** and a female dog with genotype **bb**. The table is



incomplete.

	Male dog	Female dog
Parent genotype	( <b>Bb</b> )	( <b>bb</b> )
Sex cells produced	( <b>B</b> ) or ( <b>b</b> )	( <b>b</b> )
Offspring genotype	(   ) or (   )	

(i) Complete the table by writing the two possible genotypes of the offspring that could result from this cross.

(ii) What is the probability of the offspring having a black coat?  
Put a tick (✓) in the correct box.

0%       25%       50%       75%       100%

(iii) If a different male dog, with genotype **BB**, was bred with the same female dog, what would be the probability of their offspring having a black coat?  
Put a tick (✓) in the correct box.

0%       25%       50%       75%       100%

**Question 12**

**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.

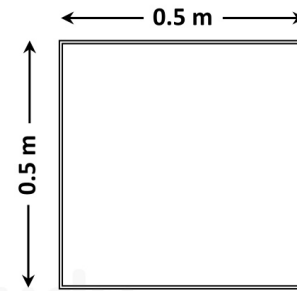
The size of the quadrat used by the students was  $0.5 \text{ m} \times 0.5 \text{ m}$ .

- (e) Calculate the area of the quadrat in  $\text{m}^2$ .

Calculation:



SimpleStudy



- (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  $3500 \text{ m}^2$ , calculate the total number of ragwort plants in the field.

Calculation:



SimpleStudy

## Question 13

### Question 11

**(30 marks)**

Sodium chloride (table salt) is a white crystalline solid.

Water is a solvent with a boiling point of 100 °C.

Sodium chloride can dissolve in water.



A student was asked to investigate what effect adding salt has on the boiling point of water.

- (a) Write a suitable hypothesis for this investigation.


- (b) What is meant by the boiling point of a substance?


- (c) The laboratory instrument used to measure the mass of the salt is shown in the photograph.

Identify this instrument.

--



- (d) In the space below, draw a labelled diagram of the arrangement of the apparatus used to determine the boiling point of water.

Labelled diagram

--

The student collected the following data for the boiling point of the solutions made when various masses of salt were dissolved in 60 cm<sup>3</sup> of water.

Mass of salt (g)	Boiling point (°C)					Average boiling point (°C)
0	100	101	100	100	102	100.6
2	101	104	101	100	103	101.8
4	103	105	104	106	107	
6	106	108	107	107	108	107.2
8	108	110	109	111	110	109.6

- (e) Calculate the average boiling point when 4 g of salt was dissolved in 60 cm<sup>3</sup> of water.

Calculation

- (f) Suggest a reason why the student repeated the investigation five times for each mass of salt used.


- (g) Does the data support the hypothesis you wrote in part (a)? Explain your answer.

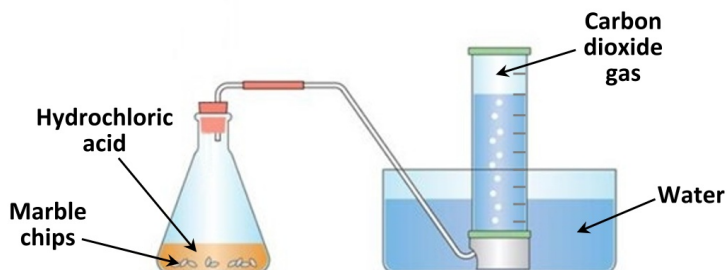

## Question 14

### 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<sup>3</sup> 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
<b>Student 1</b>	220 cm <sup>3</sup>	210 cm <sup>3</sup>	230 cm <sup>3</sup>
<b>Student 2</b>	240 cm <sup>3</sup>	240 cm <sup>3</sup>	240 cm <sup>3</sup>
<b>Student 3</b>	220 cm <sup>3</sup>	220 cm <sup>3</sup>	220 cm <sup>3</sup>

The correct total volume of gas that should have been collected was **240 cm<sup>3</sup>**.

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

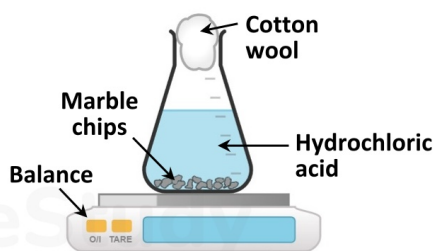
(c) Which student collected data that were both accurate and precise?

Student 1       Student 2       Student 3

The students carried out a second investigation.

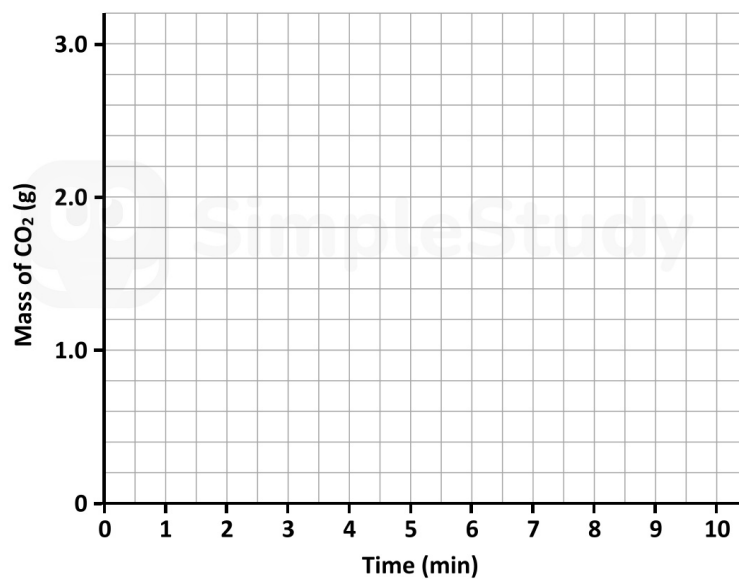
This time they measured the mass of carbon dioxide produced at regular intervals using the apparatus on the right.

The data collected by the students are shown below.



Time (min)	0	1	2	3	4	5	6	7	8	9	10
<b>Mass of CO<sub>2</sub> (g)</b>	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 15

### 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.

--

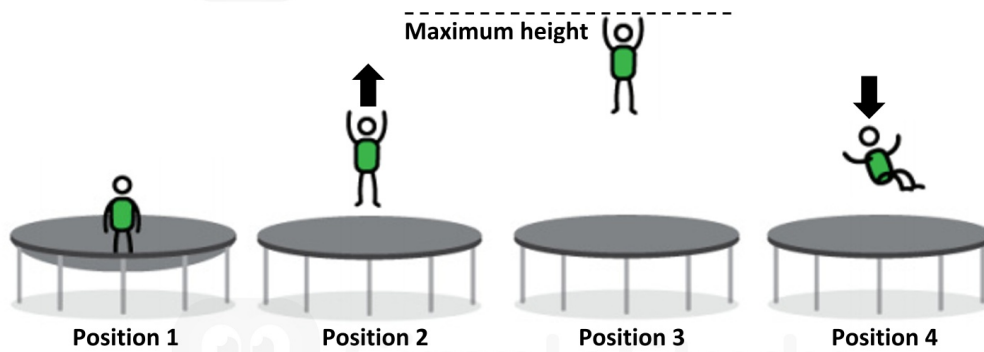
## Question 16

### Question 15

(60 marks)

Energy exists in many forms. The energy stored by an object due to its position or shape is called potential energy. The energy of an object due to its motion is called kinetic energy.

Potential energy is converted to kinetic energy when a person jumps on a trampoline. The diagrams show the position of a person at certain times while jumping.



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

(i) Identify a position where the person has least kinetic energy.

Position 1  Position 2  Position 3  Position 4

(ii) Identify a position where the trampoline has its greatest potential energy.

Position 1  Position 2  Position 3  Position 4

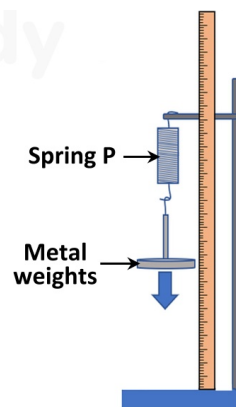
(b) Name a force responsible for the motion of the person in position 4.

(c) Heat energy is also produced when a person uses a trampoline. Describe one possible source of this heat energy.



An experiment was carried out to investigate the relationship between the length of a trampoline spring and the force applied to it.

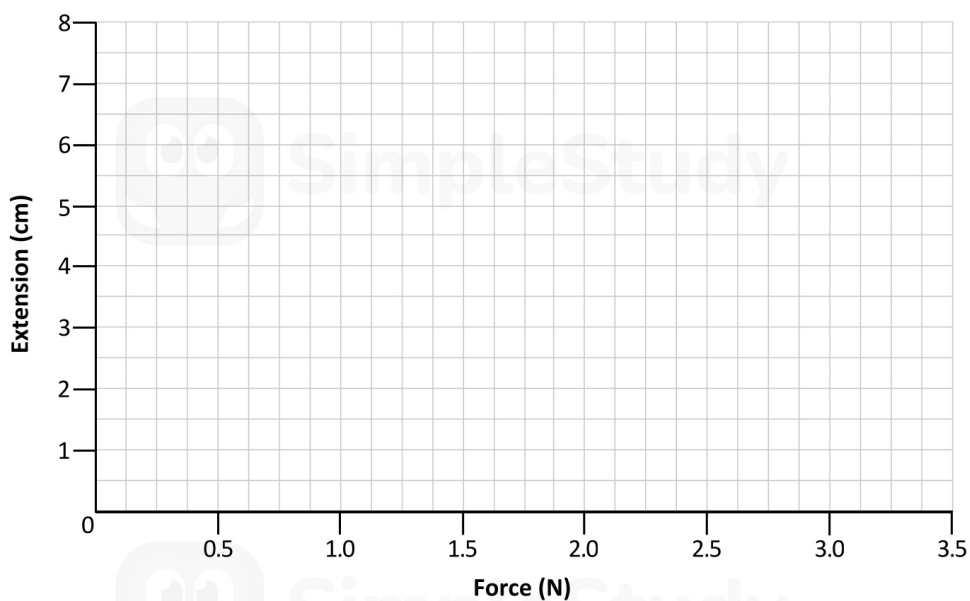
The experiment was carried out using spring **P** as shown. It was then repeated using spring **Q**, taken from a different trampoline.



Forces were applied to the springs by attaching known weights. The extension of the springs was calculated for each force applied. The results are shown in the table.

Force (N)		0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Extension (cm)	Spring P	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
	Spring Q	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0

(d) In the space below, draw a line graph of force against extension for **each** spring.




(e) State two conclusions supported by the graphs you have drawn.



(f) Spring **Q** had a length of 11 cm before any force was applied to it. Calculate its total length when a force of 1.25 N was applied.

Calculation

- (g) On Earth, a mass of 128 g has a weight of approximately 1.25 N.  
Explain the underlined terms.

 SimpleStudy

- (h) A trampoline manufacturer is trying to decide which spring, **P** or **Q**, to use when making a new trampoline.  
Which spring, **P** or **Q**, stores more energy when it is stretched by 3 cm?  
Justify your answer.

 SimpleStudy