



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Cycle Final Examination 2022

Science

Common Level

Monday 13 June Morning 9:30 – 11:30

360 marks

Examination Number

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Day and Month of Birth

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For example, 3rd February is
entered as 0302

Centre Stamp

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Instructions

Write your Examination Number and your Day and Month 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	5 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)**

Scientists use instruments, such as the ones shown below, to take measurements.

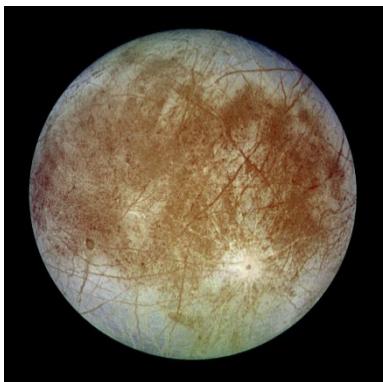
**Thermometer****Voltmeter****Stopwatch****Ohmmeter****Graduated cylinder**

For each of the physical quantities named in the table below, choose an instrument shown above that is used to measure that physical quantity.

Physical Quantity	Instrument
Volume	
Time	
Temperature	
Resistance	
Potential difference	

Question 2**(15 marks)**

The images below show three celestial objects found in our solar system.
The objects are not shown on the same scale.

**Moon****Star****Planet**

- (a)** Match the name of each celestial object with the correct description in the table below.

Description	Name of celestial object
Consists of burning gas	
Orbits a planet	
Orbits a star	

- (b)** Which of the celestial objects above has the largest diameter?

- (c)** Draw a labelled diagram to show the positions of a moon, a star and a planet during a lunar eclipse, i.e., an eclipse of the moon.

Question 3

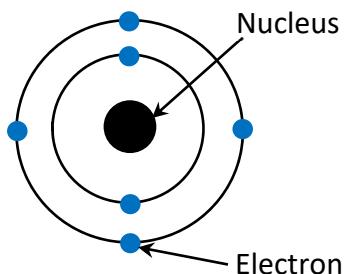
(15 marks)

An atom of element X is shown in the diagram.

- (a) Name one subatomic particle found in the nucleus of an atom.

For more information about the study, please contact Dr. [REDACTED] at [REDACTED].

- (b)** Answer the following question by putting a tick (✓) in the correct box.



The charge on the electron is:

Positive

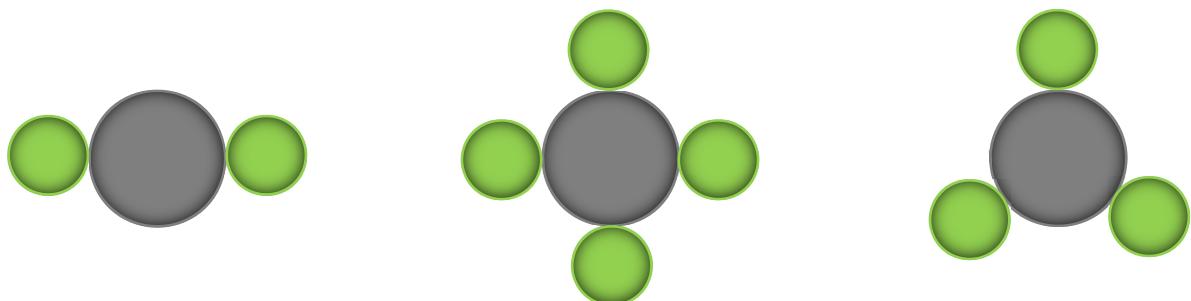
Negative

Neutral

- (c) Place an X on the Periodic Table shown below to indicate the position of element X.
You may use the Periodic Table on page 79 of the *Formulae and Tables* booklet to help you answer this question.

A large, empty 10x10 grid of squares, likely used for drawing or writing practice.

- (d) Element X forms a compound with hydrogen. Element X is shown in grey. Hydrogen is shown in green. Circle the diagram below which represents the compound formed. Justify your answer.



Question 4**(15 marks)**

The theory of evolution by natural selection describes how organisms evolve and change over generations.

- (a) A student made the following statements about the theory of evolution by natural selection. Indicate if each of the statements is true or false by putting a tick (✓) in the correct column.

Statement	True	False
Evolution involves genetic mutations.		
Natural selection is based on competition.		
Natural selection involves survival of the weakest.		

Organisms can evolve and adapt, making them better suited to their environment. The organisms pictured below have adaptations that help them survive in their habitats. A fox is an omnivore (an animal that eats plant and animal matter). A rose bush is an autotroph (an organism that makes its own food).

**Fox****Rose bush**

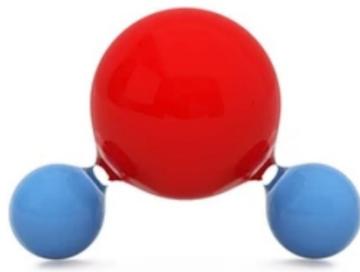
- (b) Describe one way a fox is adapted to help it survive in its habitat.

- (c) Describe one way a rose bush is adapted to help it survive in its habitat.

Question 5**(15 marks)**

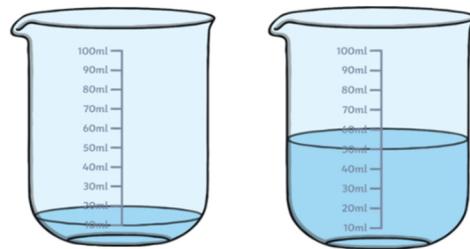
Water is a colourless, tasteless substance. Water contains hydrogen and oxygen chemically combined.

- (a) The picture on the right shows a model of a water molecule. The chemical formula for water is H_2O . Does the red sphere in the model represent hydrogen or oxygen?



- (b) In the diagram below both beakers contain pure water at 20 °C. Which one of the properties listed below is the same for the water in each beaker? Put a tick (✓) in the correct box.

Mass	<input type="checkbox"/>
Weight	<input type="checkbox"/>
Density	<input type="checkbox"/>
Volume	<input type="checkbox"/>



A student investigated the solubility of a compound in water. She added some of the compound to 50 cm³ of water at 20 °C and stirred the mixture until the compound was completely dissolved. She repeated this until no more of the compound dissolved. She found that the greatest mass of the compound that she was able to dissolve was 15 g.

- (c) Calculate the solubility of the compound in g/cm³.

Calculation

- (d) Describe two things that the student could have done to allow a greater mass of the compound to be dissolved.

Question 6**(15 marks)**

The photographs below show the Moon as seen from the Earth at certain times during the lunar cycle. The images are not in the correct order.

**Image 1****Image 2****Image 3****Image 4**

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

- (a)** Which image, **1**, **2**, **3** or **4**, shows a New Moon?

Image 1 Image 2 Image 3 Image 4

- (b)** Which image, **1**, **2**, **3** or **4**, shows the Moon during a waxing crescent phase?

Image 1 Image 2 Image 3 Image 4

- (c)** Approximately how long is the lunar cycle?

1 day 1 week 1 month 1 year

- (d)** Explain why the Moon is visible from Earth.

- (e)** An object weighs less on the Moon than on Earth.

Put a tick (\checkmark) in the box next to the sentence that explains why:

It is colder on the Moon than on Earth.

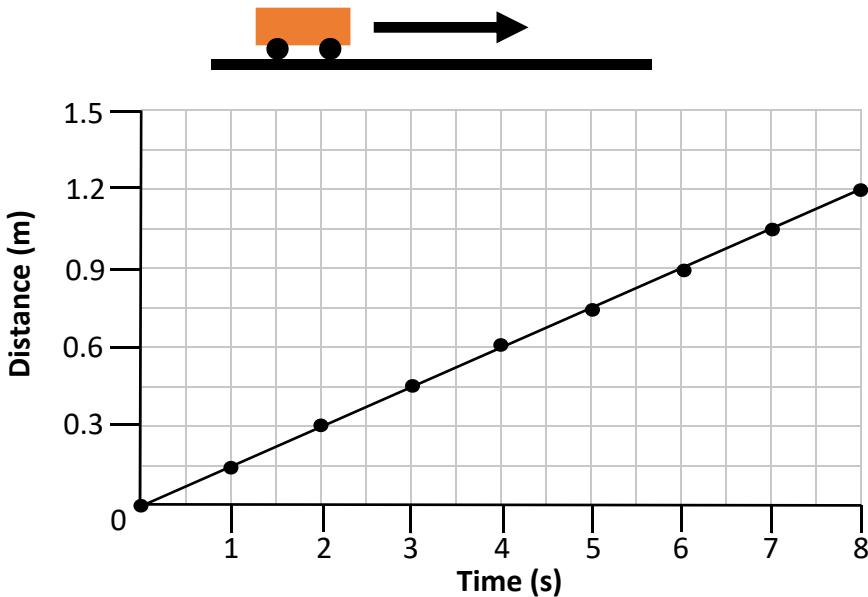
The Moon has a smaller radius than Earth.

The Moon has a smaller mass than Earth.

The Moon has no atmosphere.

Question 7**(15 marks)**

A trolley moves along a horizontal track. The distance of the trolley from its starting point was measured every second for 8 seconds. The results are shown in the graph below.



- (a) Calculate the average speed of the trolley. Include the unit for your answer.

Calculation

The student carried out a second distance-time investigation when the track was sloped.



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

- (c) The student wanted to be able to make a fair comparison between the two investigations. Describe one thing the student should have done to allow a fair comparison.

- (d) On the graph above, sketch the expected result for **your** hypothesis.

Question 8**(15 marks)**

During your studies you learned about a scientific model that helps us understand the origin of the universe.

- (a)** Name the model you studied.

Outline two pieces of evidence that support this model.

In September 2021, the SpaceX Inspiration4 mission successfully orbited the Earth. This was the world's first all-civilian space mission and represents a new era for human space exploration.



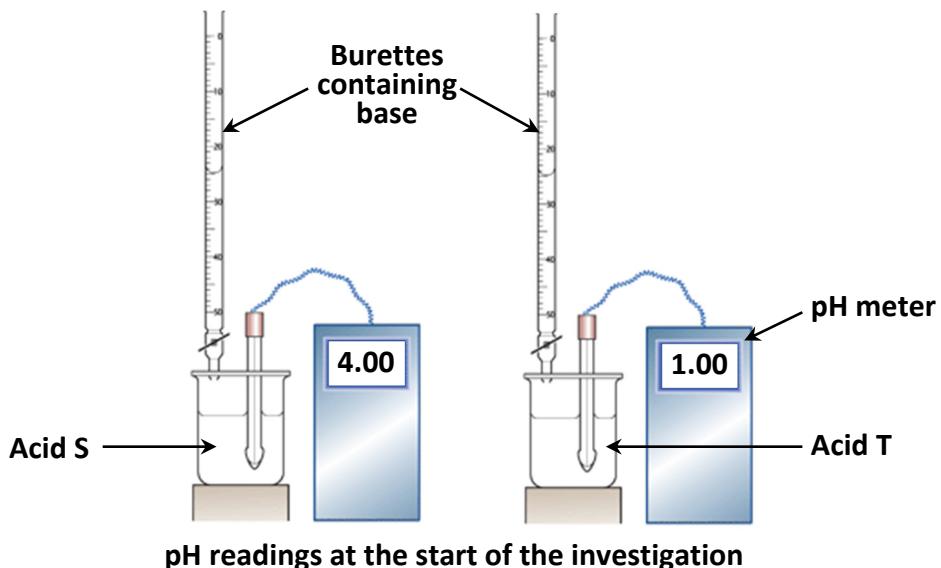
- (b)** Outline one benefit and one hazard of space exploration.

Benefit:

Hazard:

Question 9**(15 marks)**

A student was given two acids, **S** and **T**. He set up the apparatus shown below to investigate how the pH of **S** and **T** changed when they reacted with a base. The diagrams below show the pH of **S** and **T** at the start of the investigation.



- (a) Which acid, **S** or **T**, was more acidic at the start of the investigation?

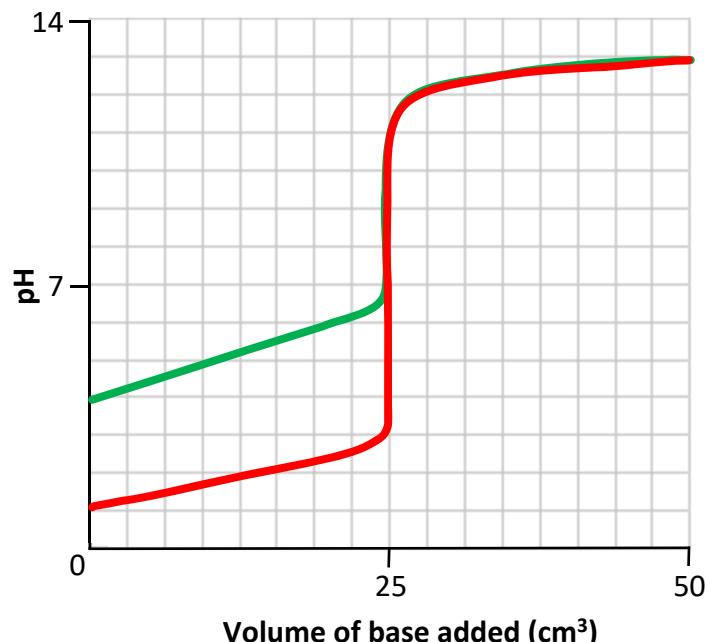
- (b) State one safety precaution the student should have followed when handling the acids.

The student opened the tap on each burette and allowed the base to flow into the beakers of acid. The changes in pH were recorded as the base was added. The graph shows both sets of results.

- (c) What was the pH of the solutions when 50 cm^3 of base had been added?

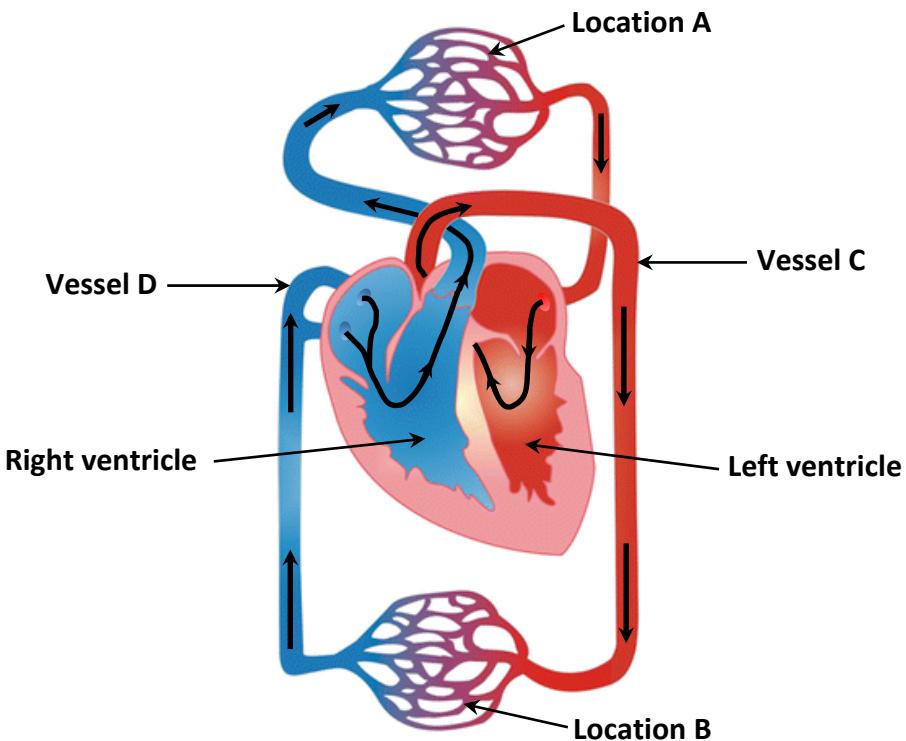
- (d) What is the pH of a neutral solution?

- (e) Identify a laboratory base the student could have used in this investigation.



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 C is deoxygenated.		
The organs found at location A are part of the respiratory system.		
Carbon dioxide leaves the blood at location B.		
Vessel D is a vein.		

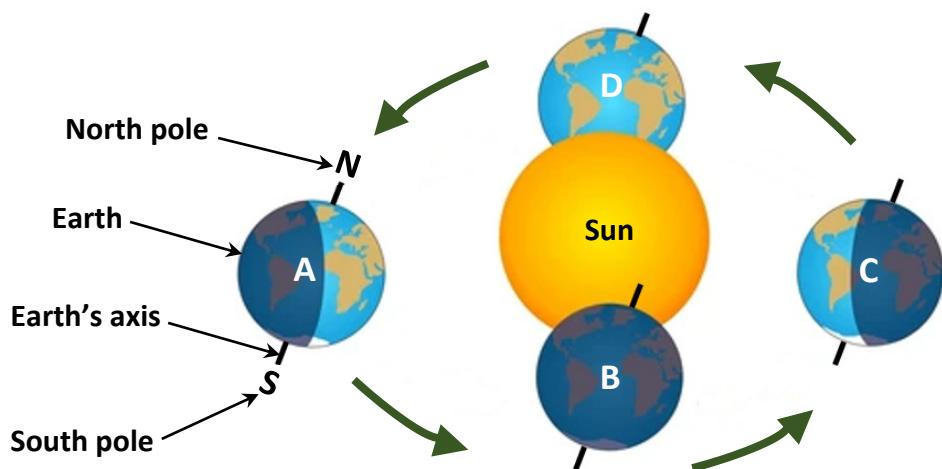
- (b) Vessel C has thicker walls than vessel D.

Explain why.

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 the movement of the Earth around the Sun. The letters **A**, **B**, **C** and **D** represent four positions of the Earth as it moves around the Sun.



- (a) Starting at position **A**, what will be the position of the Earth when 18 months have passed?
Put a tick (✓) in the correct box.

Position **A** Position **B** Position **C** Position **D**

- (b) Which letter, **A**, **B**, **C** or **D**, represents the position of the Earth during summer in the northern hemisphere? Justify your answer.

- (c) Select a letter, **A**, **B**, **C** or **D**, which represents a position of the Earth when day and night last approximately the same length of time.

Position **A** Position **B** Position **C** Position **D**

- (d) Which one of the following statements explains why seasons occur on Earth?
Put a tick (✓) in the correct box.

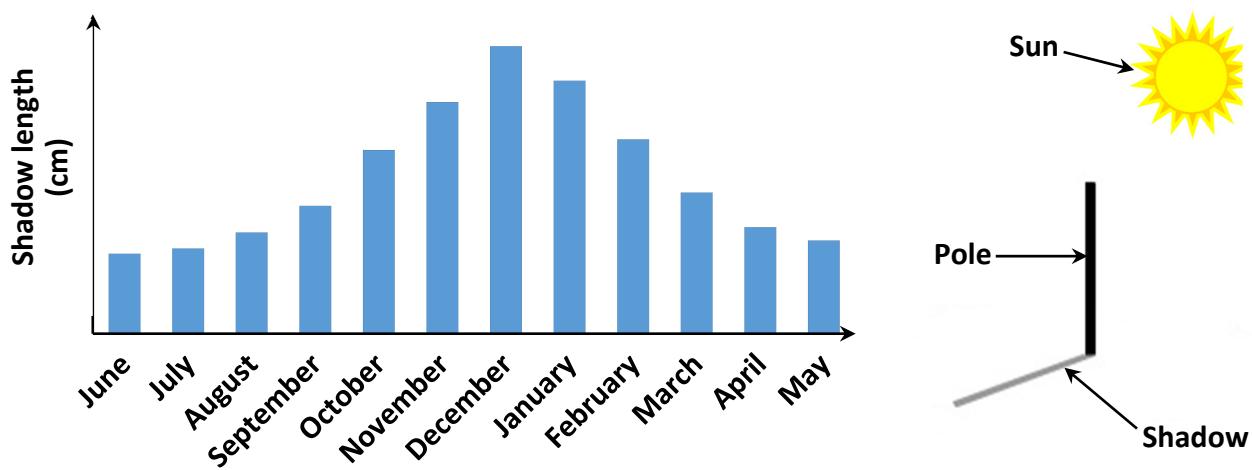
The Moon moves around its axis.

The tilted Earth moves around the Sun.

The tilted Earth moves around its axis.

There are sunspots on the surface of the Sun.

The length of the shadow cast by an object depends on the position of the Sun in the sky. Two groups of students in Ireland, group **A** and group **B**, investigated how the length of a shadow varied over a year. The graph below shows the results obtained by group **A**, who used a pole to cast the shadow.



- (e) Name an instrument the students could have used to measure the length of the shadow.

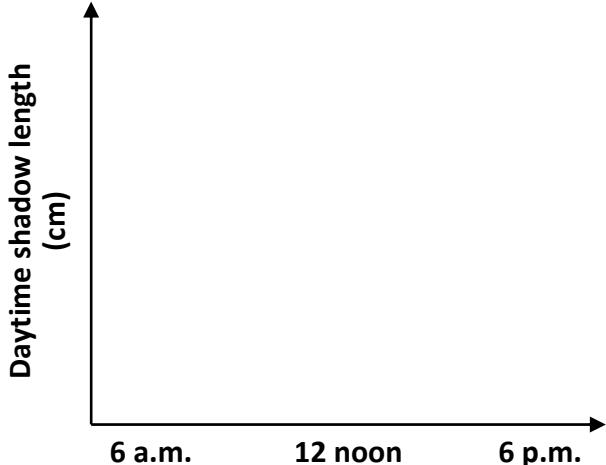
- (f) State one variable the students in group **A** should have kept constant.

- (g) Group **B** carried out the same investigation, but instead of using a pole to create a shadow, they used a student from the group.

Which group, **A** or **B**, carried out a better investigation? Justify your answer.

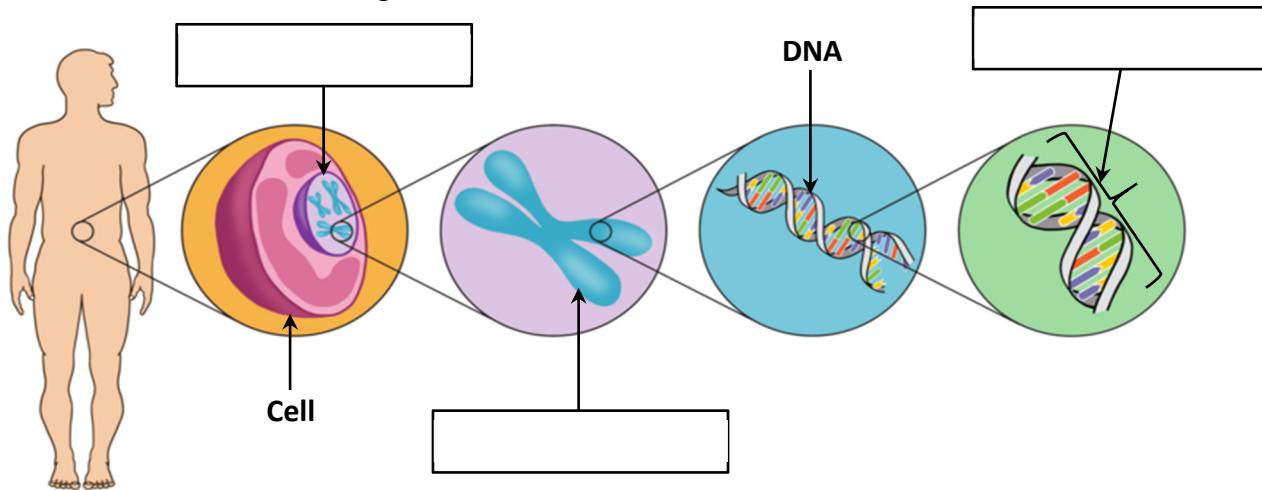
- (h) Group **A** also investigated how the length of the shadow cast by the pole changed during a sunny day in June.

Using the axes on the right, sketch the curve the students should have obtained.



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	Bb	bb
Sex cells produced	B or b	b
Offspring genotype		

- (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.

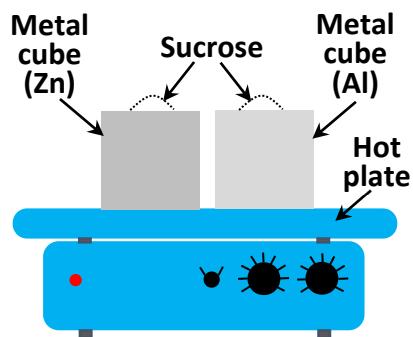
0% 25% 50% 75% 100%

Question 13**(45 marks)**

A student carried out a series of experiments to investigate the properties of sucrose (table sugar).

In the first experiment, the student investigated the melting point of sucrose.

Two metal cubes of equal volume were placed on a hotplate as shown in the diagram. One was made of zinc (**Zn**) and the other was made of aluminium (**Al**). One gram of sucrose was placed on top of each cube and the hotplate was turned on.



- (a)** What is meant by the melting point of a substance?

- (b)** Is melting an example of a physical change or a chemical change? Explain your answer.

- (c)** The aluminium cube had a smaller mass than the zinc cube. Explain why.

- (d)** The sucrose on the aluminium melted before the sucrose on the zinc. What does this result tell us about the two metals? Put a tick (✓) in the correct box.

Aluminium is a better conductor of heat than zinc.

Aluminium has a higher melting point than zinc.

Aluminium is less reactive than zinc.

Aluminium atoms have less neutrons than zinc atoms.

- (e)** Explain why the sugar melted but the metals did not.

- (f)** The dials on the hotplate were made of plastic, a non-metal. State two properties of non-metals.

In the second experiment the student dissolved sucrose in water. They used some of the following components to investigate if the resulting solution could conduct electricity.

Buzzer

Wires

Bulb

Battery

- (g) Using electrical circuit symbols, draw a labelled diagram of a circuit the student could have used to carry out this investigation. You may use the symbols on pages 72 – 78 of the *Formulae and Tables* booklet to help you answer this question.

Labelled diagram

- (h) The student was then given the task of separating the sucrose from the water. Describe how the student could have separated these two substances. You should include a labelled diagram in your answer **and** indicate the location of the sucrose at the end of the separation.

Labelled diagram

Question 14**(45 marks)**

Read the following article, adapted from a European Union (EU) website, and answer the questions that follow.

The European Green Deal outlines a plan to make Europe the first climate-neutral continent by 2050. This involves boosting the economy, caring for nature, and improving our health and quality of life. The *Farm to Fork Strategy* is at the heart of the Green Deal. It addresses the challenges of sustainable food systems and recognises the links between healthy people, healthy societies and a healthy planet.

We need to do much more to keep ourselves and the planet healthy. The increasing occurrence of droughts, floods, forest fires, and new pests are a constant reminder that our food system is under threat and must become more sustainable.

Since 1990, EU agriculture has reduced its greenhouse gas emissions by 20%. However, food systems remain one of the key drivers of climate change and environmental degradation. The European Commission aims to further reduce greenhouse gas emissions from agriculture by 2050.

The move towards a sustainable food system will not happen without a shift in our diets. It is essential to take action to change consumption patterns and reduce food waste. While about 20% of the food we produce is wasted, obesity is also rising. Over half of the adult population are now overweight, contributing to a high occurrence of diet-related diseases and related healthcare costs.

Farm to Fork Strategy, European Union, May 2020

- (a)** State one aim of the European Green Deal.

- (b)** Name a natural phenomenon which threatens our food supply system.

- (c) (i)** EU agriculture has reduced its greenhouse gas emissions by 20% since 1990. Name a greenhouse gas which drives climate change and is produced by agricultural practices.

- (ii)** Describe an initiative that could be undertaken to reduce the production of this gas.

- (d) 20% of the food we produce is not eaten.
Suggest one way in which a household could reduce its food waste.

Human health is affected by environmental factors such as nutrition.

The table below compares the nutritional value of two similar foods, **Food A** and **Food B**.

	Food A	Food B
Nutrient	Mass per 80 g serving	Mass per 80 g serving
Sugar	18 g	7 g
Saturated fat	7 g	3 g
Cholesterol	55 mg	33 mg
Sodium	330 mg	200 mg
Protein	12 g	20 g

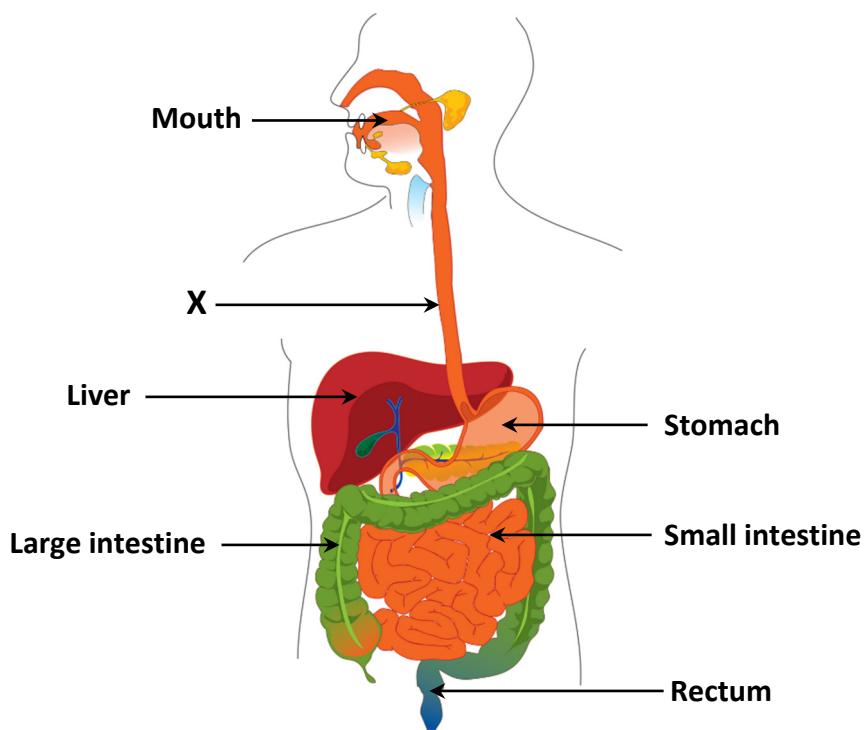
- (e) Identify one piece of evidence from the table which shows that the two foods were compared fairly.

- (f) Which food, **A** or **B**, would be a better choice as part of a healthy diet? Use two pieces of evidence from the table to support your answer.

- (g) Calculate the percentage protein in food **A**.

Calculation

- (h) Food is broken down in the digestive system. The diagram below shows the anatomy of the human digestive system and some of its associated organs.



- (i) On the diagram, draw a circle around a part of the digestive system which is also a part of the respiratory system.
(ii) Identify structure X.

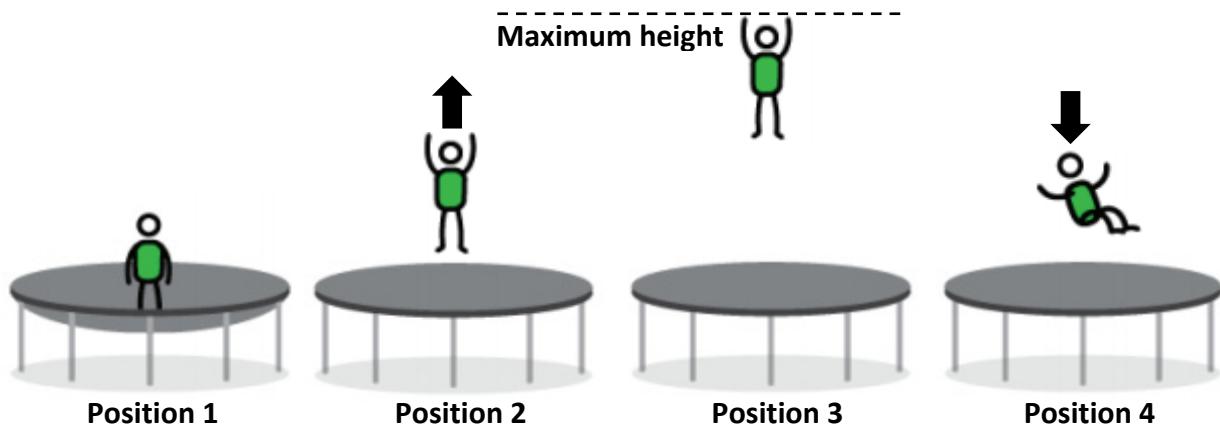
- (iii) Complete the table below by matching the part of the digestive system from the diagram with its function.

Function	Part of digestive system
Absorbs water from fully-digested matter	
Secretes hydrochloric acid to kill bacteria in food	
Absorbs fully-digested food into the bloodstream	

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	<input type="checkbox"/>	Position 2	<input type="checkbox"/>	Position 3	<input type="checkbox"/>	Position 4	<input type="checkbox"/>
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(ii) Identify a position where the trampoline has its greatest potential energy.

Position 1	<input type="checkbox"/>	Position 2	<input type="checkbox"/>	Position 3	<input type="checkbox"/>	Position 4	<input type="checkbox"/>
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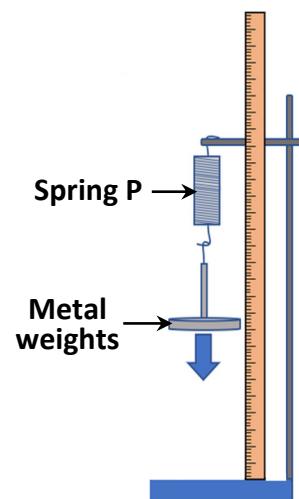
(b) Name a force responsible for the motion of the person in position 4.

(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.

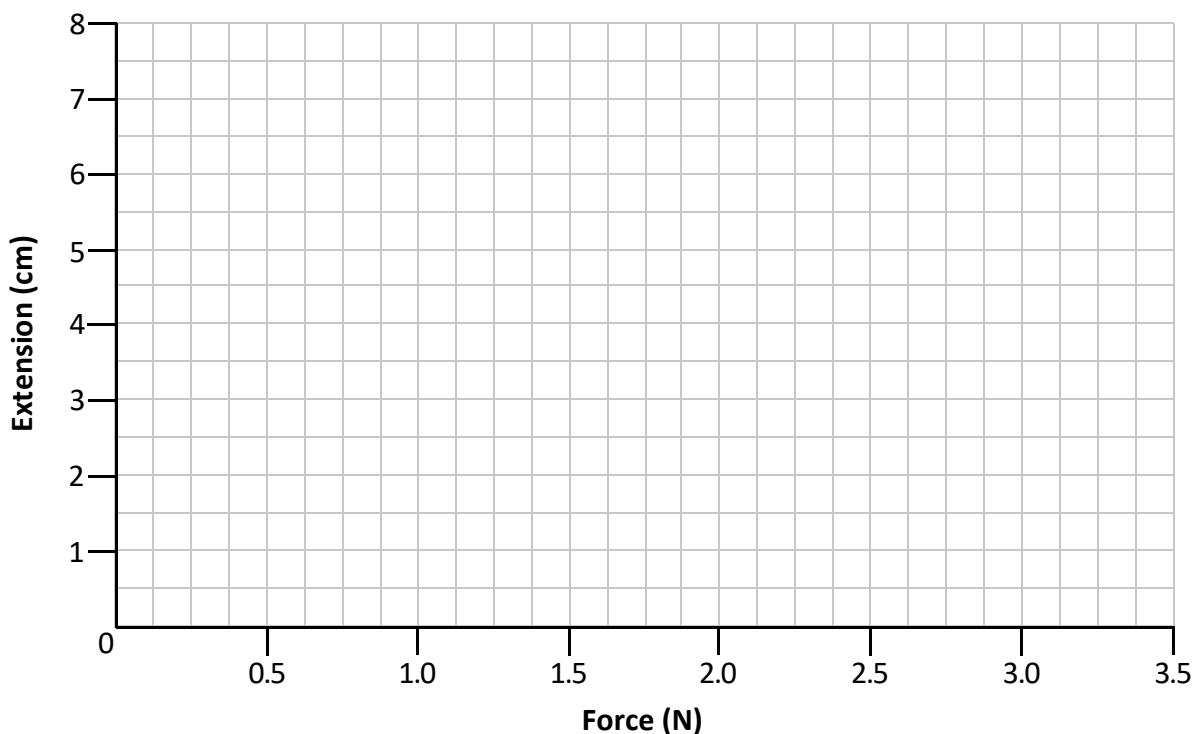
The experiment was carried out using spring **P** as shown. It was then repeated using spring **Q**, taken from a different trampoline.



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.

- (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.

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

Acknowledgements

Images

Images on page 3:	ie.rs-online.com; indiamart.com; ldalearning.com; pharmasystems.com
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Image on page 23:	tcschools.org
Images on page 24:	protrampolines.com; keystagewiki.com

Text

Text on page 20: *Farm to Fork Strategy*, European Union, May 2020.

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Junior Cycle Final Examination – Common Level

Science

Monday 13 June

Morning 9:30 – 11:30