2022.S26

2022J057C1EL

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**

**Day and Month of Birth**

For example, 3rd February is entered as 0302

**Centre Stamp**

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

Green: model answers
Blue: explanation
Original page 1

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

## 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.

Green: model answers
Blue: explanation
Original page 2

TEACHER MODEL
2022 SCIENCE

Match each quantity to its measuring instrument. A voltmeter measures potential difference; an ohmmeter measures resistance.

## 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.

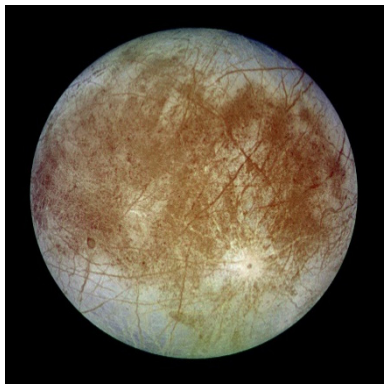
| Physical Quantity | Instrument |
|---|---|
| Volume | Graduated cylinder |
| Time | Stopwatch |
| Temperature | Thermometer |
| Resistance | Ohmmeter |
| Potential difference | Voltmeter |

Green: model answers
Blue: explanation
Original page 3

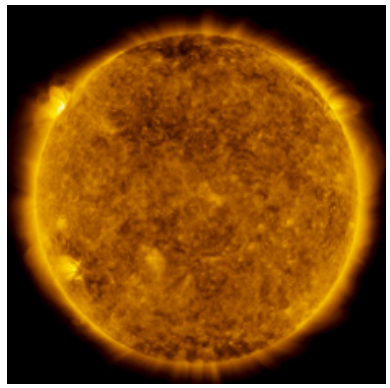
TEACHER MODEL
2022 SCIENCE

**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**

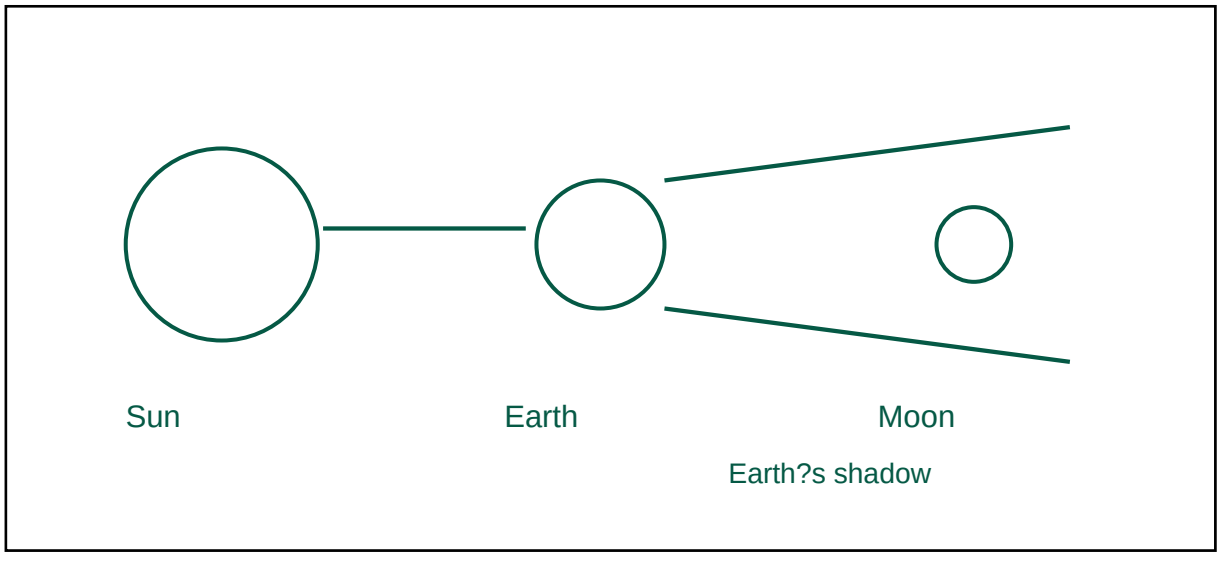
**(a)** Match the name of each celestial object with the correct description in the table below.

| Description | Name of celestial object |
|---|---|
| Consists of burning gas | Star |
| Orbits a planet | Moon |
| Orbits a star | Planet |

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

Star

**(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.

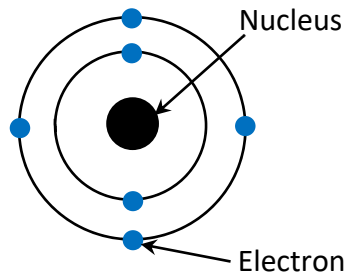



A lunar eclipse happens when Earth blocks sunlight from reaching the Moon. The Sun, Earth and Moon are aligned.

Green: model answers
Blue: explanation
Original page 4

**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.

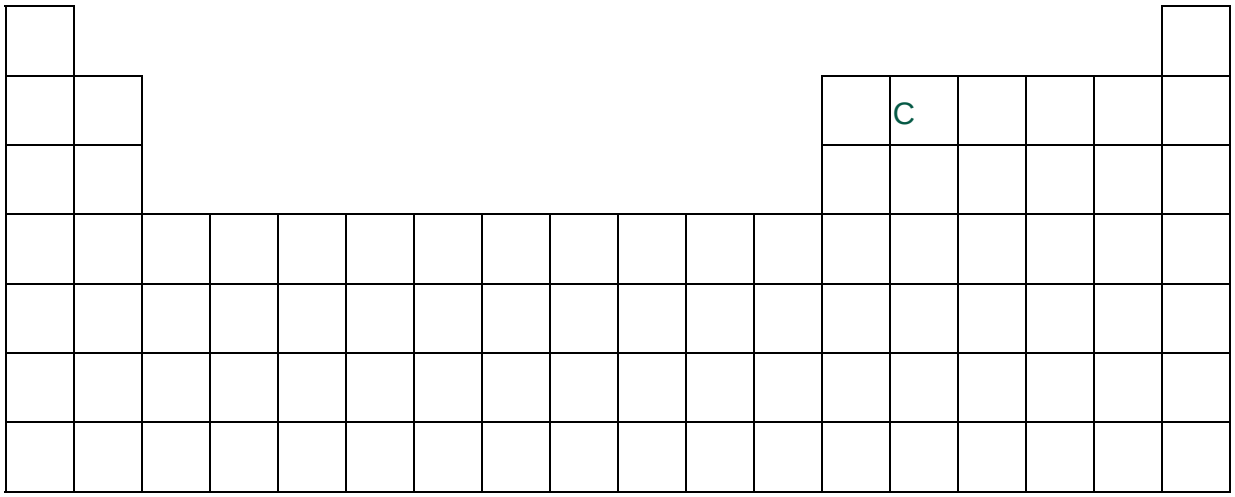
Proton

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

The charge on the electron is:

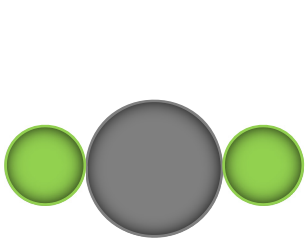
Positive ☐ Negative ☑ Neutral ☐

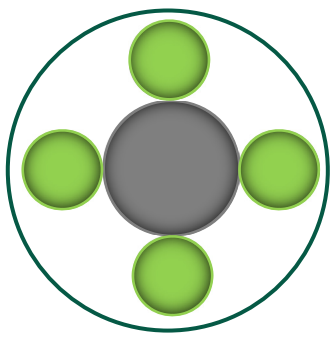
**(c)** Place an **X** on the Periodic Table shown below to indicate the position of element **X**.
You may use the Periodic Table on page 79 of the *Formulae and Tables* booklet to help you answer this question.

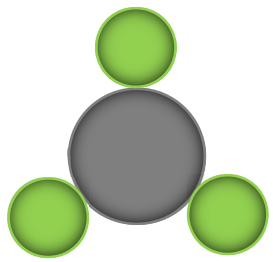



**(d)** Element **X** forms a compound with hydrogen. Element **X** is shown in grey. Hydrogen is shown in green. Circle the diagram below which represents the compound formed. Justify your answer.

| Carbon has four outer-shell electrons and forms four bonds with hydrogen atoms. |
|---|
| |
| |







TEACHER MODEL
2022 SCIENCE

Carbon has four outer-shell electrons and forms four bonds. In methane, each hydrogen forms one bond.

Green: model answers
Blue: explanation
Original page 5

TEACHER MODEL
2022 SCIENCE

**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. | | ✓ |

An adaptation is an inherited feature that improves survival or reproduction in a particular habitat.

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.

Sharp canine teeth grip and tear prey.

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

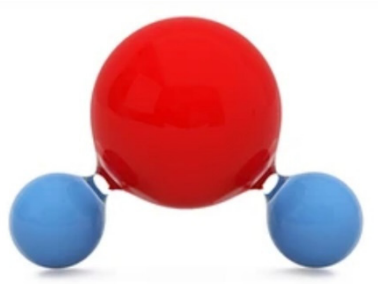
Thorns discourage animals from eating it.

Green: model answers
Blue: explanation
Original page 6

TEACHER MODEL
2022 SCIENCE

**Question 5** **(15 marks)**

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

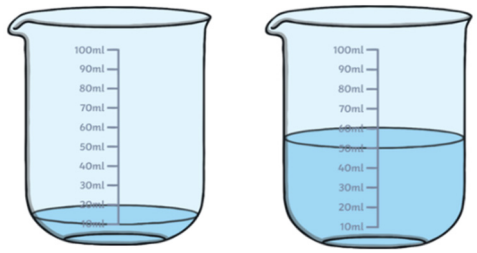


**(a)** The picture on the right shows a model of a water molecule. The chemical formula for water is $H_2O$. Does the red sphere in the model represent hydrogen or oxygen?

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 | ☐ |
| Weight | ☐ |
| Density | ☑ |
| Volume | ☐ |




A student investigated the solubility of a compound in water. She added some of the compound to 50 $cm^3$ 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 $g/cm^3$.

Calculation

Solubility = 15 / 50 = 0.30 $g/cm^3$

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

| |
|---|
| |
| Use a greater volume of water. |
| Increase the temperature (if this increases the solubility). |
| |
| |
| |
| |

Solubility = mass dissolved / volume of water. Here the units are grams per cubic centimetre.

Green: model answers
Blue: explanation
Original page 7

TEACHER MODEL
2022 SCIENCE

**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 (✓) 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.

The Moon reflects light from the Sun.

**(e)** An object weighs less on the Moon than on Earth.
Put a tick (✓) 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. ☐

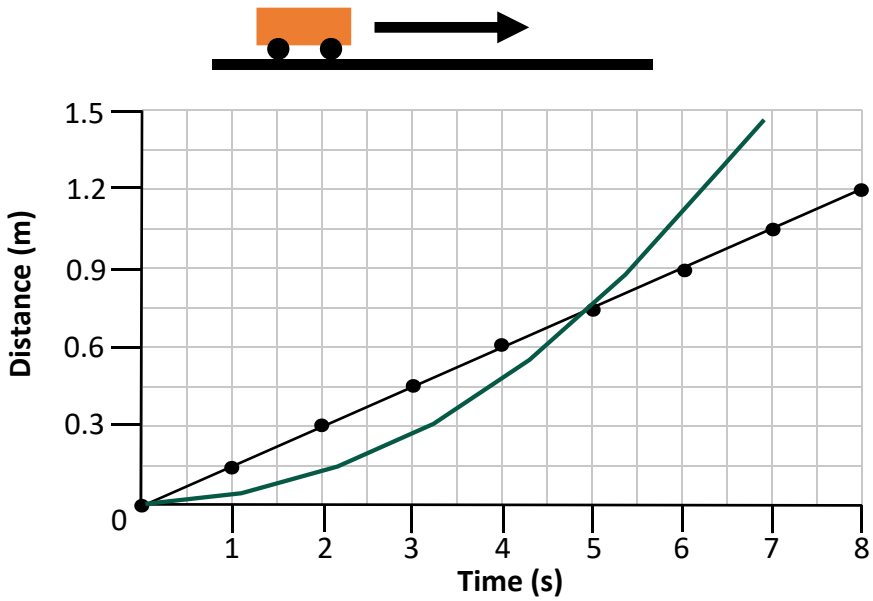
The Moon reflects sunlight. Its phases depend on how much of the sunlit half we can see from Earth. Lower mass means weaker gravitational attraction.

Green: model answers
Blue: explanation
Original page 8

TEACHER MODEL
2022 SCIENCE

**Question 7** **(15 marks)**

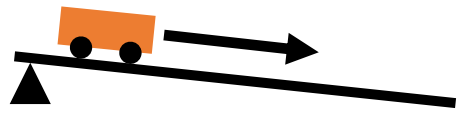
A trolley moves along a horizontal track. The distance of the trolley from its starting point was measured every second for 8 seconds. The results are shown in the graph below.




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

| Calculation |
| --- |
| Average speed = 1.2 / 8 = 0.15 m/s |

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



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

| The trolley accelerates down the slope. |
| --- |
| |

**(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.

| Use the same trolley and release it from rest. |
| --- |
| |

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

Speed is the gradient of a distance-time graph. A steeper gradient means greater speed. Acceleration makes the curve progressively steeper.

Green: model answers
Blue: explanation
Original page 9

TEACHER MODEL
2022 SCIENCE

**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.

| |
|---|
| The Big Bang model |

Outline two pieces of evidence that support this model.

| |
|---|
| Galaxies show redshift: the universe is expanding. |
| Cosmic microwave background radiation. |
| |
| |

Redshift supports an expanding universe. Cosmic microwave background radiation is evidence of its hot early state.

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: |
|---|
| Weather satellites improve weather forecasts. |
| |

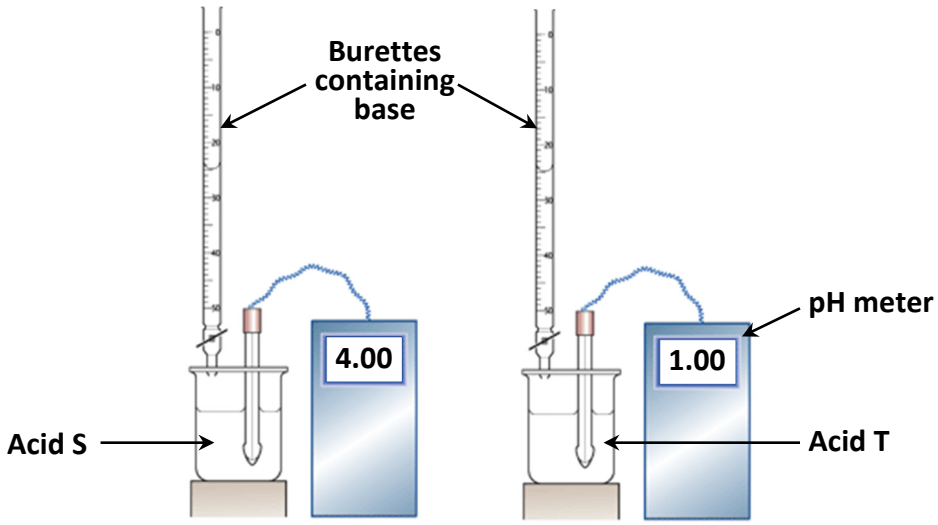
| Hazard: |
|---|
| Ionising radiation can damage cells. |
| |

Green: model answers
Blue: explanation
Original page 10

TEACHER MODEL
2022 SCIENCE

**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.




**pH readings at the start of the investigation**

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

T

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

Wear safety goggles.

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?

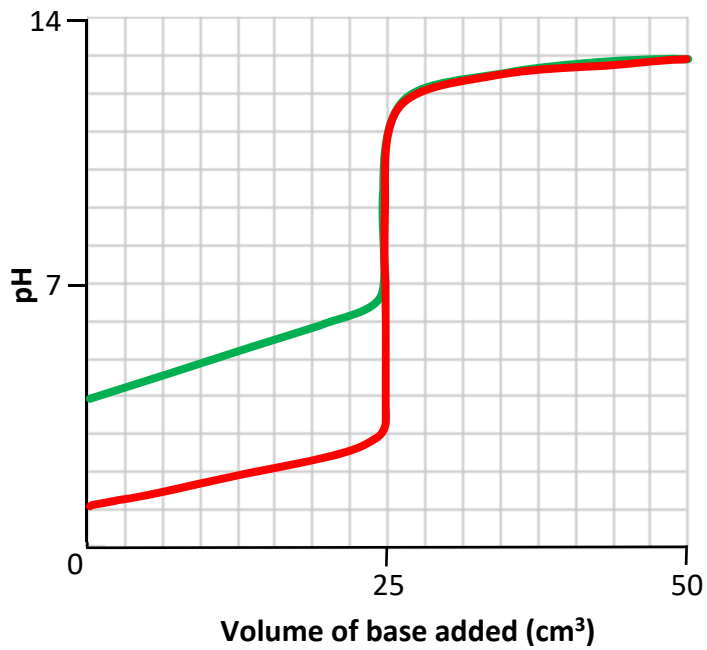
13

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

7

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

Sodium hydroxide



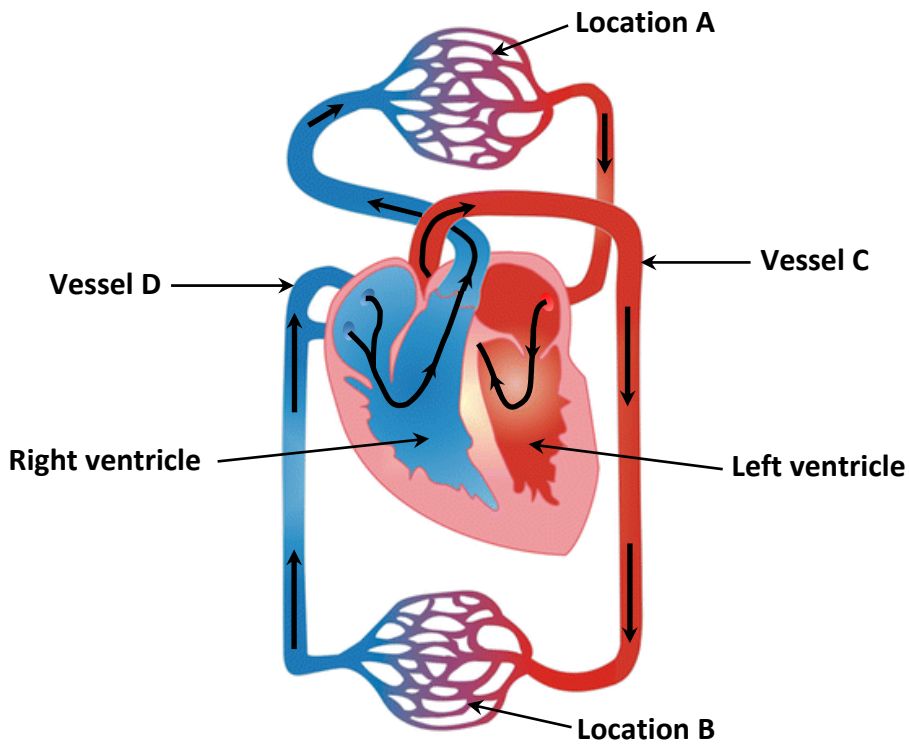

Lower pH means more acidic. A neutral solution has pH 7. The final pH is read from the level part of the curve.

Green: model answers
Blue: explanation
Original page 11

TEACHER MODEL
2022 SCIENCE

**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.

| |
|---|
| Vessel C carries blood at higher pressure. Its thicker wall withstands this pressure. |
| |
| |

The left ventricle pumps to the whole body. Its artery carries blood at high pressure, so it needs a thick wall.

Green: model answers
Blue: explanation
Original page 12

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

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

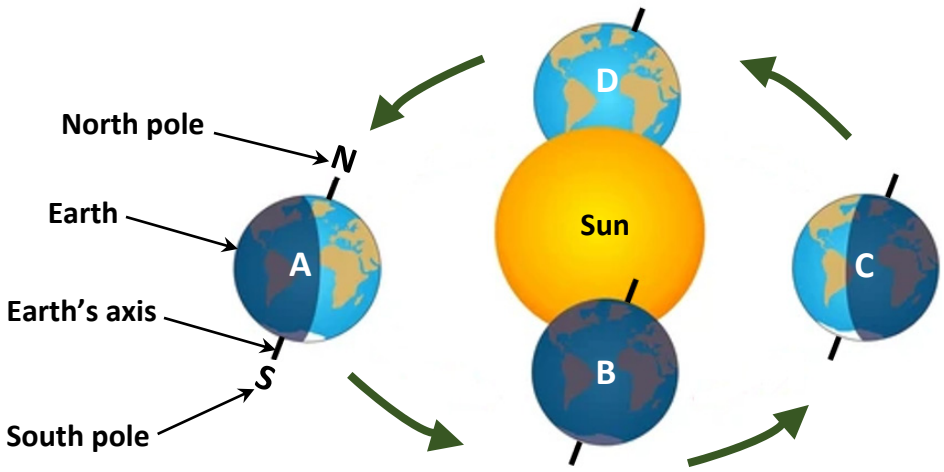
Green: model answers
Blue: explanation
Original page 13

TEACHER MODEL
2022 SCIENCE

## 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.

A: the northern hemisphere is tilted towards the Sun.

**(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.

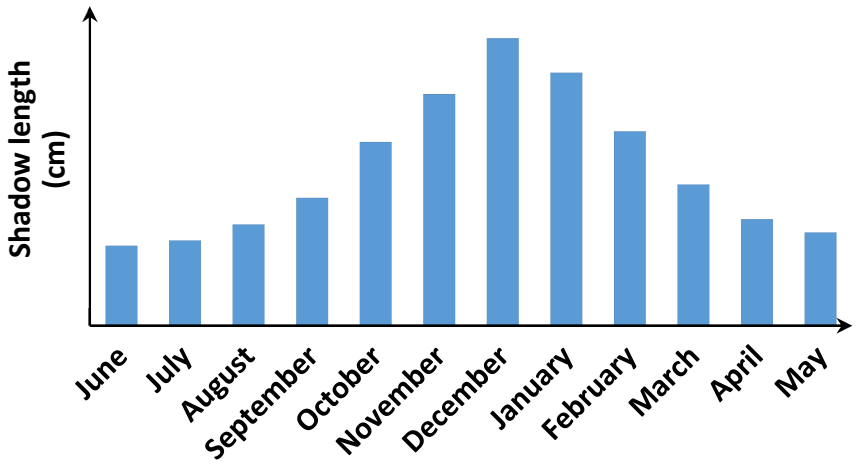
| | |
|---|---|
| The Moon moves around its axis. | ☐ |
| The tilted Earth moves around the Sun. | ☑ |
| The tilted Earth moves around its axis. | ☐ |
| There are sunspots on the surface of the Sun. | ☐ |

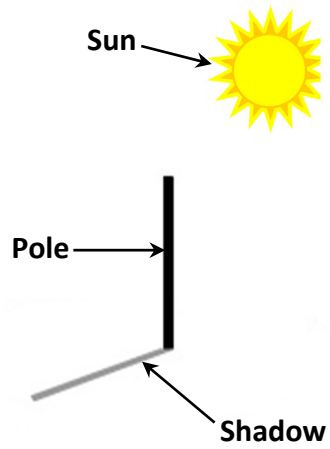
Seasons are caused by Earth?s tilted axis as it orbits the Sun, not by changing distance from the Sun.

Green: model answers
Blue: explanation
Original page 14

TEACHER MODEL
2022 SCIENCE

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.

Metre stick

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

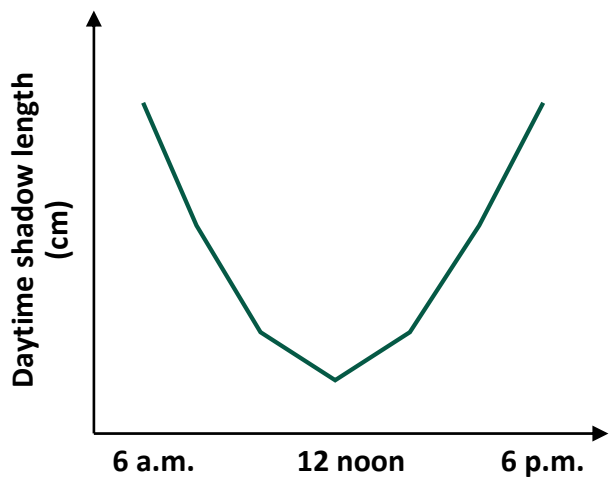
Height of pole; time of day.

**(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.

Group A. A pole has a fixed height and position, so changes in shadow length are due to the Sun.

**(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.



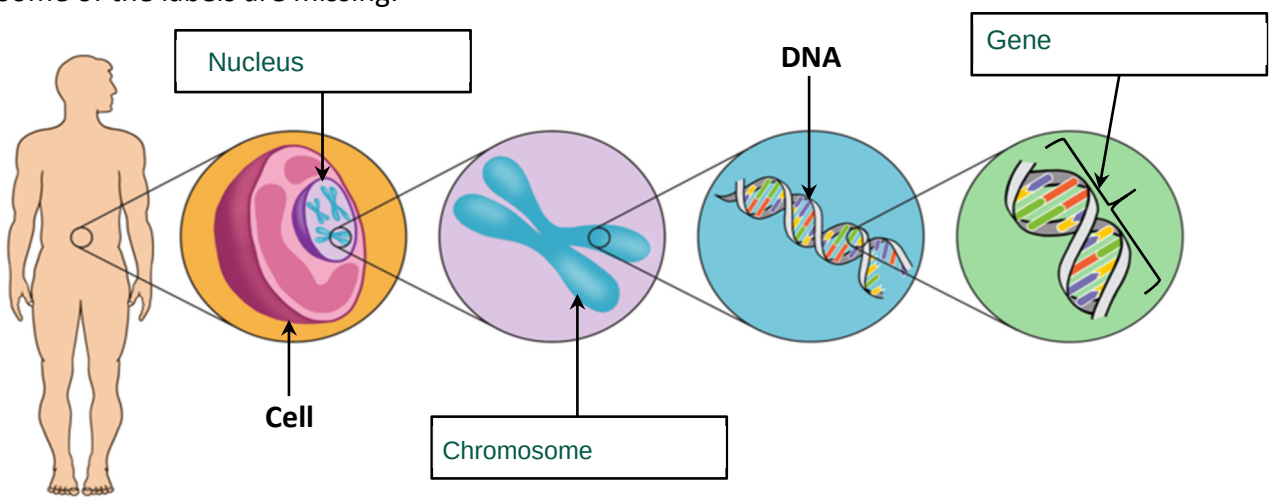

Keep other factors constant to make comparisons fair. Shadows are shortest when the Sun is highest in the sky.

Green: model answers
Blue: explanation
Original page 15

TEACHER MODEL
2022 SCIENCE

**Question 12** **(30 marks)**

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




Genes are sections of DNA on chromosomes. Body cells have 46 chromosomes; gametes have 23.

**(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.

Microscope

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 ☐

Green: model answers
Blue: explanation
Original page 16

TEACHER MODEL
2022 SCIENCE

**(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** | Bb or bb | |

B is dominant. Bb therefore gives a black coat; bb gives a white coat. Each offspring has an independent chance.

**(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% ☑

Green: model answers
Blue: explanation
Original page 17

TEACHER MODEL
2022 SCIENCE

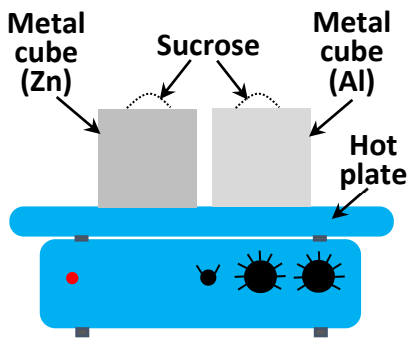
Melting is a change of state: no new substance forms. Density compares mass for the same volume.

**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?

The temperature at which a solid changes to a liquid.

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

Physical change: no new substance forms.

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

Aluminium has a lower density than zinc.

**(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.

Sugar has a lower melting point than the metals.

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

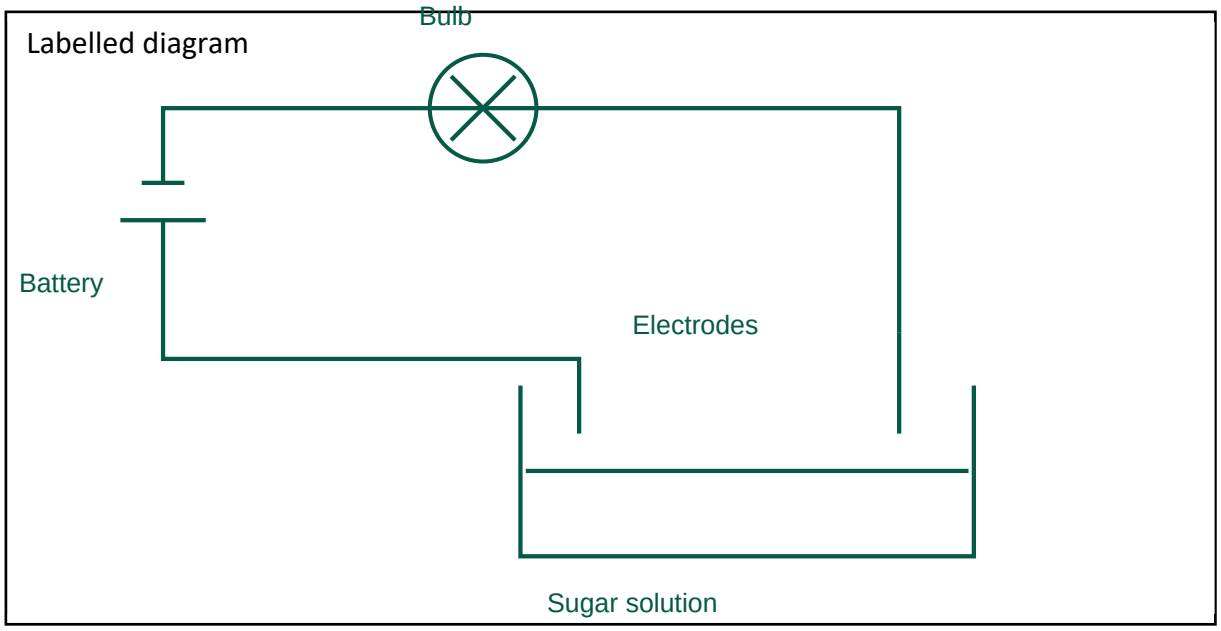
Poor conductors of heat and electricity.

Green: model answers
Blue: explanation
Original page 18

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**

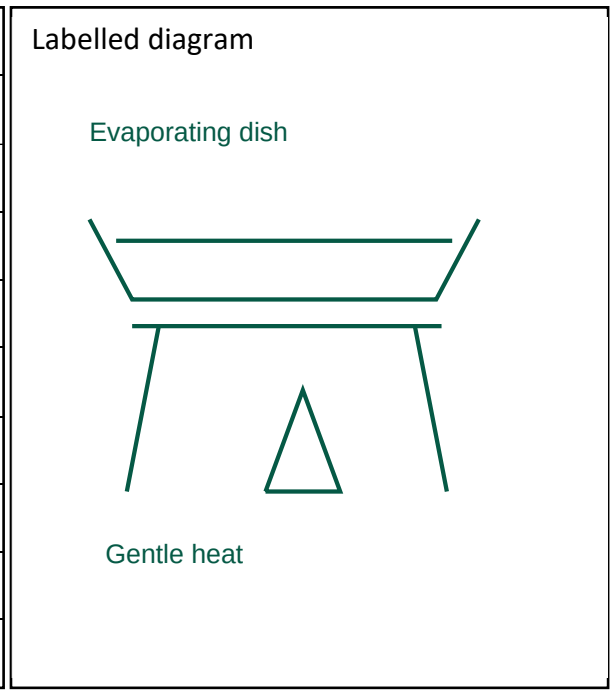
**(g)** Using electrical circuit symbols, draw a labelled diagram of a circuit the student could have used to carry out this investigation. You may use the symbols on pages 72 – 78 of the *Formulae and Tables* booklet to help you answer this question.




The electrodes must not touch. Dissolved sugar does not provide mobile ions. Evaporation removes water; gentle heating avoids decomposing sugar.

**(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.

| |
|---|
| |
| Gently heat the solution in an evaporating dish. |
| Allow some water to evaporate; cool to form sugar crystals. |
| Do not heat to dryness. |
| |
| |
| |
| |
| |




Green: model answers
Blue: explanation

TEACHER MODEL
2022 SCIENCE

**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.

Make Europe climate-neutral by 2050.

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

Drought.

**(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.

Carbon dioxide.

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

Power farm equipment using renewable electricity instead of fossil fuels.

Reducing fossil-fuel use lowers carbon dioxide emissions. Choose a specific action rather than simply saying ?reduce pollution?.

Green: model answers
Blue: explanation
Original page 20

TEACHER MODEL
2022 SCIENCE

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

| |
|---|
| Plan meals and use leftovers. |
| |

Compare equal portions. A food percentage is nutrient mass divided by serving mass, multiplied by 100.

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.

| |
|---|
| Both foods are compared per 80 g serving. |
| |

**(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.

| |
|---|
| Food B: less sugar (7 g compared with 18 g) and less saturated fat (3 g compared with 7 g). |
| |
| |

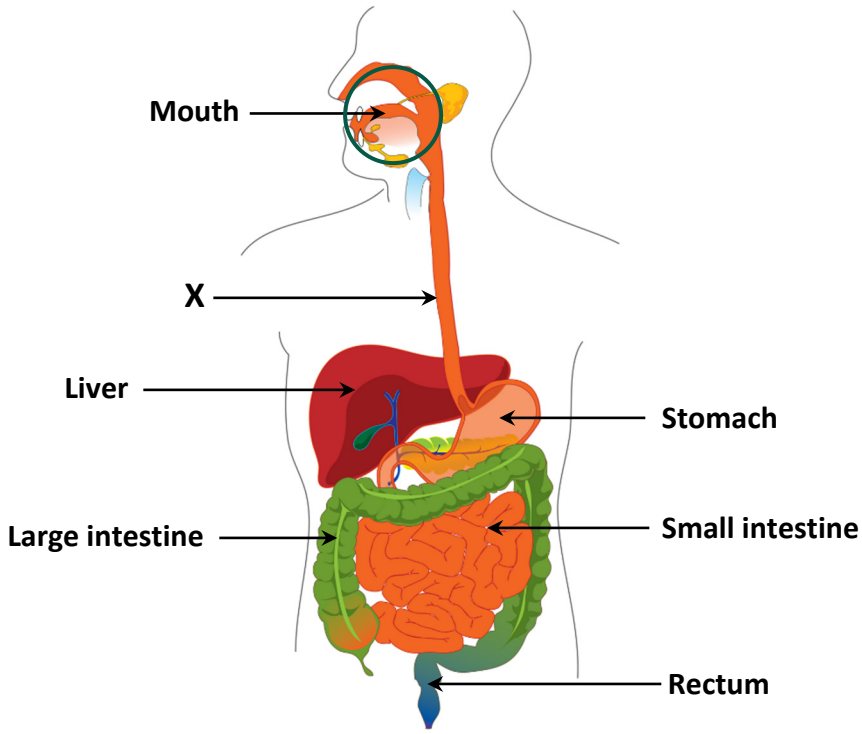
**(g)** Calculate the percentage protein in food **A**.

| |
|---|
| Calculation<br>Percentage protein = (12 / 80) × 100 = 15% |

Green: model answers
Blue: explanation
Original page 21

TEACHER MODEL
2022 SCIENCE

**(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.




The mouth belongs to both the digestive and respiratory pathways. Most nutrient absorption takes place in the small intestine.

**(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**.

Oesophagus

**(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 | Large intestine |
| Secretes hydrochloric acid to kill bacteria in food | Stomach |
| Absorbs fully-digested food into the bloodstream | Small intestine |

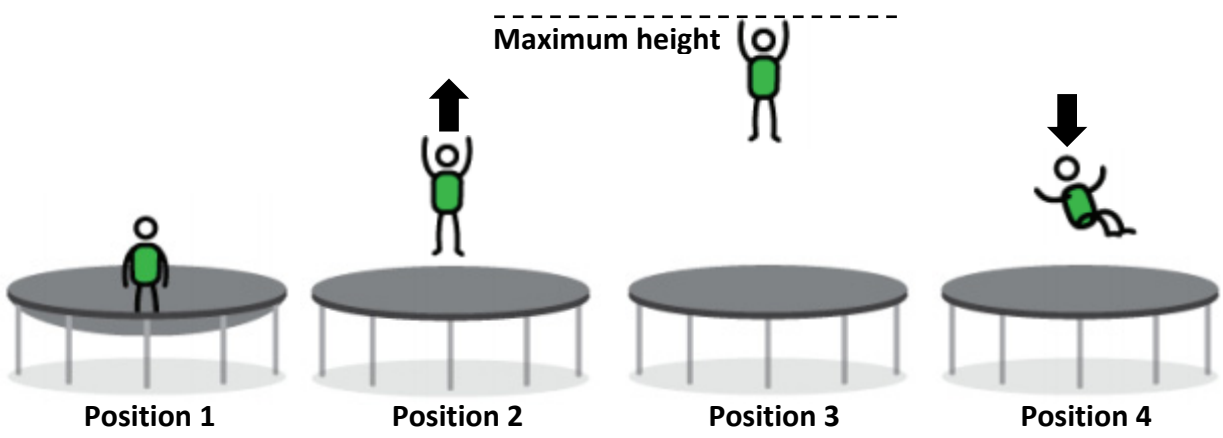
Green: model answers
Blue: explanation
Original page 22

TEACHER MODEL
2022 SCIENCE

**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**.

Gravity.

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

Friction between the person and the trampoline.

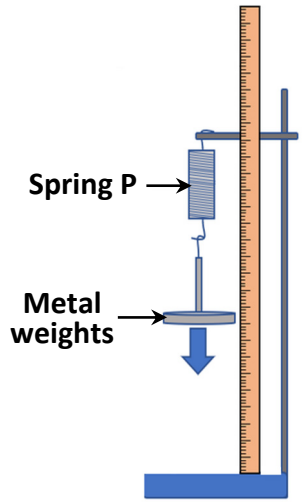
Gravitational potential energy is greatest at maximum height. Friction transfers mechanical energy into heat.

Green: model answers
Blue: explanation
Original page 23



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

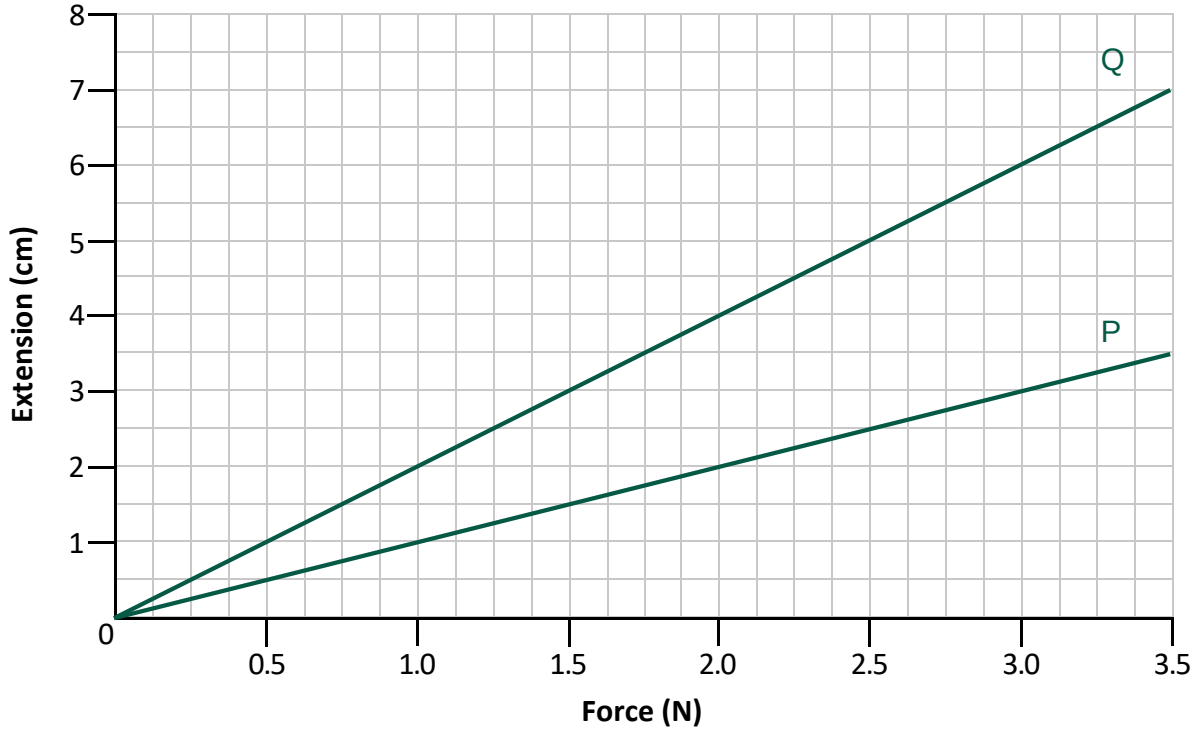
The experiment was carried out using spring **P** as shown. It was then repeated using spring **Q**, taken from a different trampoline.




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.




TEACHER MODEL
2022 SCIENCE

Force is on the horizontal axis; extension is on the vertical axis. Both lines pass through the origin. Q has twice P?s extension at equal force.

Green: model answers
Blue: explanation
Original page 24

TEACHER MODEL
2022 SCIENCE

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

Extension is proportional to force for both springs.
At the same force, Q extends twice as much as P.

**(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

Q extends 2.5 cm at 1.25 N.
Total length = 11 + 2.5 = 13.5 cm.

Extension is not total length. Add the original 11 cm. Stored elastic energy is half × force × extension, for a spring obeying Hooke?s law.

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

Mass is the amount of matter in an object.
Weight is the gravitational force on an object.

**(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.

~~Spring P. At 3 cm extension it requires 3 N; Q needs 1.5 N. Since E = ½Fx, P~~
stores more energy.

Green: model answers
Blue: explanation
Original page 25

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

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

Green: model answers
Blue: explanation
Original page 26

**Acknowledgements**

**Images**

| | |
|---|---|
| Images on page 3: | ie.rs-online.com; indiamart.com; ldalearning.com; pharmasystems.com |
| Images on page 4: | wikipedia.org |
| Images on page 5: | State Examinations Commission |
| Images on page 6: | flickr.com; edutopia.org |
| Images on page 7: | shutterstock.com; twinkl.ie |
| Images on page 8: | nasa.gov |
| Images on page 9: | State Examinations Commission |
| Image on page 10: | nasaspaceflight.com |
| Image on page 11: | wiley.com |
| Image on page 12: | springer.com |
| Image on page 14: | shutterstock.com |
| Image on page 15: | State Examinations Commission |
| Image on page 16: | anatomyofevolution.com |
| Image on page 17: | lockwoodresource.com |
| Image on page 18: | State Examinations Commission |
| Image on page 22: | thinglink.com |
| 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. |

Material may have been adapted, for the purpose of assessment, without the authors' prior consent.

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

Green: model answers
Blue: explanation
Original page 27

TEACHER MODEL
2022 SCIENCE

Worked answers based on the SEC marking scheme. Added explanations are teaching notes, not official SEC annotations.

Do not write on this page

**Copyright notice**
This examination paper may contain text or images for which the State Examinations Commission is not the copyright owner, and which may have been adapted, for the purpose of assessment, without the authors' prior consent. This examination paper has been prepared in accordance with *Section 53(5) of the Copyright and Related Rights Act, 2000*. Any subsequent use for a purpose other than the intended purpose is not authorised. The Commission does not accept liability for any infringement of third-party rights arising from unauthorised distribution or use of this examination paper.

Junior Cycle Final Examination – Common Level

# Science

Monday 13 June
Morning 9:30 – 11:30

Green: model answers
Blue: explanation
Original page 28