University of Worcester Science Equivalency Test Sample Paper 2020

Candidate number	
Date of test	

Time allowed
120 minutes

Instructions

- To answer questions in the form of text, you should position your cursor at the line(s) provided after each question. When your cursor is in the correct position, the area will show up as shaded. Click on the shading, then start to type your answer. You can use the normal 'delete' key to remove text if you want to change your answer
- To place a 'tick' in a checkbox, you should position your over the centre of the box and click to select. If you want to remove the tick, you just need to hover your cursor over it and click again.
- You can answer the questions in any order.

Information

- The marks for individual questions are shown in brackets.
- The maximum mark for this paper is 120.
- You are reminded of the need for good English and clear presentation in your answers.

For examiner Use				
Question	Mark		**Question**	Mark
1			**11**	
2			**12**	
3			**13**	
4			**14**	
5			**15**	
6			**16**	
7			**17**	
8			**18**	
9			**19**	
10			**Total**	

Q1. Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

clones	**chromosomes**	**embryos**	**genes**

GM crops are produced by cutting ..... out of the .....

of one plant and inserting them into the cells of a crop plant.

(2)

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1 .....

2 .....

(2)

(ii) Give **two** reasons why many people are against the growing of GM crops.

1 .....

2 ..... **(2)**

(Total 6 marks)

Q2. (a) Use words from the box to complete the sentences about curing disease.

antibiotics	**antibodies**	**antitoxins**	**painkillers**	**statins**

The substances made by white blood cells to kill pathogens

are called ..... .

The substances made by white blood cells to counteract poisons produced by

pathogens are called ..... .

Medicines which kill bacteria are called ..... . **(3)**

(b) The MMR vaccine protects people against three diseases.

Write down the names of **two** of these diseases.

1 .....

2 .....

(2)

(c) All vaccinations involve some risk.

The table shows the risk of developing harmful effects:

- from the disease if a child is **not** given the MMR vaccine
- if a child **is** given the MMR vaccine.

Harmful effect	**Risk of developing the harmful effect from the disease if not given the MMR vaccine**	**Risk of developing the harmful effect if given the MMR vaccine**
Convulsions	1 in 200	1 in 1000
Meningitis	1 in 3000	Less than 1 in 1 000 000
Brain damage	1 in 8000	0

A mother is considering if she should have her child vaccinated with the MMR vaccine.

Use information from the table to persuade the mother that she should have her child vaccinated.

.....

.....**(2)**

.(Total 7 marks)

Q3. Humans reproduce sexually.

(a) Use words from the box to complete the sentences below.

gametes	**chromosomes**	**genes**	**nuclei**

i) At fertilization …… join together. **(1)**

ii) At fertilisation a single cell forms. The cell has new pairs of …… **(1)**

(b) A child inherits cystic fibrosis. The child's parents do **not** have cystic fibrosis.

(i) What does this information tell us about the cystic fibrosis allele?

Tick (✓) **one** box.

The allele is dominant. ☐

The allele is recessive. ☐

The allele is strong. ☐ **(1)**

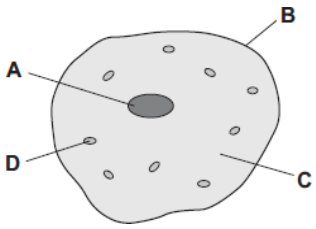
(ii) How many copies of the cystic fibrosis allele does the child have?

One ☐

Two ☐

Four ☐ **(1)**

(c) The diagram shows a human body cell.



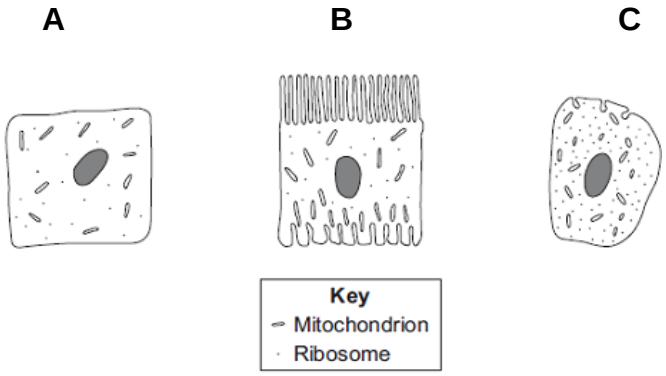
Which part of the cell, **A**, **B**, **C** or **D**:

(i) contains the allele for cystic fibrosis **(1)**

(ii) is affected by cystic fibrosis? **(1)**

(Total 6 marks)

Q4. Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



(a) Which cell, **A**, **B** or **C**, appears to be best adapted to increase diffusion into or out of the cell?

Give **one** reason for your choice.

.....

(1)

(b) (i) Cell **C** is found in the salivary glands.

Name the enzyme produced by the salivary glands.

.....

(1)

(ii) Use information from the diagram to explain how cell **C** is adapted for producing this enzyme.

.....

. .....

.....

(2)

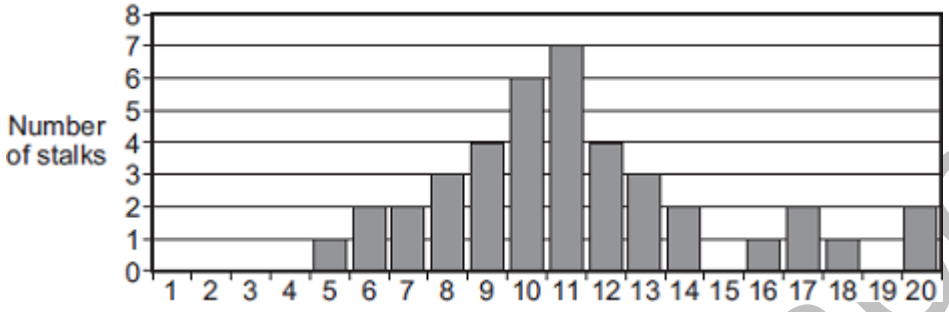
(Total 4 marks)

Q 5. Some students studied bluebell plants growing in two different habitats.

Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

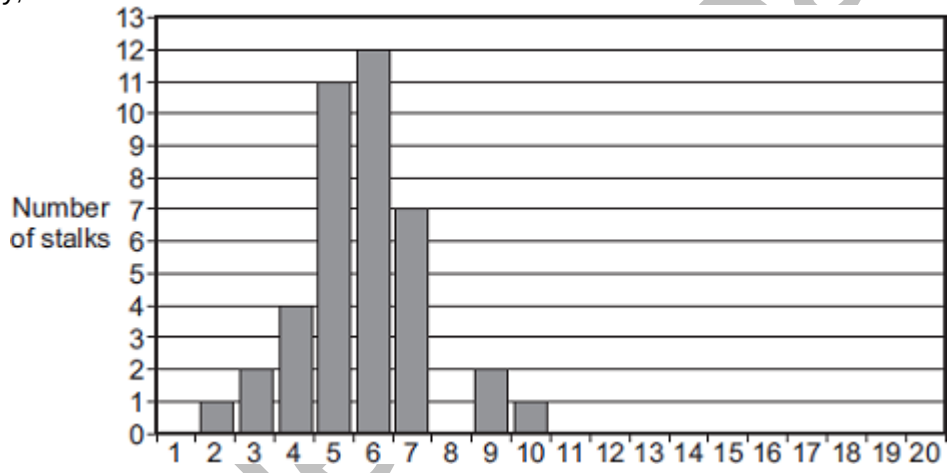
A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.

Habitat A: Sunny field next to woodland



Number of flowers per stalk

Habitat B: Shady, moist woodland



Number of flowers per stalk

(a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

.....

.....

(2)

(b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = ...

(1)

(ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

.....

.....

.....

.....

(2)

(iii) Suggest how the students cold test their hypothesis for the two habitats.

.....

.....

.....

.....

(2)

(c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

.....

.....

.....

.....

(2)

(Total 9 marks)

Q 6.A group of students investigated populations in a food chain in a garden.

The table shows the estimates of the number and biomass of some of the organisms the students found.

Organism	Number in the garden	Mean mass of each one in grams	Biomass of population in grams
Hedgehog	1	200	200
Slug	600	2	1200
Lettuce	60	100	

(a) (i) Calculate the biomass of the lettuce population.

Show clearly how you work out your answer.

.....

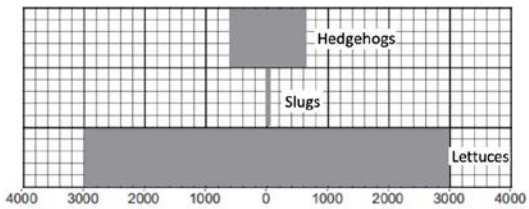
.....

Biomass = ... grams

(2)

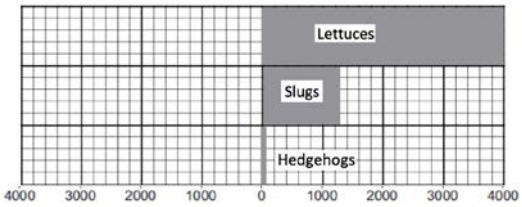
(ii) Use your answer to part (a) (i) to select the correct diagram for the pyramid of biomass in the garden

A



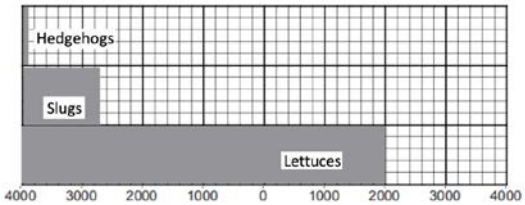
Biomass of population in grams

B



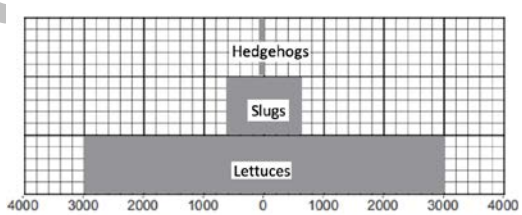
Biomass of population in grams

C



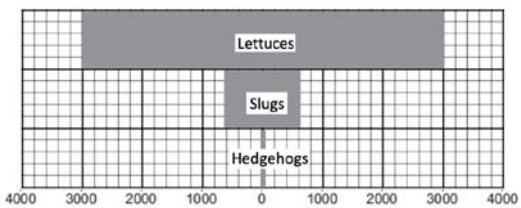
Biomass of population in grams

D



Biomass of population in grams

E



Biomass of population in grams

(b) The energy in the hedgehog population is much less than the energy in the slug population.

Explain why as fully as you can.

.....

.....

.....

.....

.....

.....

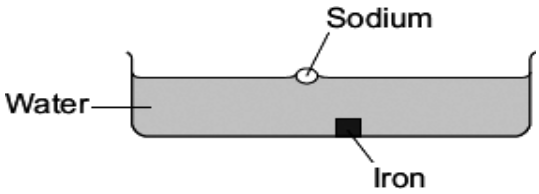
.....

(3)

(Total 7 marks)

Q7. How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.



A student observed that:

Sodium	Iron
floated on the surface of the water	sank to the bottom of the water
melted to form a molten ball of sodium	did not melt
reacted to produce a gas	did not react
no sodium was left after 5 minutes	the cube of iron remained after 5 minutes

(a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

Sodium compared with iron	Tick(✓)
sodium has a higher boiling point	
sodium has a lower density	
sodium is harder	
sodium is more reactive	
sodium is softer	

(2)

(b) Select the correct answer from the box to complete the word equation.

carbon dioxide	**hydrogen**	**oxygen**

sodium + water → sodium hydroxide + _____

(1)

(c) Select the correct answer from the box to complete the word equation.

$H^+(aq)$	**$OH^-(aq)$**	**$Na^+(aq)$**

Sodium hydroxide is an alkali because it produces _____ ions in aqueous solution. **(1)**

(Total 4 marks)

Q8. The picture shows two different cars.

(a) Some properties of aluminium are given below.

Tick (✓) **two** reasons why aluminium is better than steel for car bodies.

Reason	Tick (✓)
Aluminium is not a transition metal.	
Aluminium has a low density.	
Aluminium is expensive to extract.	
aluminium is resistant to corrosion.	

(2)

(b) Each car body is made from an *alloy*.

(i) What is an *alloy*?

.....

(1)

(ii) An alloy is used to make a car body. A pure metal is **not** used to make a car body.

Suggest why.

.....

(1)

(c) The car with a steel body uses petrol for fuel.

Select the correct answer to complete each of the sentences

(i) Petrol is made up from _____

air

crude oil

metal ores **(1)**

(ii) Petrol is a mixture of _____ including C_8H_{18}

carbonates

hydrocarbons

polymers **(1)**

(iii) In the car engine petrol reacts with _____ to produce carbon dioxide and water

argon

nitrogen

oxygen **(1)**

(d) Look at the substances coming out of each car's exhaust.

(i) Suggest the name of the fuel used in the car with the aluminium alloy body.

Name of fuel .....

(1)

(ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

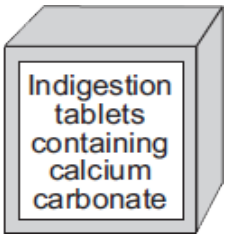
.....

.....

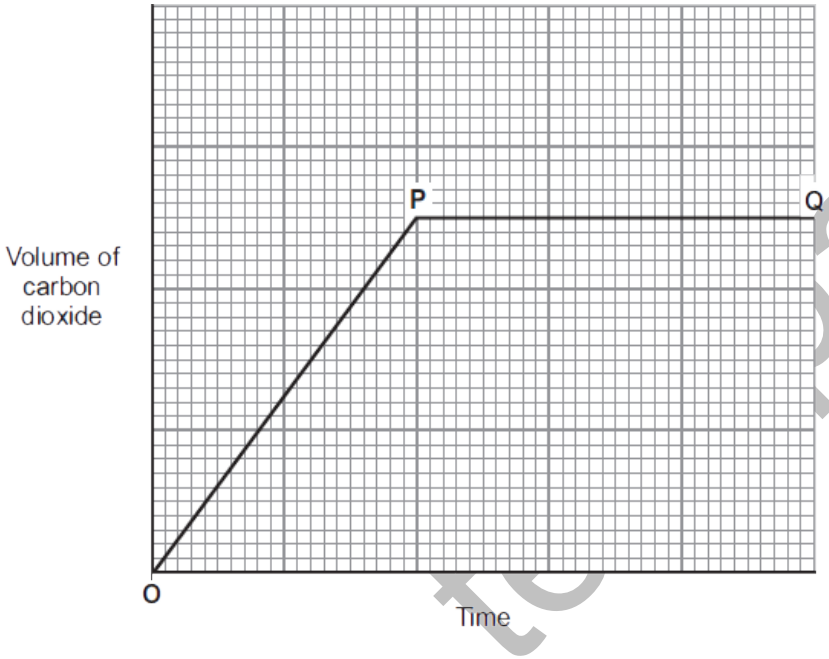
(1)

(Total 9 marks)

Q9. Human stomachs contain hydrochloric acid.
Stomach ache can be caused by too much acid in the stomach.
Indigestion tablets can be used to reduce the amount of acid in the stomach.



(a) The graph shows how the volume of carbon dioxide produced changes with time, after some calcium carbonate is added to hydrochloric acid.



(i) Complete the sentence to explain what happens between **O** and **P**.

Between **O** and **P** the calcium carbonate and hydrochloric acid ..... **(1)**

(ii) Complete the sentence to explain what happens at **P**.

At **P** the calcium carbonate and hydrochloric acid .....

because .....

(2)

(iii) Describe the test for carbon dioxide gas.

Test .....

Result of the test .....

(2)

(b) Calcium carbonate is found in limestone.

Limestone is removed from the ground by quarrying.

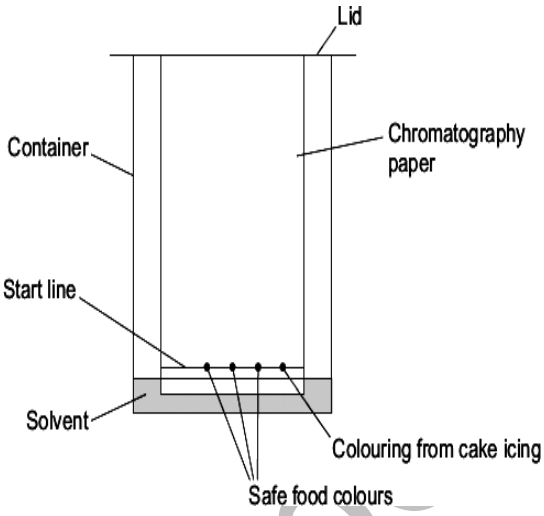
Tick (✓) **one** advantage and tick (✓) **one** disadvantage of quarrying limestone.

Statement	Advantage Tick (✓)	Disadvantage Tick (✓)
Quarrying limestone destroys the shells and skeletons of marine organisms that formed the limestone.	☐	☐
Quarrying limestone releases dust, and lorries release carbon dioxide from burning diesel fuel.	☐	☐
Quarrying limestone provides building materials, employment and new road links.	☐	☐
Quarrying limestone removes ores from the ground.	☐	☐

(2)
(Total 7 marks)

Q10. Icing on cakes is tested to check that safe colours were used when they were made.

Paper chromatography is one method of testing which colours are in cake icing.



a) The diagram shows an experiment a student did.

(i) Suggest why there is a lid on the container

……...

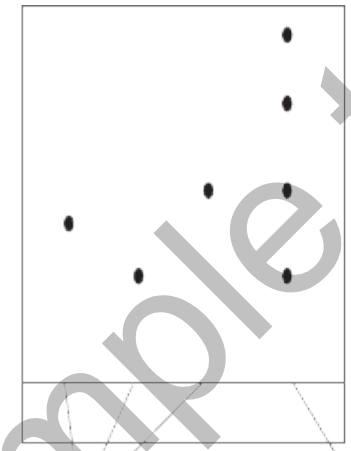
……**(1)**

(ii) The start line should be drawn in pencil **not** in ink.
Suggest why.

.....

(1)

(b) The diagram shows the results of the paper chromatography experiment.



Safe food colours Colouring from cake icing

(i) How many different food colours were used in the colouring from the cake icing?

..... **(1)**

(ii) Is the cake icing safe to eat?

Give a reason for your answer.

.....

..... **(1)**

(c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

(i) Give **two** advantages of gas chromatography compared with paper chromatography.

.....

..... **(2)**

(ii) What does gas chromatography do to the mixture of solvents?

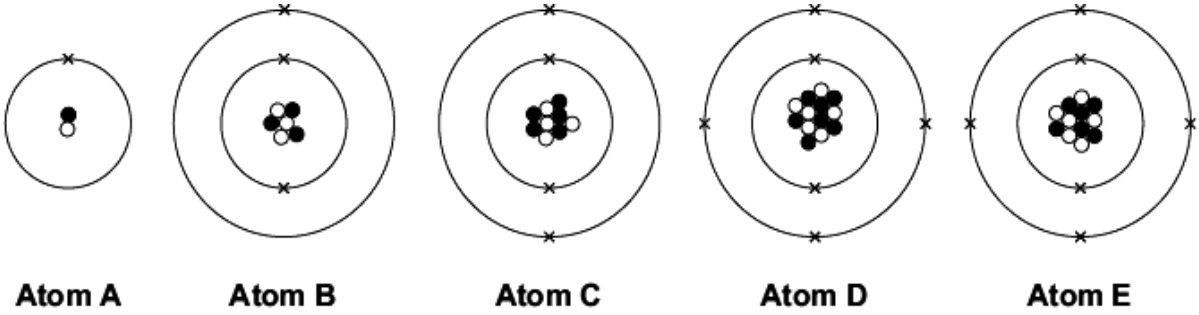
..... **(1)**

(iii) What information does mass spectroscopy give?

..... **(1)**

(Total 8 marks)

Q11. The diagrams show five different atoms, **A**, **B**, **C**, **D** and **E**.



Atom A **Atom B** **Atom C** **Atom D** **Atom E**

Key
○ represents a proton
● represents a neutron
× represents an electron

(a) Which atom, **A**, **B**, **C**, **D** or **E**:

(i) has an atomic number (proton number) of 3 **Atom**

(1)

(ii) has a mass number of 2 **Atom**

(1)

(iii) is in Group 2 of the periodic table? **Atom**

(1)

(b) Which **two** atoms from **A**, **B**, **C**, **D** and **E** are isotopes of the same element?

Atom and **Atom**

(1)

(c) Which particle in an atom has a negative charge? ..... **(1)**

(Total 5 marks)

Q12. A student investigated an egg shell.

(a) The student did some tests on the egg shell.

The student's results are shown in the table below.

	Test	Observation
1	Dilute hydrochloric acid was added to the egg shell.	A gas was produced. The egg shell dissolved, forming a colourless solution.
2	A flame test was done on the colourless solution from test **1**.	The flame turned red.
3	Sodium hydroxide solution was added to the colourless solution from test **1**.	A white precipitate formed that did not dissolve in excess sodium hydroxide solution.
4	Silver nitrate solution was added to the colourless solution from test **1**.	A white precipitate formed.

(i) The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test **1**.

.....

(2)

(ii) The student concluded that the egg shell contains aluminium ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

.....**(2)**

(iii) The student concluded that the egg shell contains chloride ions.

Is the student's conclusion correct? Use the student's results to justify your answer.

.....**(2)**

(b) Some scientists wanted to investigate the amount of lead found in egg shells.
They used a modern instrumental method which was *more sensitive* than older methods.

(i) Name **one** modern instrumental method used to identify elements.

.....(**1**)

(ii) What is the meaning of *more sensitive*?

.....(**1**)

(Total 8 marks)

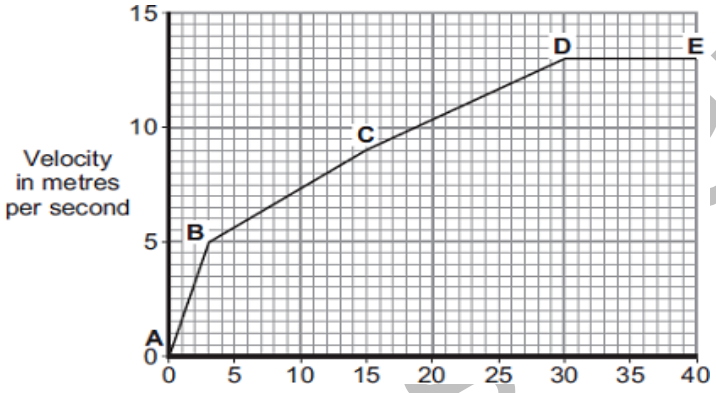
Q13. Some students designed and built an electric-powered go-kart.
The go-kart is shown below.

(a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

1 .....

2 ..... **(2)**

(b) A go-kart with a new design is entered into a race.
The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



(i) Between which **two** points did the go-kart have the greatest acceleration?

Tick (✓) **one** box.

A–B ☐

B–C ☐

C–D ☐

Give a reason for your answer.

.....

(2

(ii) The go-kart travels at a speed of 13 m/s between points **D** and **E**.
The total mass of the go-kart and driver is 140 kg.

Calculate the momentum of the go-kart and driver between points **D** and **E**.

.....

Momentum = ... kg m/s

(2)

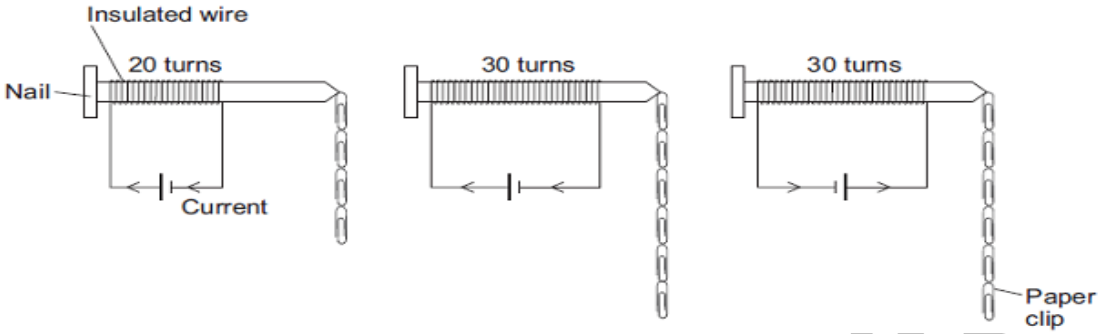
(Total 6 marks)

Q14. A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1



Electromagnet **A** Electromagnet **B** Electromagnet **C**

No more paper clips can be hung from the bottom of each line of paper clips.

(a) (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will .....

the strength of the electromagnet.

(1)

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

Pair 1: Electromagnets ..... and .....

Pair 2: Electromagnets ..... and .....

(1)

(iii) Suggest **two** variables that the student should control in this investigation.

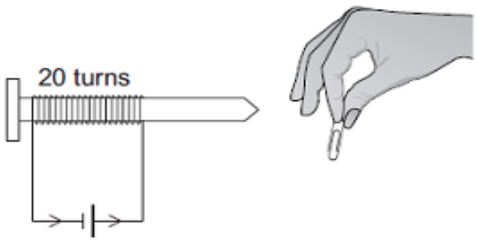
1 .....

2 .....

(2)

(b) The cell in electromagnet **A** is swapped around to make the current flow in the opposite direction. This is shown in **Figure 2**.

Figure 2



What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

fewer than 4 ☐ **4** ☐ **more than 4** ☐

Give **one** reason for your answer.

.....

.....

(2)

(c) Electromagnet **A** is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = ...

(1)

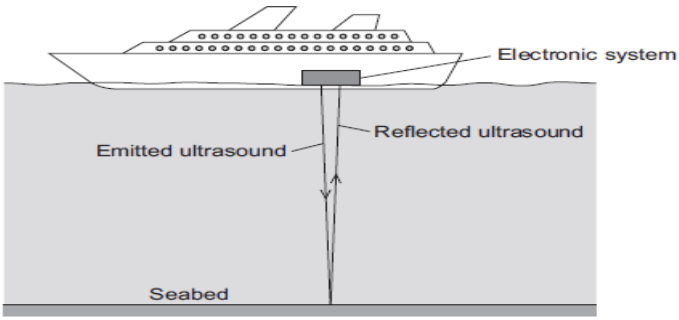
(Total 7 marks)

Q15. (a) What is ultrasound?

.....**(1)**

(b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water. Speed of ultrasound in water = 1600 m / s

.....

Depth of water = ... metres

(3)

(c) Ultrasound can be used in medicine for scanning. State **one** medical use of ultrasound scanning.

.....**(1)**

(d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

Figure 2

State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

Advantage of CT scanning

.....

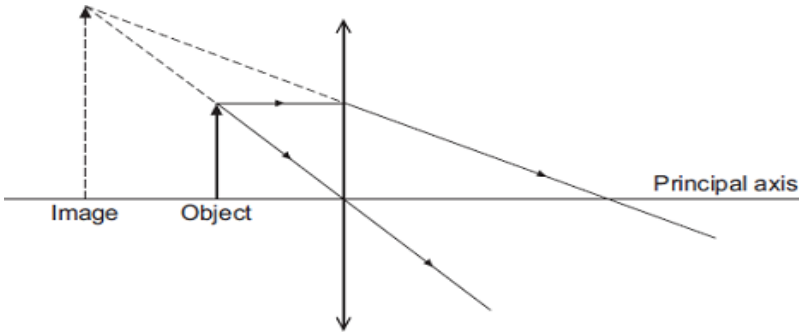
Disadvantage of CT scanning

.....**(2)**

(Total 7 marks)

Q16. (a) The diagram shows how a convex lens forms an image of an object.

This diagram is **not** drawn to scale.



(i) Which **two** words describe the image?

Draw a ring around each correct answer.

diminished **inverted** **magnified** **real** **upright**

(2)

(ii) The object is 4 cm from the lens. The lens has a focal length of 12 cm.

Calculate the image distance.

.....

.....

.....

Image distance = ... cm

(3)

(b) What does a minus sign for an image distance tell us about the nature of the image?

.....

(1)

(Total 6 marks)

Q17. The box below contains three statements about energy sources which are used to generate electricity.

1. Uses energy from falling water
2. Uses energy from inside the Earth
3. Is unpredictable
4. Produces dangerous waste

Select the correct statement from the box to complete each of the following statements

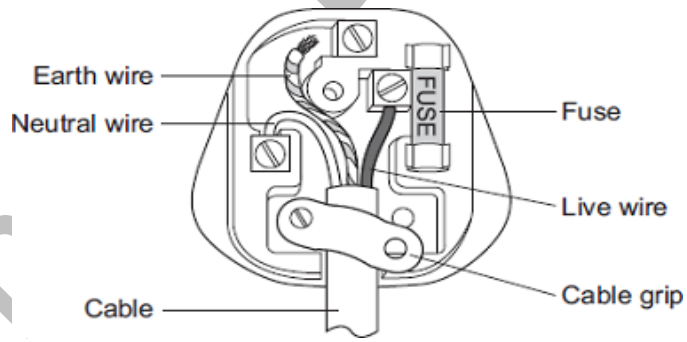
(i) Geothermal energy ……

(ii) Hydroelectric energy ……

(iii) Nuclear energy ……

(Total 3 marks)

Q18. (a) The diagram shows the inside of an **incorrectly** wired three-pin plug.



(i) What **two** changes need to be made so that the plug is wired correctly?

1 .....

2 .....

(2)

(ii) The fuse inside a plug is a safety device.

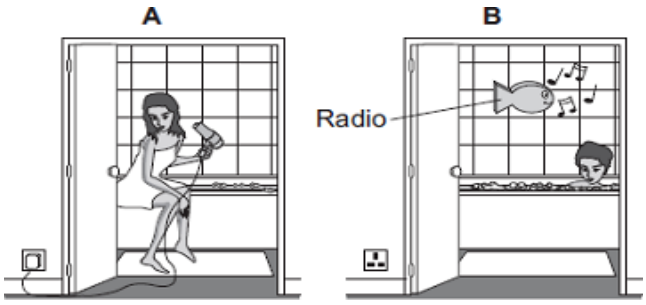
Explain what happens when too much current passes through a fuse.

.....

.....

(2)

(b) Each of these pictures shows an electrical appliance being used in a bathroom.



Using the hairdryer in picture **A** is dangerous. However, it is safe to use the battery-operated radio in picture **B**.

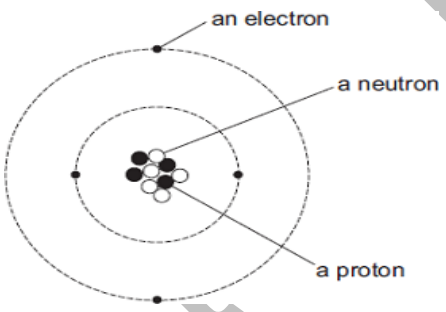
Explain why.

.....

.....

(2)
(Total 6 marks)

Q19. The diagram represents an atom of beryllium. The three types of particle that make up the atom have been labelled.



(a) Use the labels from the diagram to complete the following statements.

Each label should be used once.

The particle with a positive charge is ..... .

The particle with the smallest mass is ..... .

The particle with no charge is ..... .

(2)

(b) What is the mass number of a beryllium atom?

Tick the box showing the correct answer.

4 ☐	**5** ☐	**9** ☐	**13** ☐

Give a reason for your answer.

.....

(2)
(Total 4 mark)