

Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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12	
13	
14	
TOTAL	



General Certificate of Secondary Education
Higher Tier
June 2015

Science A 1

SCA1HP

Unit 5

H

Friday 5 June 2015 1.30 pm to 3.00 pm

For this paper you must have:

- a ruler
- a calculator
- the Chemistry Data Sheet and Physics Equations Sheet booklet (enclosed).

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 6 should be answered in continuous prose. In this question you will be marked on your ability to:
 - use good English
 - organise information clearly
 - use specialist vocabulary where appropriate.

Advice

- In all calculations, show clearly how you work out your answer.



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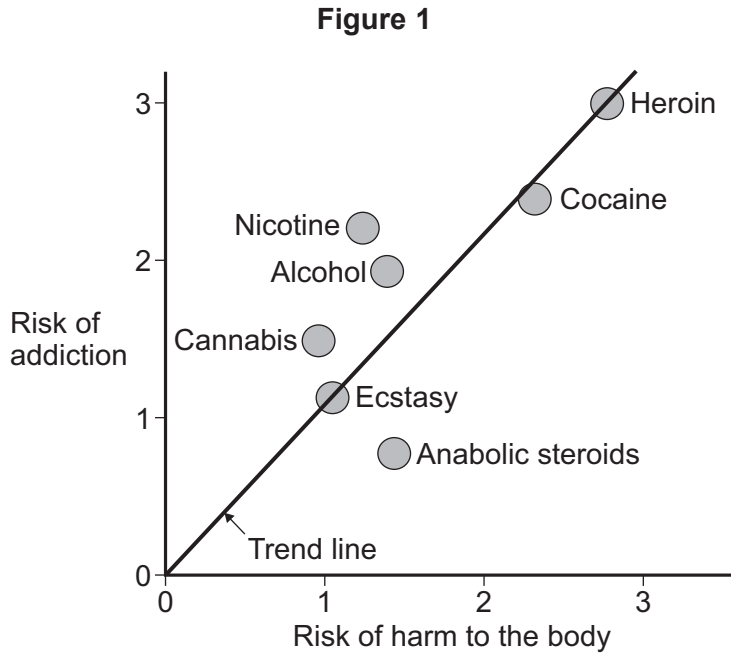
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SCA1HP

Answer **all** questions in the spaces provided.

Biology Questions

1 **Figure 1** shows the risk of addiction and risk of harm to the body for some drugs.



1 (a) (i) Name **two** legal recreational drugs shown in **Figure 1**.

[1 mark]

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1 (a) (ii) The overall impact of legal drugs on health is much greater than the impact of illegal drugs.

Use information from **Figure 1** and your own knowledge to give **two** reasons for this.

[2 marks]

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1 (b) A student concluded that as the risk of addiction to a drug increases, the risk of harm to the body increases.

1 (b) (i) Give **one** piece of evidence from **Figure 1** that supports this conclusion.

[1 mark]

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1 (b) (ii) Give **one** piece of evidence from **Figure 1** that does **not** support this conclusion.

[1 mark]

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Turn over for the next question

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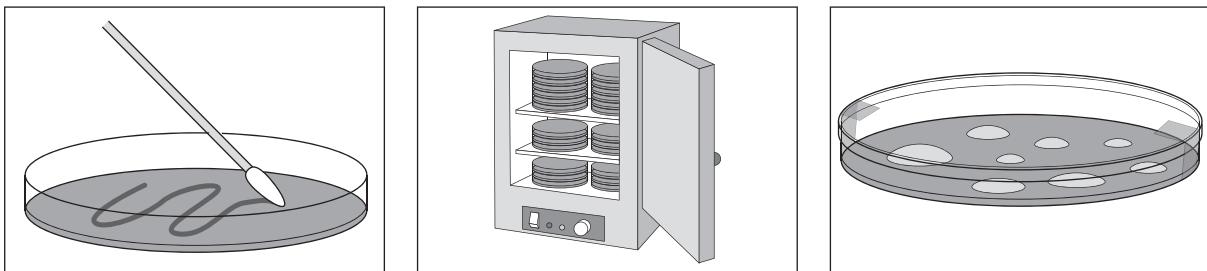
- 2 Five students investigated which areas of school were most contaminated with microorganisms.

Each student took samples from surfaces in different parts of the school using sterile cotton buds. They streaked each cotton bud across a sterile agar plate, then fastened the lid on with tape.

The students put the agar plates in an incubator for two days and then counted how many bacterial colonies had grown on each agar plate.

Figure 2 shows the procedure.

Figure 2



- 2 (a) In school laboratories agar plates should be incubated at a maximum temperature of 25 °C.

- 2 (a) (i) Give **one** reason for using 25 °C as a maximum temperature to incubate agar plates in a school laboratory.

[1 mark]

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- 2 (a) (ii) In industrial laboratories higher temperatures are used to incubate agar plates.

Give **one** reason why.

[1 mark]

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2 (b) The number of bacterial colonies that grew on each agar plate is shown in **Table 1**.

Table 1

Surface sampled	Number of colonies that grew on each agar plate					Mean number of colonies
Laboratory bench	7	10	7	9	8	8.2
Gym exercise mat	21	17	20	25	28	22.2
Computer keyboard	11	15	17	13	18	14.8
Canteen service area	6	9	8	8	8	7.8

2 (b) (i) What is the range for the mean number of colonies?

[1 mark]

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2 (b) (ii) Give **one** conclusion that can be made from the data in **Table 1**.

Suggest an explanation for this conclusion.

[2 marks]

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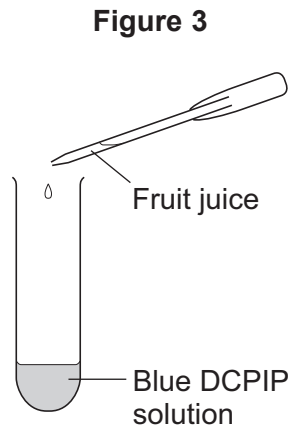
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- 3** Vitamin C is needed in the diet to prevent a deficiency disease called scurvy.
- Fruits such as oranges contain vitamin C.
- A group of students investigated the amount of vitamin C in four different fruit juices.
- Figure 3** shows the method the students used.



DCPIP solution is blue. When vitamin C is added to DCPIP solution the blue colour disappears.

The mean results for the students are shown in **Table 2**.

Table 2

Type of fruit juice	Mean number of drops of fruit juice needed to decolourise DCPIP solution
Apple	More than 30
Grapefruit	9
Orange	11
Lemon	6



3 (a) (i) What type of variable is the number of drops of fruit juice needed to decolourise the DCPIP solution?

[1 mark]

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3 (a) (ii) Give **one** conclusion that can be made from the results shown in **Table 2**.

[1 mark]

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3 (b) (i) The food label on a carton of grapefruit juice states that 100 cm³ of juice contains 25 mg of vitamin C.

The Recommended Daily Amount (RDA) of vitamin C for an adult is 80 mg.

What percentage of the recommended daily amount of vitamin C is provided by a 200 cm³ serving of grapefruit juice?

[1 mark]

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3 (b) (ii) The RDAs for vitamins given on food packaging labels are only guideline values.

Suggest why the values are only guidelines.

[1 mark]

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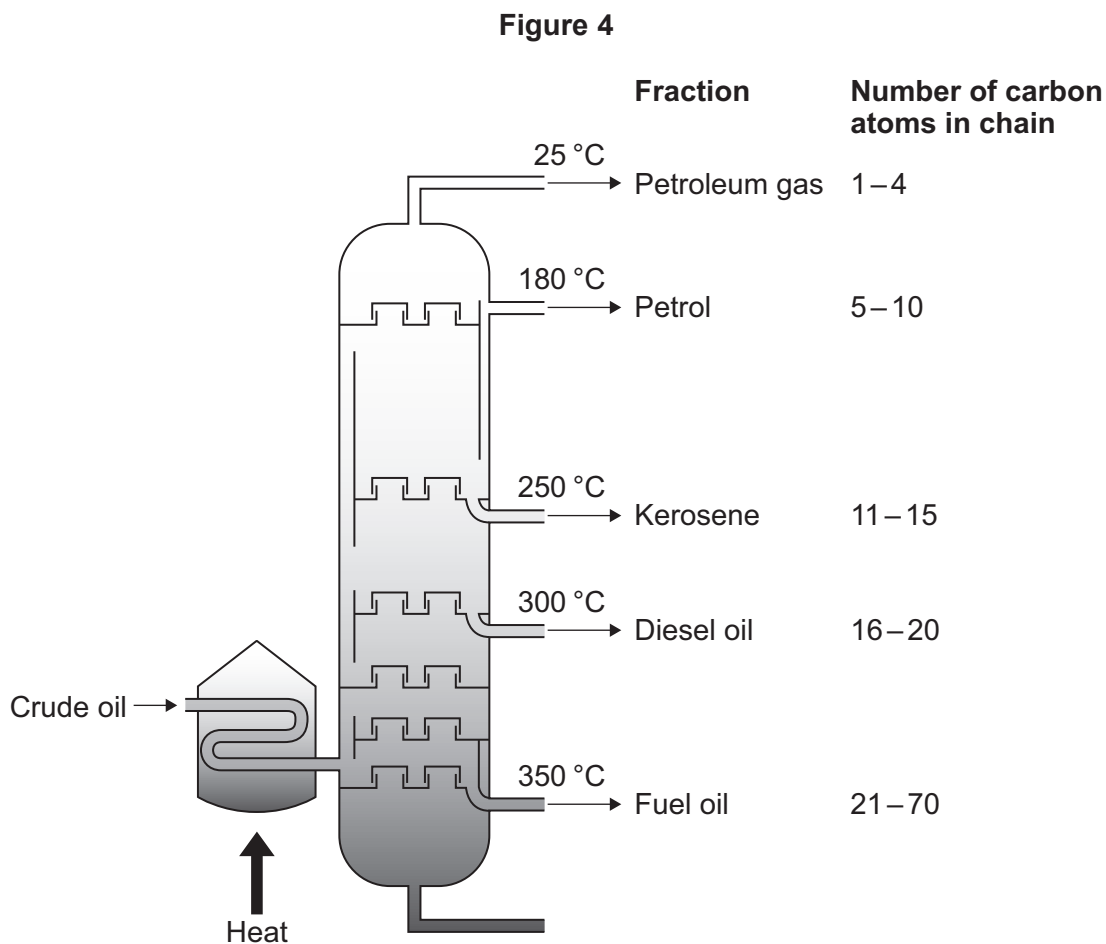


Chemistry Questions

4 Many fuels are produced from crude oil.

4 (a) Crude oil is separated into fractions by distillation in a fractionating column.

Figure 4 shows a fractionating column.



4 (a) (i) Describe how crude oil is separated into fractions by fractional distillation.

[3 marks]

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4 (a) (ii) Some properties of hydrocarbons change as the size of the molecules increases.

Describe the trends in boiling point and viscosity as the number of carbon atoms in the molecule increases.

[2 marks]

Boiling point

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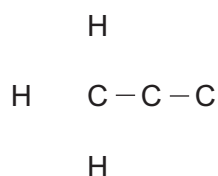
Viscosity

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4 (b) LPG (liquefied petroleum gas) is a fuel. LPG contains propane (C_3H_8).

4 (b) (i) Complete the displayed (structural) formula for propane.

[1 mark]



4 (b) (ii) Burning fuels releases energy. Name **two** products formed when LPG is burnt.

[2 marks]

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4 (b) (iii) Some cars are now designed to use LPG as a fuel. LPG is about 50p per litre cheaper than petrol.

Suggest **one** reason why most car owners use cars designed to use petrol and not LPG as a fuel.

[1 mark]

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5 This question is about lithium.

5 (a) A lithium atom has an atomic number of 3 and a mass number of 7.

Describe the atomic structure of lithium.

Include in your answer:

- the number of each type of particle
- where in the atom each particle is found.

[4 marks]

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5 (b) (i) Name **one** other element with similar chemical properties to lithium.

Use the Chemistry Data Sheet to help you name the element.

[1 mark]

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5 (b) (ii) Why are lithium and the element you named in part **(b)(i)** classed as different elements?

[1 mark]

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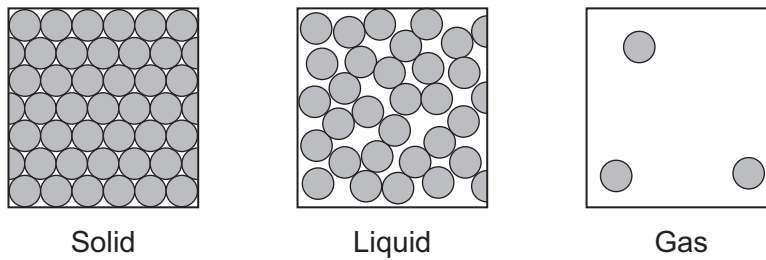


Physics Questions

6 In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Figure 5 shows the arrangement of particles in a solid, a liquid and a gas.

Figure 5



Use **Figure 5** and your own knowledge to compare solids, liquids and gases in terms of their particles.

You should include information about the arrangement, movement and energy of the particles.

[6 marks]

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Extra space

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7 **Figure 6** shows a woman filling her bathroom sink with hot water.

Figure 6



7 (a) The mirror changes from being dry to being covered with small drops of water.

Name the process causing this change on the mirror.

[1 mark]

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7 (b) The woman dries herself with a towel. She hangs the wet towel in the bathroom to dry. **Figure 7** shows two places she could hang the towel.

Figure 7



The towel will dry faster if it is hung from the unheated towel rail instead of the towel ring.

Explain why.

[2 marks]

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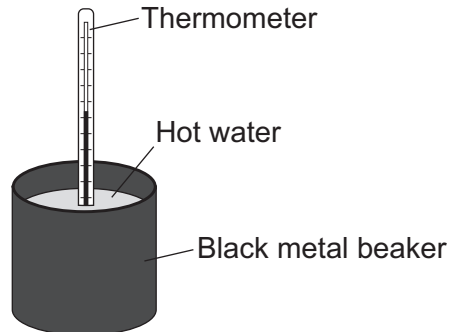
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- 8 A student investigated the hypothesis that the starting temperature of hot water affects the rate of cooling of the water. **Figure 8** shows the equipment he used.

Figure 8



The student measured the temperature of the water at the start of the investigation and after 5 minutes. He repeated this three times for each starting temperature and calculated the mean. The results are shown in **Table 3**.

Table 3

Starting temperature in °C	Mean temperature after 5 minutes in °C
80	66
71	59
60	52
50	45
39	37

- 8 (a) State **one** advantage of calculating a mean.

[1 mark]

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8 (b) What is the resolution of the thermometer used in this investigation?

[1 mark]

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8 (c) The student concluded that water at a higher starting temperature cooled faster than water at a lower starting temperature.

Use the results for starting temperatures of 80 °C and 50 °C in **Table 3** to explain why the student came to this conclusion.

You should include relevant calculations in your answer.

[2 marks]

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8 (d) Explain why the water at a higher starting temperature cooled faster.

[2 marks]

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8 (e) Predict how the results would be different if the student repeated the investigation with a shiny metal beaker, rather than the black metal beaker.

[1 mark]

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Biology Questions

9 Antibiotics are used to treat bacterial infections, but not viral infections.

9 (a) Explain why antibiotics are **not** effective against viral infections.

[2 marks]

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9 (b) New strains of bacteria have developed that are resistant to antibiotics. There is no effective treatment against these resistant strains.

What must be done to make sure we will be able to treat bacterial infections in the future?

[2 marks]

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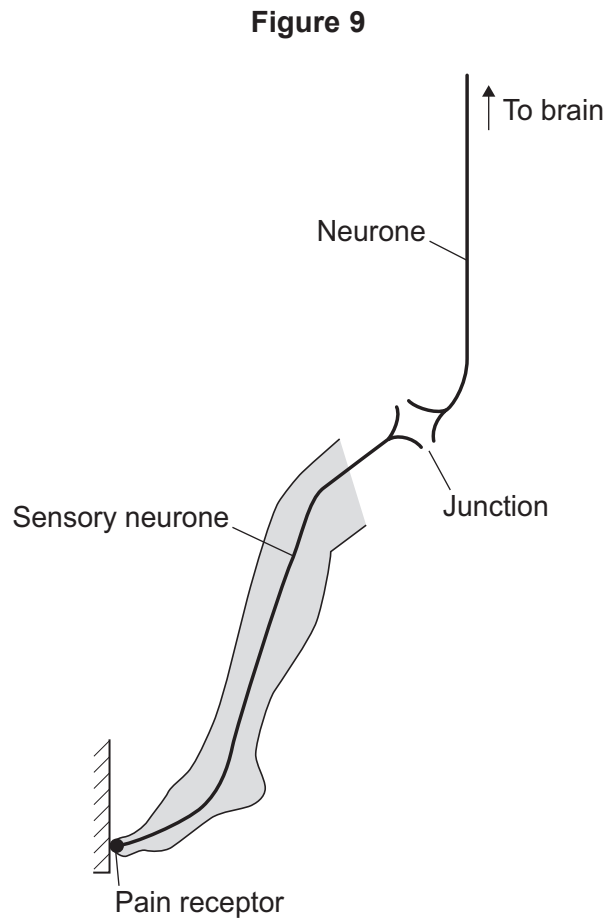
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- 10** **Figure 9** shows the pathway of an impulse from a pain receptor when someone bangs their toe on a hard surface.



- 10 (a) (i)** What is the junction between neurones called?

[1 mark]

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- 10 (a) (ii)** How does information cross the junction between neurones?

[1 mark]

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10 (b) If you bang your toe you feel the pressure of the impact before you feel the pain. This is because the impulse from a touch receptor travels faster than the impulse from a pain receptor.

The speed of transmission of the impulse from a touch receptor is 76.2 m/s.

The speed of transmission of the impulse from a pain receptor is 0.60 m/s.

The following equation can be used to calculate how long it takes for each impulse to reach the brain:

$$\text{Speed of transmission} = \frac{\text{distance}}{\text{time}}$$

If the distance each impulse has to travel from the toe to the brain is 1.920 metres, it will take 0.025 seconds for the impulse from the touch receptor to reach the brain.

Calculate how much **longer** it will take the impulse from the pain receptor to reach the brain.

You must show your working.

[3 marks]

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..... seconds

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11 A couple wanted to have a baby, but after several years of trying the woman did not become pregnant. Their doctor suggested IVF treatment.

11 (a) Describe the main stages in IVF treatment.

[4 marks]

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11 (b) As women get older they become less fertile. Eventually the ovaries stop releasing eggs, so a woman cannot become pregnant.

IVF treatment means it is now possible for women in their 50s and 60s to have children, but not everyone thinks this is a good idea.

Suggest reasons for **and** against women in their 50s and 60s having IVF treatment to have children.

[3 marks]

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Chemistry Questions

12 Limestone is mainly calcium carbonate.

12 (a) Limestone is used to make cement.

What is added to limestone to make cement?

Draw a ring around the correct answer.

[1 mark]

aggregate

clay

mortar

sand

12 (b) Manufacturing cement from 1000 kg of limestone produces a total of 800 kg of carbon dioxide.

One of the reactions in manufacturing cement is the thermal decomposition of calcium carbonate.

The equation shows what happens when 1000 kg of calcium carbonate decomposes to form 560 kg of calcium oxide at 1500 °C.



12 (b) (i) How much carbon dioxide is produced when 1000 kg of calcium carbonate is completely decomposed?

[1 mark]

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12 (b) (ii) Suggest why the total amount of carbon dioxide produced by the manufacturing process is greater than your answer to part **(b)(i)**.

[1 mark]

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Question 12 continues on the next page

Turn over ►



12 (c) Cement and sand are used to make concrete.

A student made some 1 kg concrete blocks.

The student varied the percentage of cement in the mixture.

The student tested the strength of the concrete blocks by hanging masses from the block, as shown in **Figure 10**, until the block broke.

Figure 10

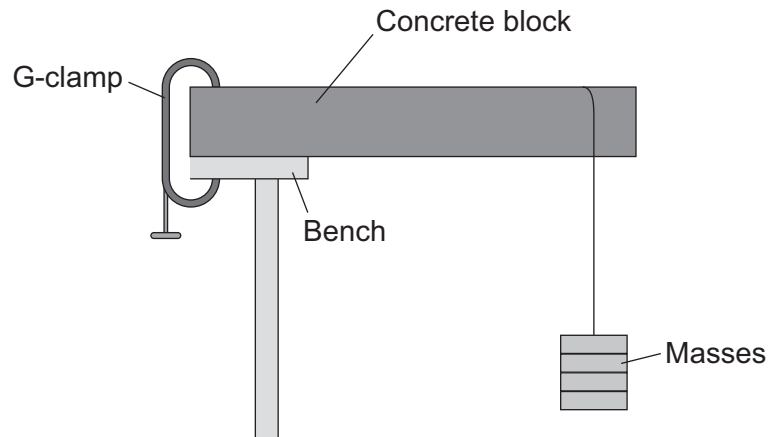
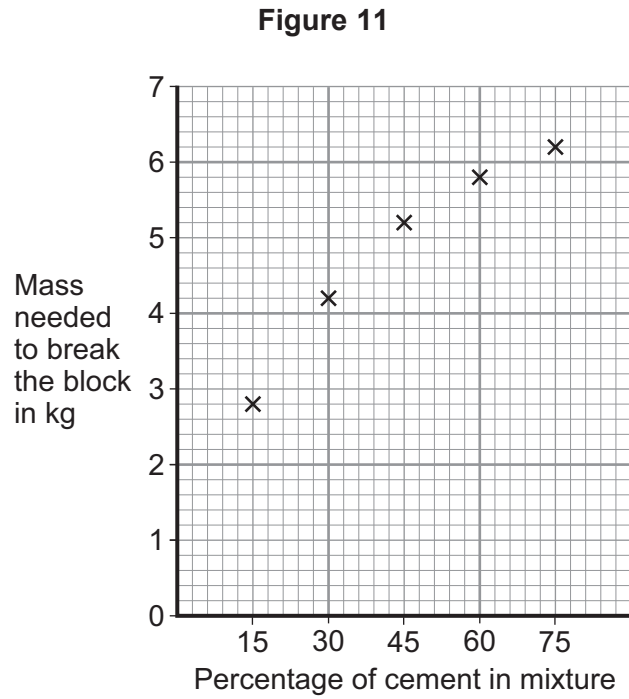


Figure 11 shows the student's results.



Give **two** conclusions that can be made from these results.

[2 marks]

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13 The Mary Rose was a wooden warship built in 1510. The Mary Rose sank in 1545 but was lifted from the sea bed in 1982. Scientists are now preserving the ship.

Metal objects found on the Mary Rose included some made from gold, some made from iron, but none made from aluminium.

13 (a) (i) Why is gold found in the Earth's crust as the element?

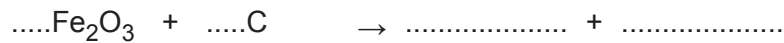
[1 mark]

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13 (a) (ii) Iron is extracted from iron(III) oxide by reduction with carbon.

Complete and balance the symbol equation for the reaction.

[2 marks]



13 (a) (iii) Scientists were not able to extract aluminium until the 19th century.

Explain why.

[2 marks]

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- 13 (b)** **Figure 12** shows the Mary Rose being supported on poles as it is preserved. As part of the preservation process the ship was sprayed with water for 12 years.

Figure 12



Table 4 gives information about two materials which could have been used to make the poles to support the Mary Rose.

Table 4

Material	Density in g/cm^3	Relative strength	Cost in £ per kg
Steel	7.85	1	4
Titanium	4.51	3.9	4000

- 13 (b) (i)** Compare the physical properties of the materials in **Table 4** to suggest why the poles were made of titanium instead of steel.

[1 mark]

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- 13 (b) (ii)** Give **one** other property of titanium, not shown in **Table 4**, which makes titanium very suitable for use in supporting the Mary Rose in the preservation process.

[1 mark]

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13 (b) (iii) Why is the extraction of titanium a very expensive process?

[3 marks]

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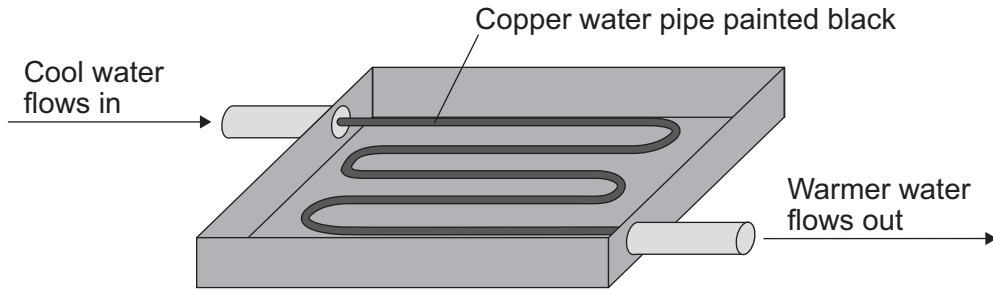
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Physics Questions

- 14 (a)** **Figure 13** shows a solar panel. Solar panels can be fitted to house roofs and used to heat water for domestic hot water systems.

Figure 13



- 14 (a) (i)** Use **Figure 13** to explain how the design of the water pipe increases the rate of energy transfer from the Sun to the water.

[3 marks]

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Question 14 continues on the next page

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14 (a) (ii) A layer of material separates the panel from the house roof. This layer of material reduces energy transfer through the bottom of the panel.

The U-values of three materials are given below.

Which material would be the best to use?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

0.7 W/m² °C

0.9 W/m² °C

1.1 W/m² °C

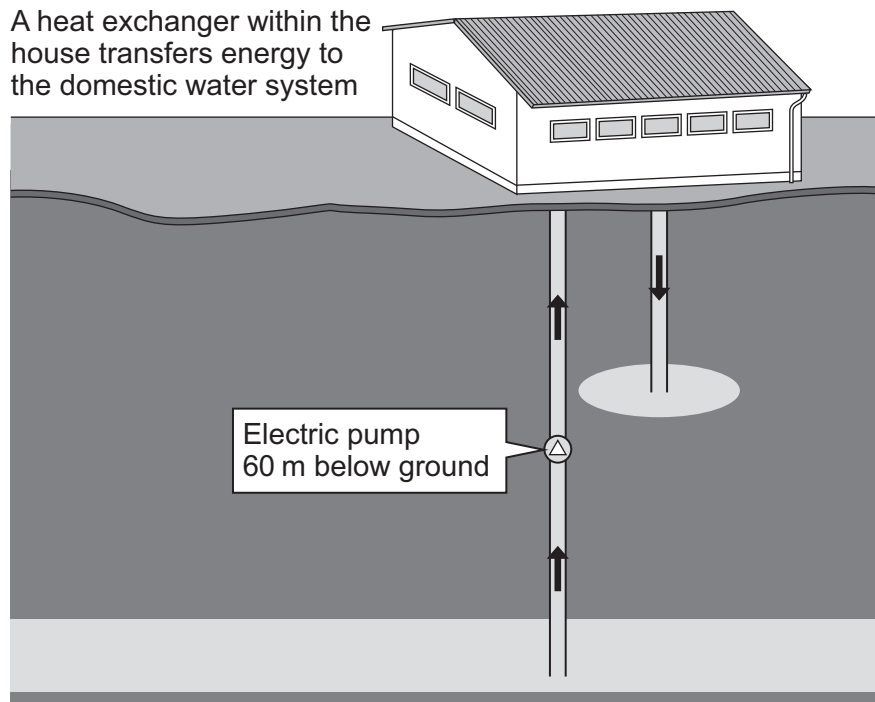
Reason

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- 14 (b)** **Figure 14** shows a different method of heating water called a ground source heat pump. Two holes are drilled into the ground and fitted with pipes. Warm water is pumped up one pipe and waste water is returned to the ground through the other pipe. In the house, energy is transferred from the warm water by a heat exchanger.

Figure 14



- 14 (b) (i)** Suggest **one** advantage of using this method of heating water rather than using solar panels.

[1 mark]

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Question 14 continues on the next page

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14 (b) (ii) A leaflet about a ground source heat pump states:

**‘Ground source heat pumps are 300–400% efficient.
For each joule of mains electrical energy the pumps use, they transfer three to four times more energy from the water.’**

Two students read the leaflet.

Student **A** says, ‘It is incorrect to say that a device is 300–400% efficient.’

Student **B** says, ‘The statement is correct.’

Both conclusions could be considered to be correct.

Explain why.

[4 marks]

Student **A**’s conclusion

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Student **B**’s conclusion

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14 (b) (iii) Domestic water enters the heat exchanger at a temperature of 7.0 °C and leaves the heat exchanger at a temperature of 55 °C.

Each day 19 000 000 joules of energy are supplied to the water passing through the heat exchanger.

Calculate the mass of water that can be heated each day.

Choose the correct equation from the Physics Equations Sheet.

Specific heat capacity of water = 4200 J/kg °C.

Give your answer to 2 significant figures.

[4 marks]

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Mass of water = kg

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END OF QUESTIONS



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Question 13 Figure 12: Photograph of Mary Rose © Peter Titmuss / Alamy

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