ASSESSMENT AND QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education
Higher Tier
June 2010

Science B

Unit Physics P1

Physics

Unit Physics P1

PHY1H

Thursday 24 June 2010   1.30 pm

> **For this paper you must have:**
> ● a ruler.
> **You may use a calculator.**

TIME ALLOWED
● **45 minutes plus your additional time allowance.**

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

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INSTRUCTIONS

- **Use black ink or black ball-point pen.**

- **Answer ALL questions.**

- **You must answer the questions in the spaces provided.**

- **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 45.**

- **You are expected to use a calculator where appropriate.**

- **You are reminded of the need for good English and clear presentation in your answers.**

ADVICE

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

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

1   Heat exchangers are devices that are used to transfer heat from one place to another.

The diagram shows a simple heat exchanger used by a student in an investigation.
Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.
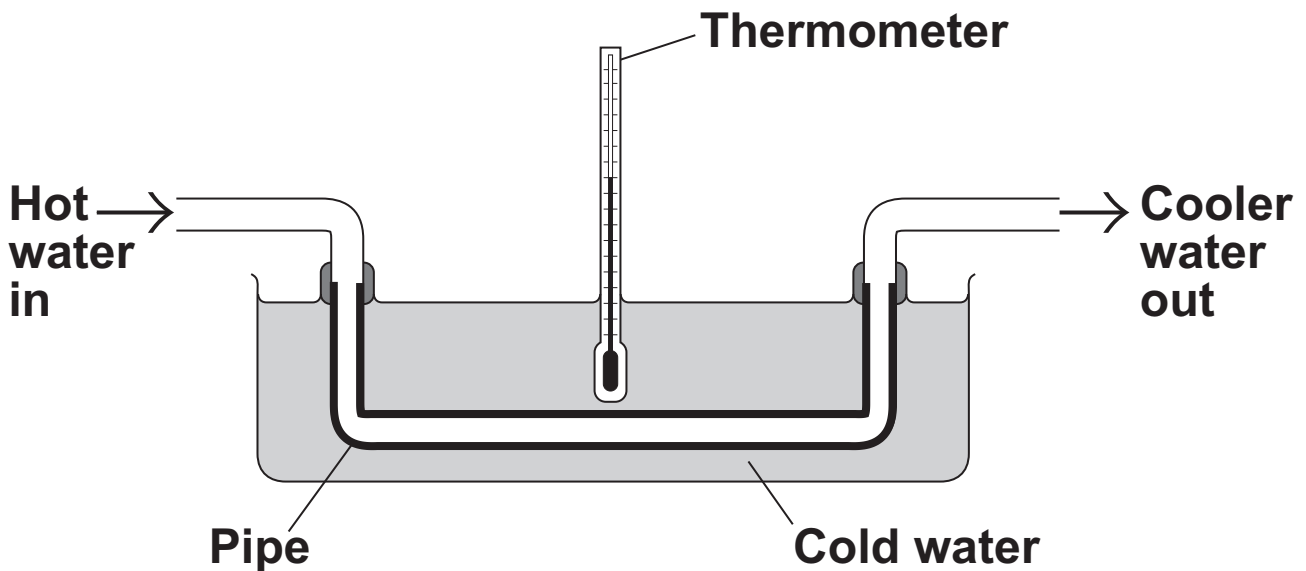
1 (a)   By which process is heat transferred from the hot water inside the pipe to the cold water outside the pipe? [1 mark]

_____

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QUESTION 1 CONTINUES ON THE NEXT PAGE

1 (b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

The results obtained by the student are recorded in the table and displayed in the bar chart.

Material	Temperature of the cold water at the start in °C	Temperature of the cold water after 10 minutes in °C
Copper	20	36
Glass	20	23
Plastic	20	21
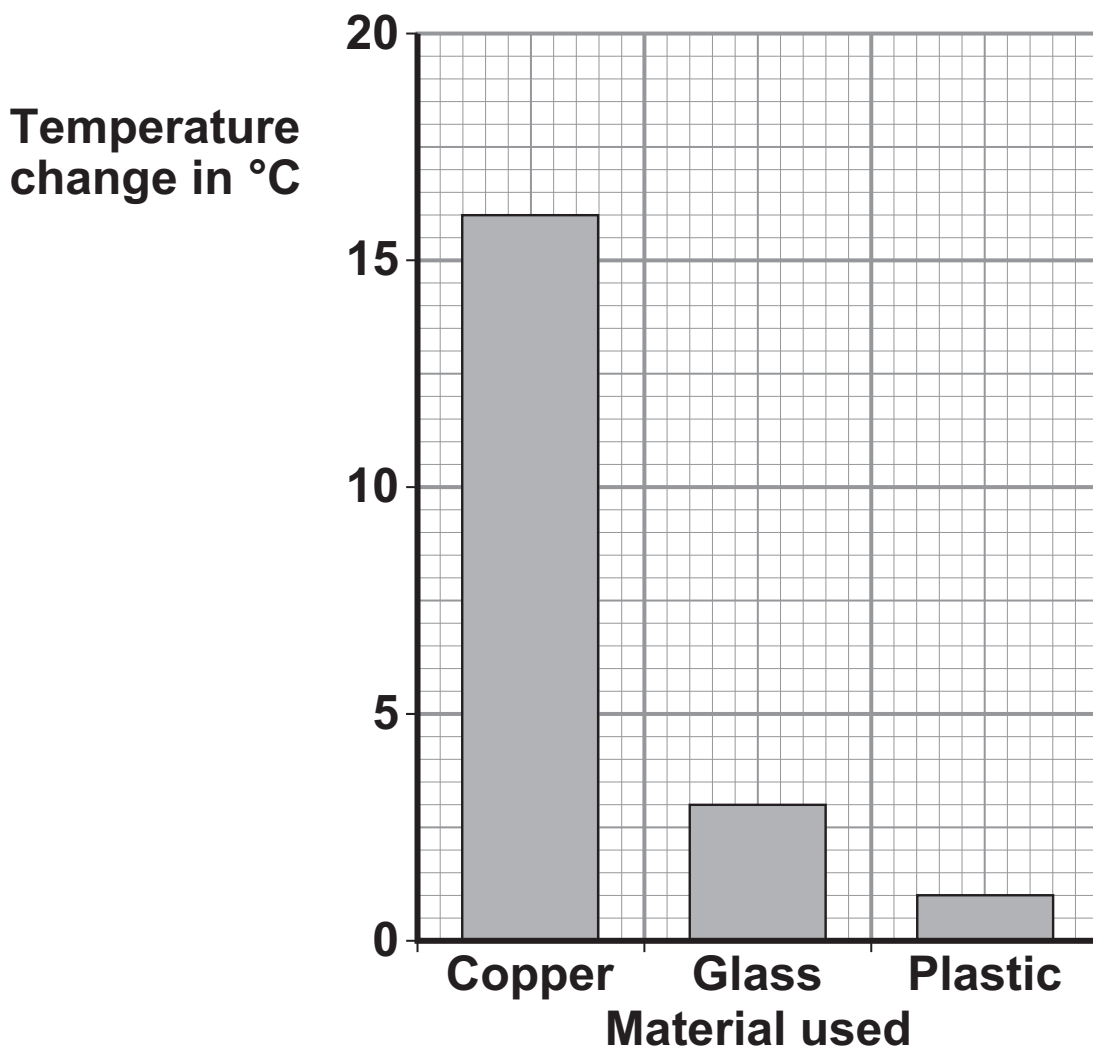
1 (b) (i) The rate of flow of hot water through the pipe was one of the control variables in the investigation.

Give ONE other control variable in the investigation. [1 mark]

_____

1 (b) (ii) Why did the student draw a bar chart rather than a line graph? [1 mark]

_____

_____

_____

1 (b) (iii) Which ONE of the three materials made the best heat exchanger? [2 marks]
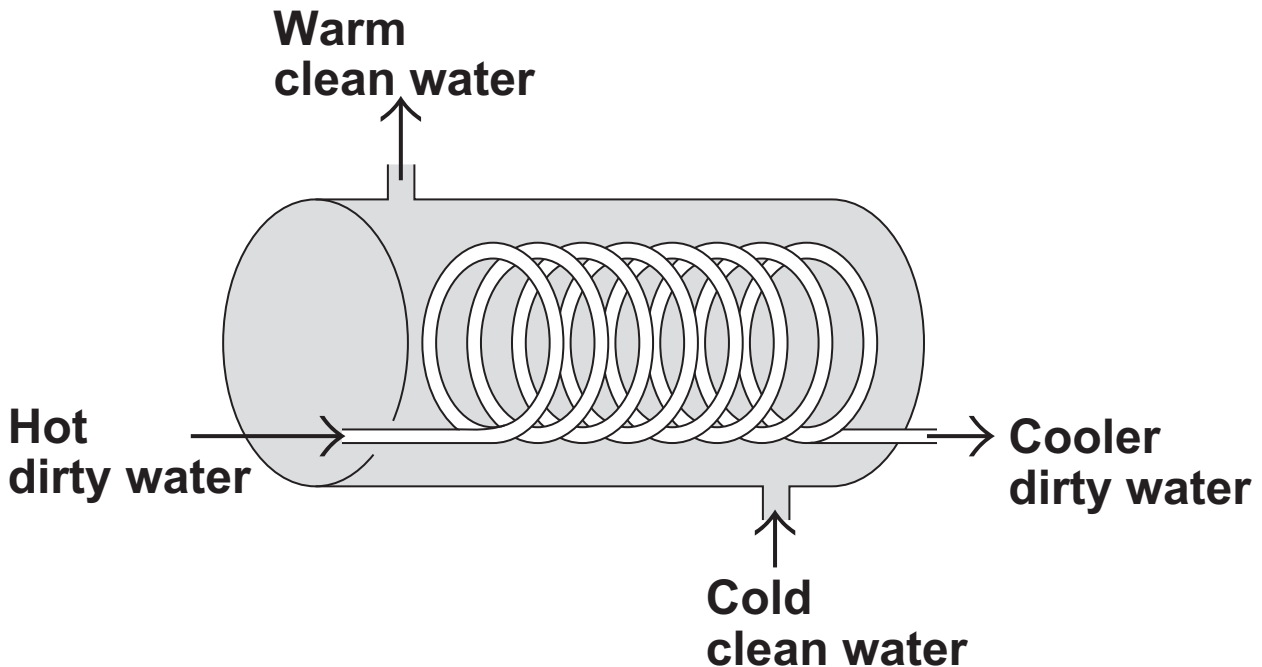
_____

Give a reason for your answer.

_____

_____

_____

_____

[Question 1 continues on the next page]

1 (c) The student finds a picture of a heat exchanger used in an industrial laundry.
The heat exchanger uses hot, dirty water to warm cold, clean water.

Warm
clean water

Hot
dirty water

Cooler
dirty water

Cold
clean water

Why does this heat exchanger transfer heat faster than the heat exchanger used by the student in the investigation? **[1 mark]**
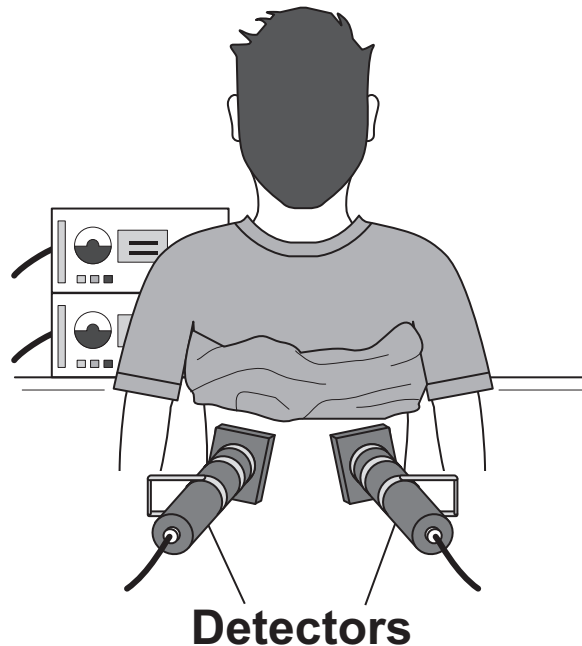
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| 6 |

2 (a) A doctor uses the radioactive isotope technetium-99 to find out if a patient's kidneys are working correctly.

Detectors

The doctor injects a small amount of technetium-99 into the patient's bloodstream.

Technetium-99 emits 'gamma radiation'.

Give TWO reasons why an isotope that emits gamma radiation is injected into the patient rather than an isotope that emits alpha radiation. [2 marks]
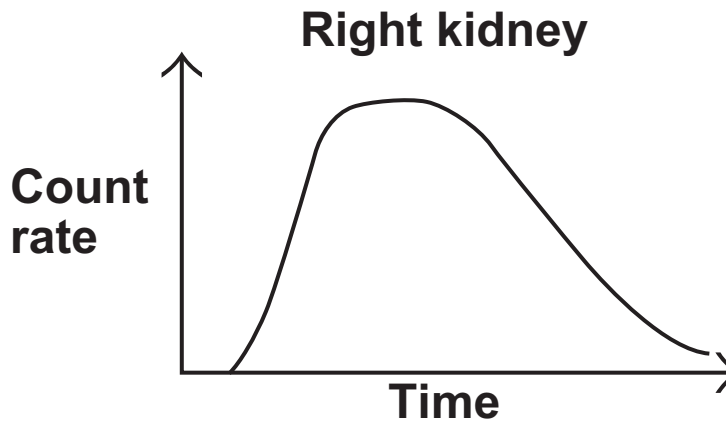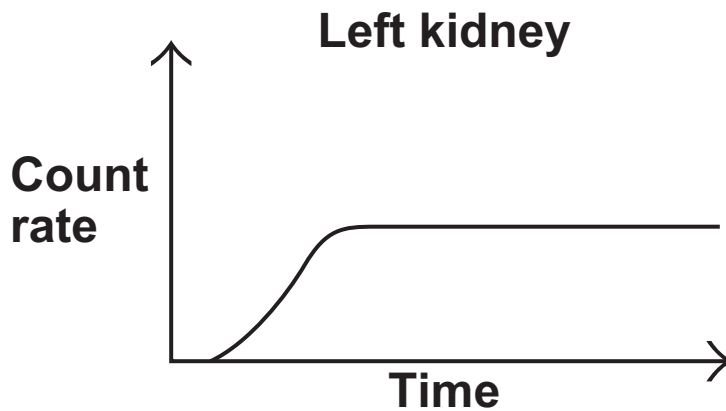
1 _____

_____

_____

2 _____

_____

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2 (b)   **If the patient's kidneys are working correctly, the technetium-99 will pass from the bloodstream into the kidneys and then into the patient's urine.**

Detectors are used to measure the radiation emitted from the kidneys.

The level of radiation emitted from each kidney is recorded on a graph.

Left kidney

Count rate

Time

Right kidney

Count rate

Time

2 (b) (i)   **How do the graphs show that technetium-99 is passing from the bloodstream into each kidney? [1 mark]**

_____

_____

_____

2 (b) (ii) **By looking at the graphs, the doctor is able to tell if there is a problem with the patient's kidneys.**

Which ONE of the following statements is correct? [3 marks]

Put a tick (✓) in the box next to your answer.

☐ **Only the right kidney is working correctly.**

☐ **Only the left kidney is working correctly.**

☐ **Both kidneys are working correctly.**

Explain the reason for your answer.

_____

_____

_____

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[Question 2 continues on the next page]

2 (c) The patient was worried about having a radioactive isotope injected into their body. The doctor explained that the risk to the patient's health was very small as technetium-99 has a short half-life.

2 (c) (i) What does the term 'half-life' mean? [1 mark]

_____

_____

_____

2 (c) (ii) Explain why it is important that the doctor uses an isotope with a short half-life rather than an isotope with a long half-life. [2 marks]
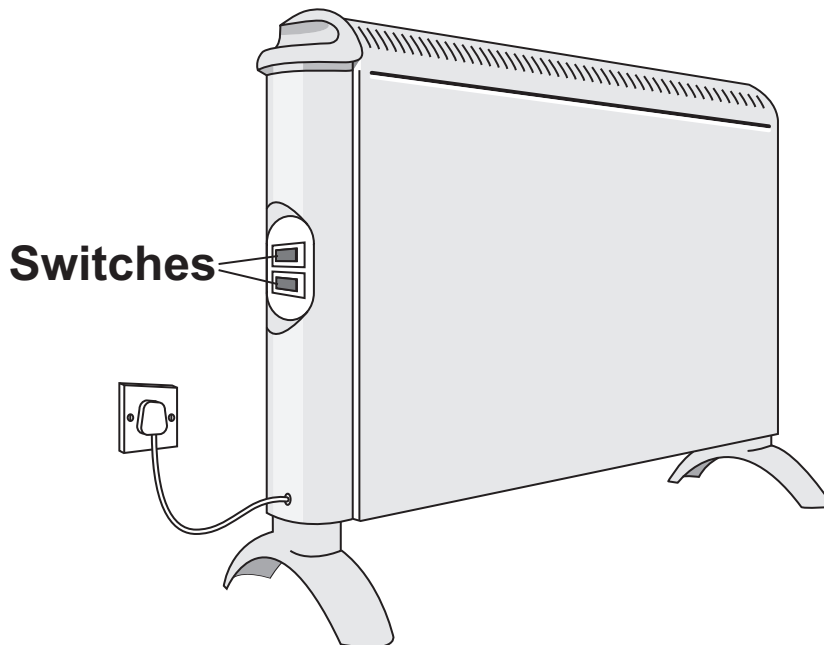
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9

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TURN OVER FOR THE NEXT QUESTION

3 (a)   **The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.**

Switches

SETTING	POWER IN watts
Low	700
Medium	1400
High	

3 (a) (i)   **When both switches are on, the heater works at the high power setting.**

What is the power of the heater, in kilowatts, when it is switched to the HIGH power setting? [1 mark]

Power = _____ kilowatts

3 (a) (ii) **The heater is used on the HIGH power setting. It is switched on for $1\frac{1}{2}$ hours.**

Use the equation to work out the energy transferred from the mains to the heater in $1\frac{1}{2}$ hours. [3 marks]

energy transferred   =   power   x   time

Show clearly how you work out your answer and give the unit.

_____

_____

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Energy transferred = _____

[Question 3 continues on the next page]

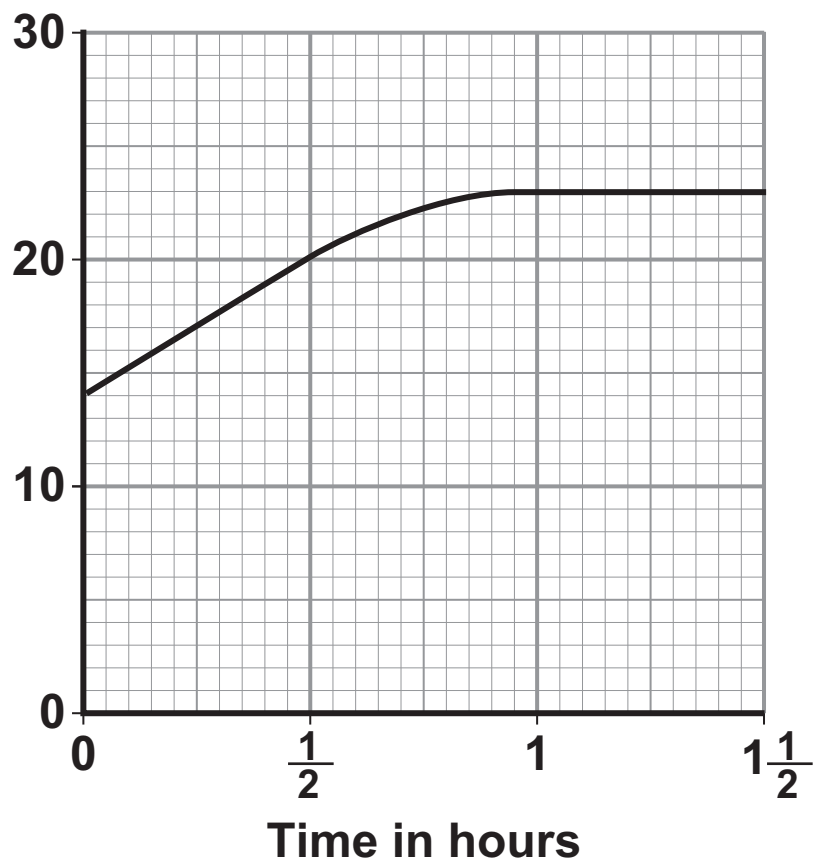**3 (a) (iii)** This type of heater is a very efficient device.

What is meant by a device being very efficient?
[1 mark]

_____

_____

3 (b) The graph shows how the temperature of a room changes during the $1\frac{1}{2}$ hours that the heater is used.

Temperature in ºC / Time in hours

After 1 hour, the temperature of the room has become constant, even though the heater is still switched on. [2 marks]

Explain why.

_____

_____

_____

_____

_____

_____

7

[Turn over for the next question]

4 (a) **Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.**

4 (a) (i) **Give TWO properties that are common to both visible light and microwaves. [2 marks]**

1 _____

_____

_____

2 _____

_____

_____

4 (a) (ii) **Name TWO more types of electromagnetic wave that can be used for communications. [1 mark]**

_____

and _____

4 (b) **Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12·5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.**

Use the equation to calculate the frequency of the microwaves used to link the computer to the router. [3 marks]

wave speed = frequency x wavelength

Show clearly how you work out your answer and give the unit.

_____

_____

_____

Frequency = _____

[Question 4 continues on the next page]

4 (c) **Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.**

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

4 (c) (i) **Suggest what the politician could have done to persuade people that what he said was not just an opinion. [1 mark]**

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4 (c) (ii) **Why did the group of scientists suggest that there is a need for further research? [1 mark]**
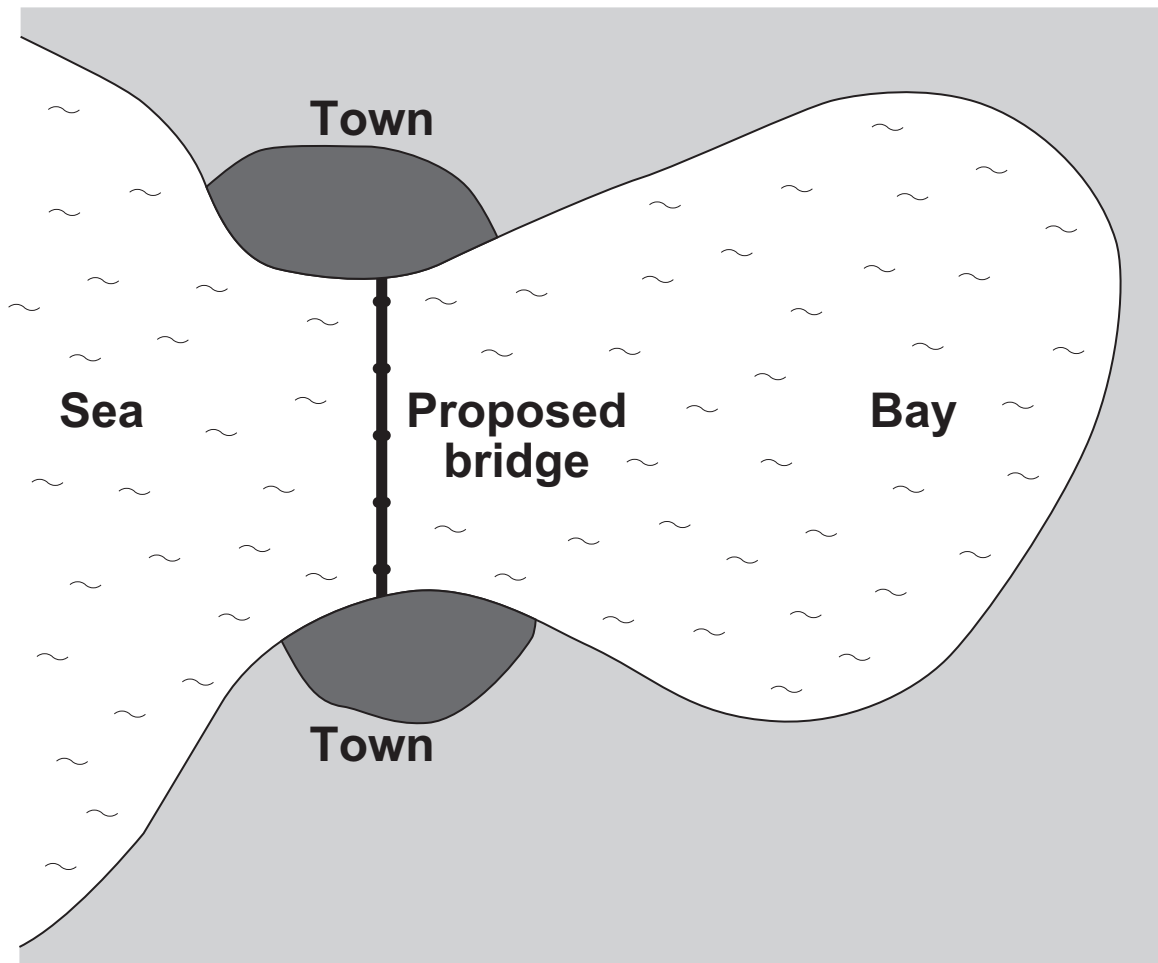
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TURN OVER FOR THE NEXT QUESTION

5   The map shows the positions of two towns
on either side of a very large coastal bay in
England. The map also shows where a bridge
may be built to link the towns. The road
journey from one town to the other is about
60 kilometres at present.

5 (a)   It is estimated that building turbines and
generators inside the legs of the bridge would
produce enough electricity for both towns.
In addition, enough electricity would be
generated to run electric buses over the bridge
between the two towns.

5 (a) (i)   If the bridge is built, what form of renewable energy will be used to generate the electricity?
[1 mark]

_____

5 (a) (ii)   Most people living in the area are in favour of the proposed bridge.

Suggest THREE reasons why people would be in favour of building the bridge and the associated electricity generating scheme.
[3 marks]

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

Reason 3 _____

_____

_____

5 (b) Even with the proposed bridge, the two towns will need to stay connected to the National Grid.

The diagram shows part of the National Grid.
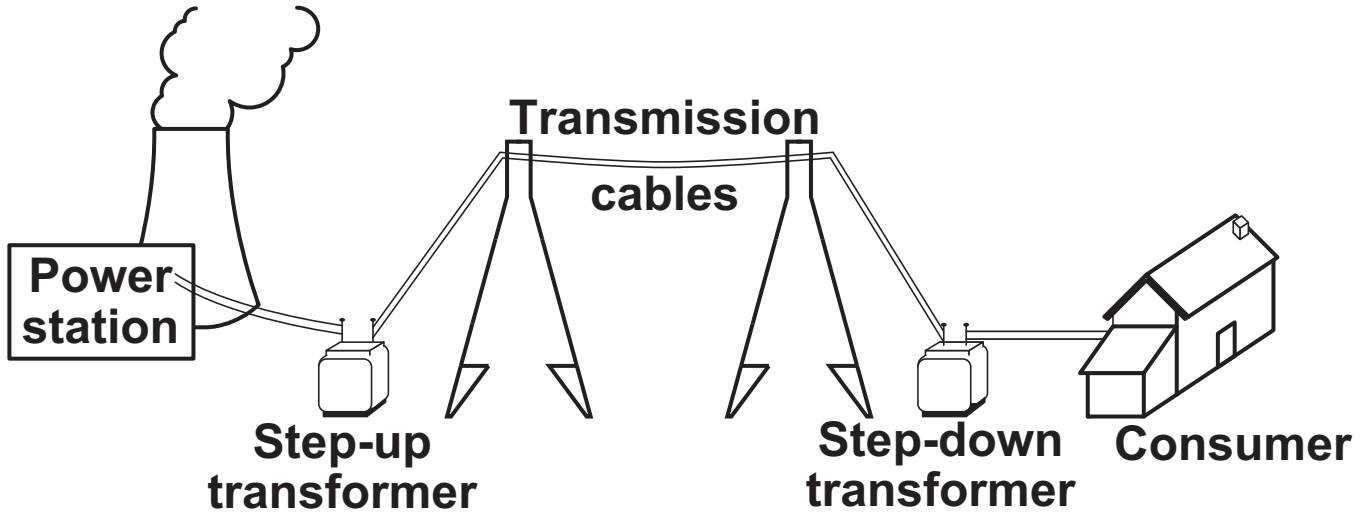
5 (b) (i) Give ONE reason why the towns need to stay connected to the National Grid. [1 mark]

_____

_____

_____

5 (b) (ii) **Explain how the step-up transformer increases the efficiency of the National Grid.** **[2 marks]**

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7

[Turn over for the next question]

6 (a) In 1929, the astronomer Edwin Hubble observed that the light from galaxies that are moving away from the Earth showed a 'red-shift'.

What is 'red-shift'? [1 mark]

_____

_____

_____

6 (b) By measuring the red-shift, Hubble was able to calculate the speed at which the galaxies are moving away from the Earth. He was also able to calculate the distance of these galaxies from the Earth.

The graph opposite shows some of the data calculated by Hubble.

6 (b) (i) The data from two galaxies, M and N, has been included in the graph. The light from galaxy M has a smaller red-shift than the light from galaxy N.

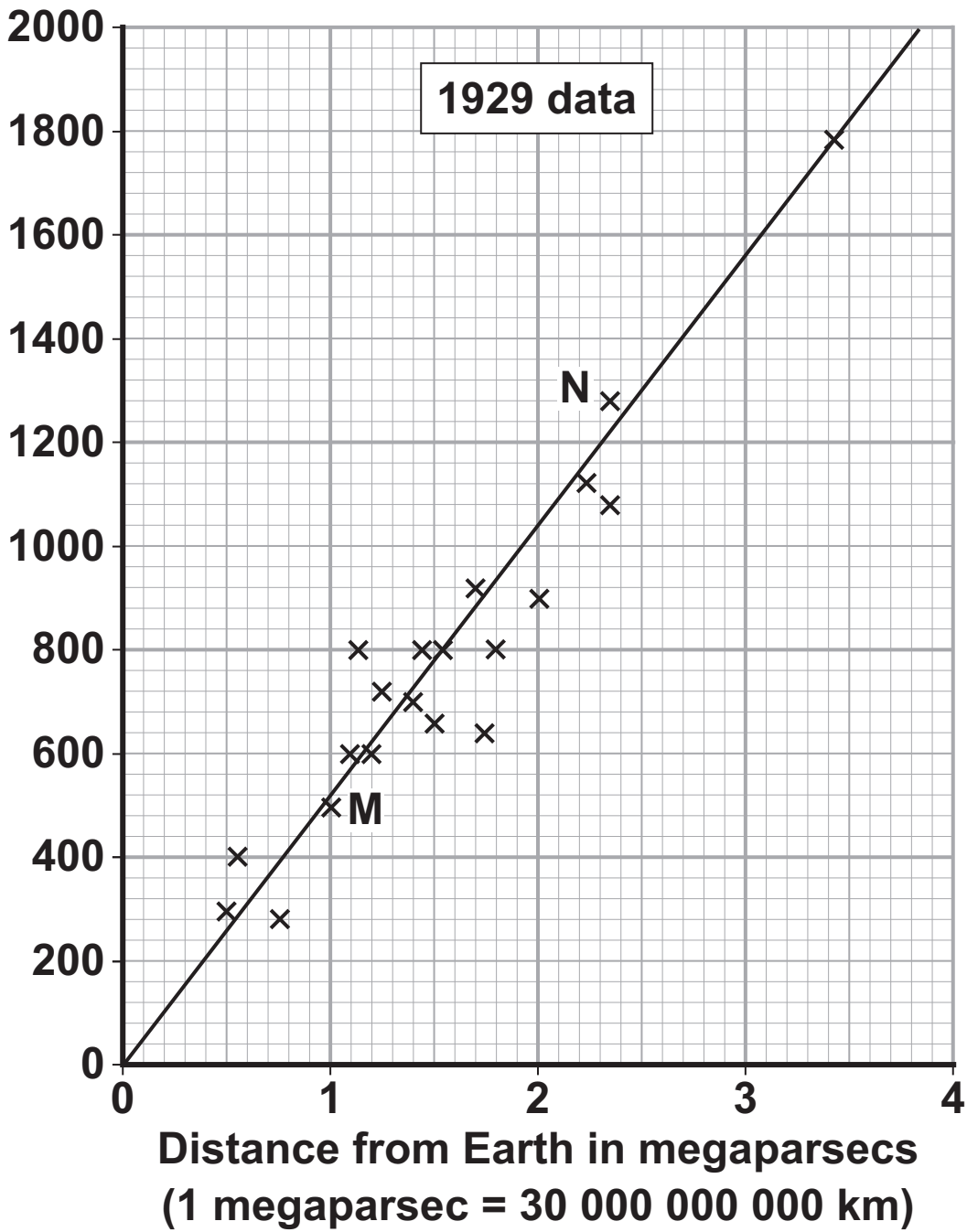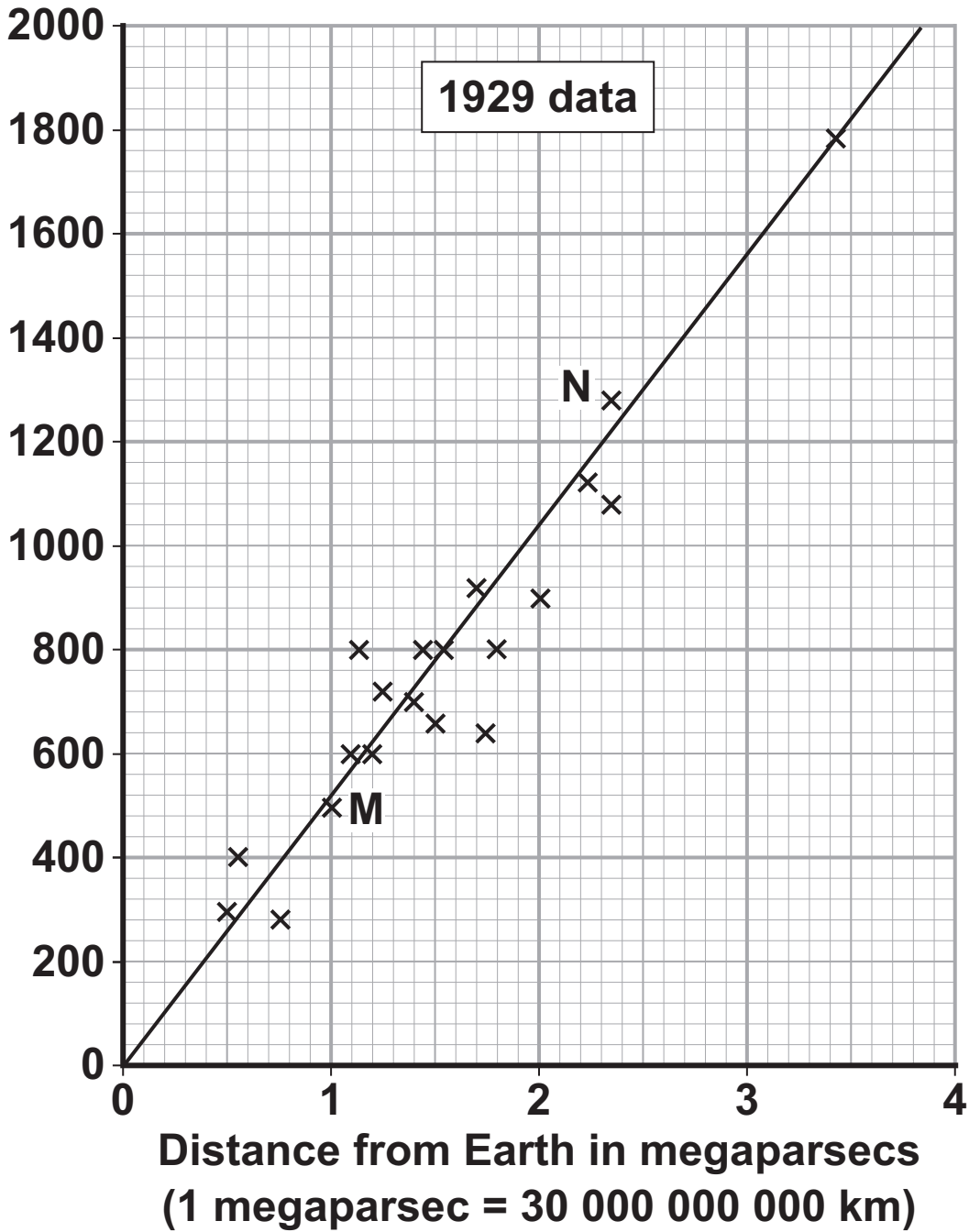What does the difference in red-shift tell scientists about the two galaxies, M and N? [2 marks]

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_____

Velocity in km/s

Distance from Earth in megaparsecs (1 megaparsec = 30 000 000 000 km)

[Question 6 continues on the next page]

The graph is repeated from page 27.

Velocity in km/s

**Distance from Earth in megaparsecs
(1 megaparsec = 30 000 000 000 km)**

6 (b) (ii) **The gradient of the line drawn on the graph gives a number known as the Hubble constant. The Hubble constant can be used to estimate when the universe began.**
Use the graph to calculate the value of the Hubble constant. [2 marks]

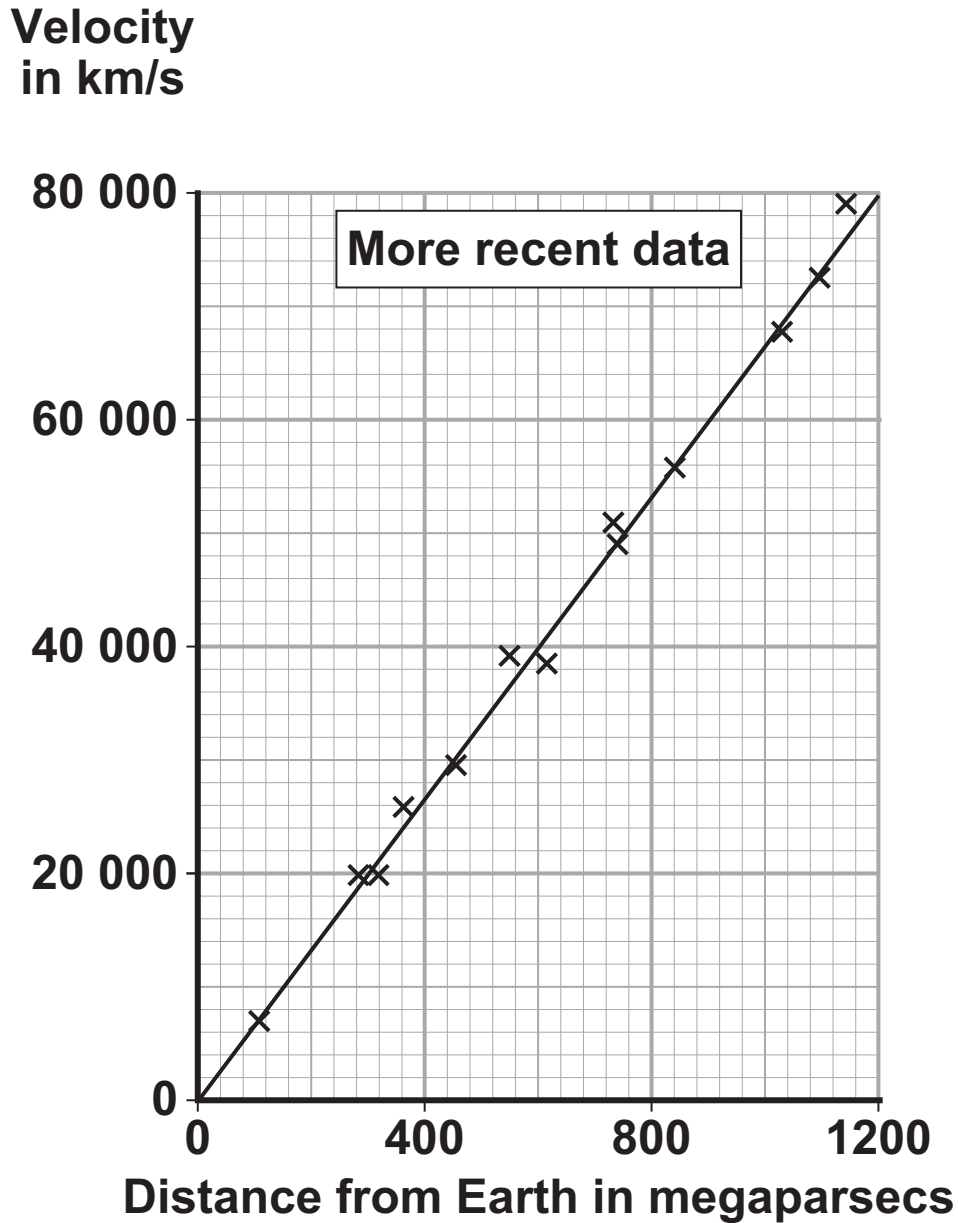**Show clearly how you obtained your answer.**

_____

_____

_____

Hubble constant = _____ km/s per megaparsec

[Question 6 continues on the next page]

6 (b) (iii) More recently, data has been obtained from more distant galaxies.

Velocity in km/s

The results from the more recent data give a totally different value for the Hubble constant to the one calculated from the 1929 data.

Which set of data, the 1929 or the more recent, is most likely to give the value closest to the true value for the Hubble constant? [1 mark]

Draw a ring around your answer.

    1929   more recent

Give a reason for your answer.

_____

_____

_____

6 (c)   The Andromeda galaxy is not moving away from the Earth. It is actually moving towards the Earth. This means that the light from Andromeda shows a blue-shift.

How do the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth? [2 marks]

_____

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8

END OF QUESTIONS

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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	