OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE
TWENTY FIRST CENTURY SCIENCE
A181/01
PHYSICS A/SCIENCE A
Modules P1 P2 P3
(Foundation Tier)
MONDAY 19 MAY 2014: Afternoon
DURATION: 1 hour
plus your additional time allowance
MODIFIED ENLARGED 24pt

Candidate forename		Candidate surname	

Centre number						Candidate number				

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (SJF/SJF) 4447569098 99767/2 **R**

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

The quality of written communication is assessed in questions marked with a pencil ().

A list of physics equations is printed on pages 4–6.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 60.

Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE
DATA SHEET

USEFUL RELATIONSHIPS

THE EARTH IN THE UNIVERSE

distance = wave speed × time

wave speed = frequency × wavelength

SUSTAINABLE ENERGY

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{amount of energy transferred} = \text{work done}$$

$$\text{change in gravitational potential energy} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

ELECTRIC CIRCUITS

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

RADIOACTIVE MATERIALS

$$\text{energy} = \text{mass} \times [\text{speed of light in a vacuum}]^2$$

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Answer ALL the questions.

1 This question is about objects which orbit the Sun.

(a) The table has data on the orbits of three planets around the Sun.

(i) Which of the following statements correctly describes a correlation shown in the table? Put a tick (✓) in the box next to the correct statement.

Bigger planets have a greater speed. ☐

Planets closer to the Sun have a greater speed. ☐

Smaller planets are more distant from the Sun. ☐

[1]

Planet	Distance from the Sun (millions of km)	Speed (km/s)	Diameter of planet (thousands of km)
Mercury	60	50	4.88
Earth	150	30	12.8
Jupiter	780	13	143

(ii) **The planet Mars orbits at a distance of 230 million km from the Sun.**

Use information from the table to ESTIMATE the speed of Mars in its orbit.

Explain your answer.

estimated speed = _____ km/s

_____

_____

[2]

BLANK PAGE

(b) Planets are not the only objects which orbit our Sun.

Complete the sentences below, using words from the list.

asteroids

comets

galaxy

moons

solar system

stars

Universe

The Sun is at the centre of our

_____ .

Many small objects orbit the Sun. Some of these are made of ice and dust, and often have orbits which are not circular.

These are _____ .

Other small objects are stony. Most of these have orbits between Mars and Jupiter.

These are _____ .

[3]

[Total: 6]

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2 This question is about earthquakes.

(a) (i) Which of the following statements about earthquakes are correct?

Put ticks (✓) in the boxes next to the TWO correct statements.

Earthquakes happen only in mountains. ☐

Earthquakes never happen under the sea. ☐

Earthquakes are caused by global warming. ☐

Earthquakes usually happen where tectonic plates meet. ☐

Volcanoes are often found in regions where earthquakes are common. ☐

[2]

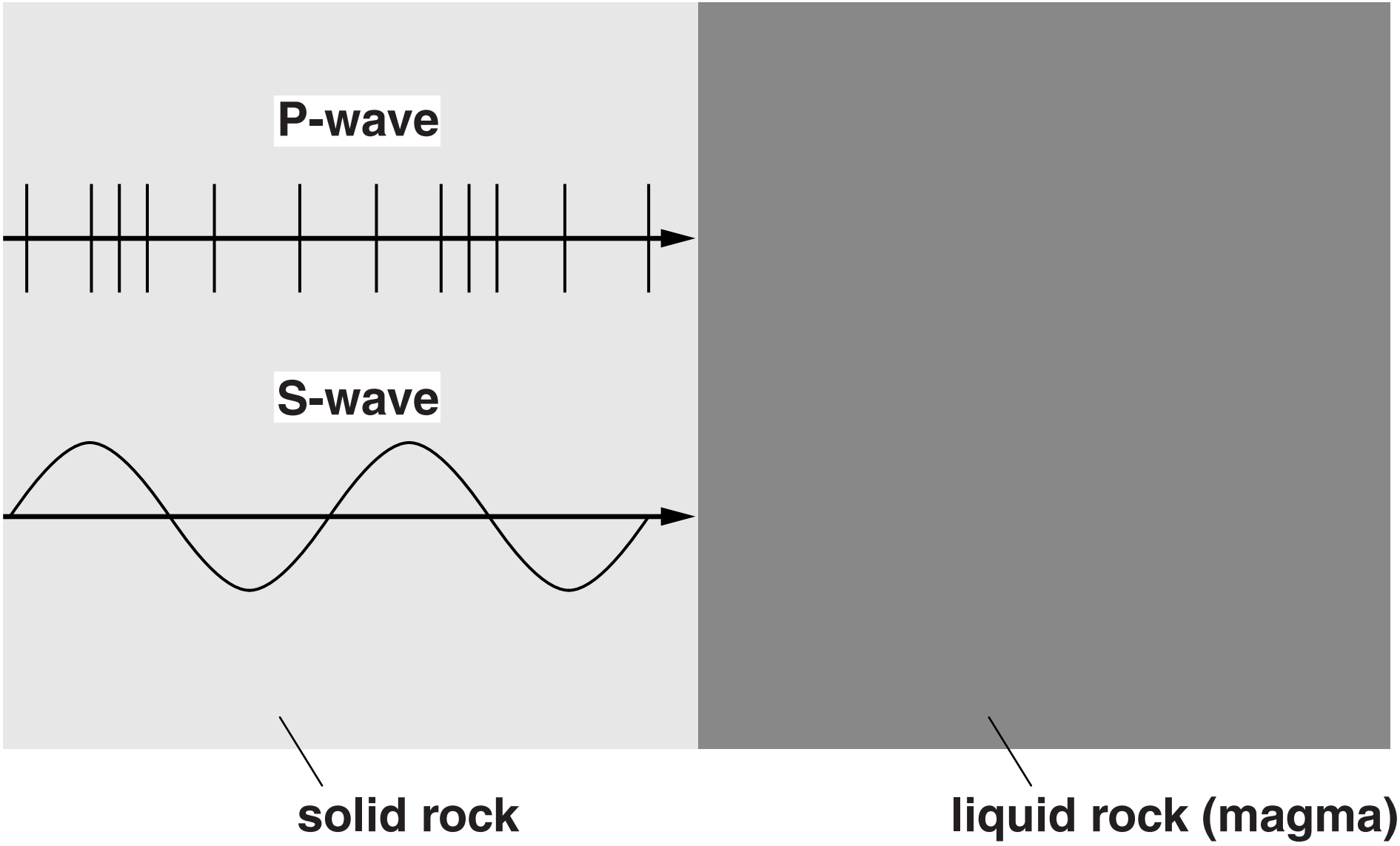
(ii) In some parts of the Earth's crust there are large regions of liquid rock (magma).
The diagram opposite shows an earthquake P-wave and an S-wave travelling through solid rock and arriving at a region of magma.

What happens to each wave when it reaches the magma?

_____

_____

_____ **[2]**


P-wave
S-wave
solid rock
liquid rock (magma)

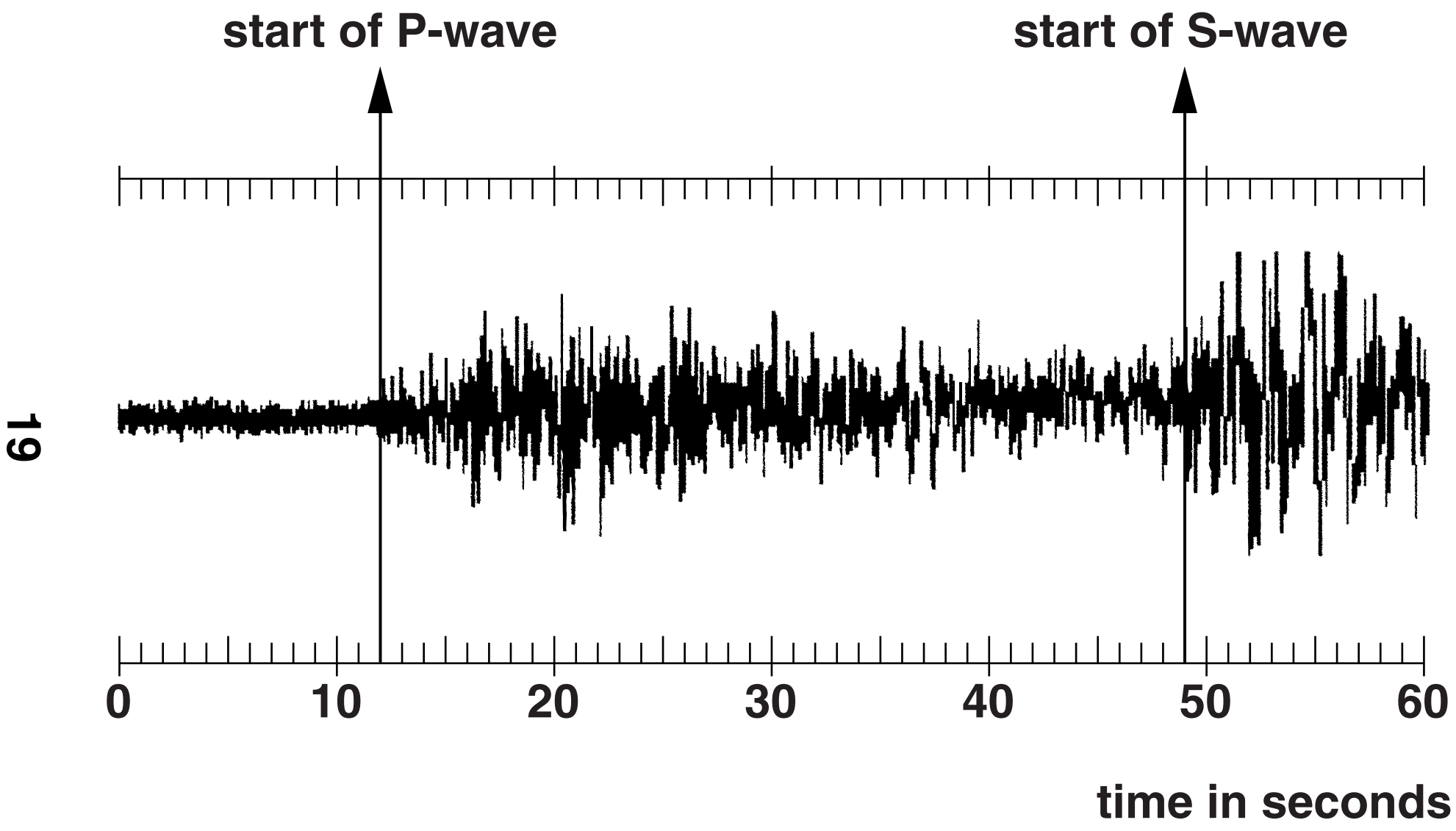
(b) The diagram opposite shows the record at a detector of an earthquake.

Earth scientists estimate the distance from an earthquake to the detector using the rule:

1 second of time delay between the arrival of the P-waves and the arrival of the S-waves corresponds to a distance of 8 km.

(i) Use the diagram to find the distance between the earthquake and the detector.

answer = _____ [2]


start of P-wave
start of S-wave
19
0
10
20
30
40
50
60
time in seconds

(ii) **The graph opposite shows the actual time delay for different distances from the earthquake.**

Use the graph to show that the '8 km for every second of delay' rule works much better at a distance of 2000 km than at a distance of 4000 km.

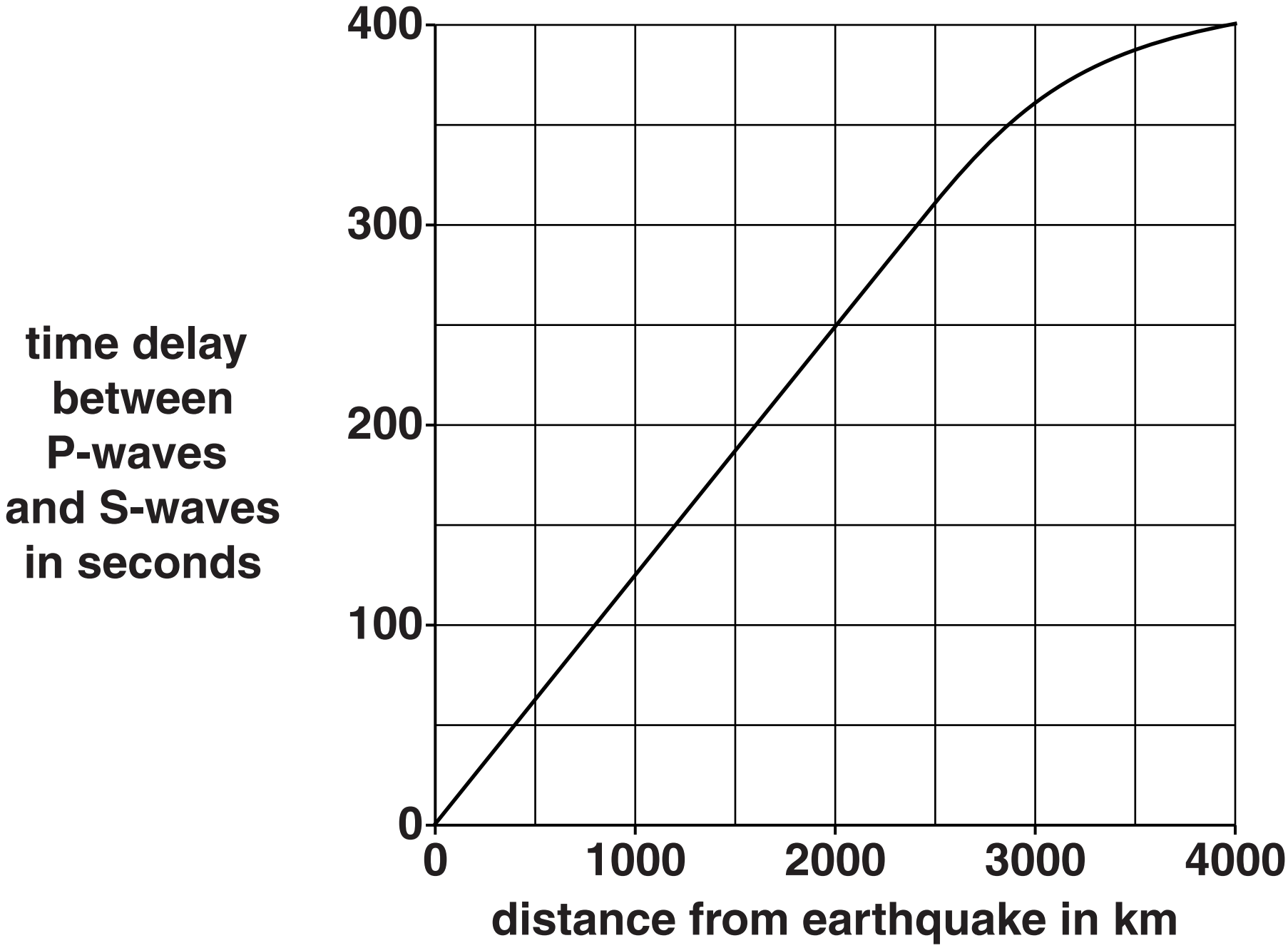
_____

_____

_____

_____ **[2]**

[Total: 8]


time delay between P-waves and S-waves in seconds
400
300
200
100
0
0
1000
2000
3000
4000
distance from earthquake in km

3 Astronomers first made measurements of distant galaxies using telescopes on the Earth.

Accurate measurements of the distances were very difficult to make.

Describe how astronomers measure distances to stars and galaxies.

Suggest why measurements made today are more accurate.

The quality of written communication will be assessed in your answer.

_____

_____

_____

_____ **[6]**

[Total: 6]

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4 (a) Some of the statements below are true, and some are false.
Put a tick (✓) in the correct box after each statement.

	TRUE	FALSE
High frequency photons have more energy than low frequency photons.	☐	☐
Microwave radiation has the lowest frequency in the electromagnetic spectrum.	☐	☐
Photons are packets of energy.	☐	☐
Red light has higher frequency than violet light.	☐	☐
The intensity of radiation gets larger when you get closer to its source.	☐	☐

[3]

(b) The diagram opposite shows two lamps giving out coloured light.

The energy of photons is measured in units called eV.

The table shows the energy of photons of these two colours of light.

Colour	Energy in eV
violet	3
orange	2

Each surface is lit up with the SAME INTENSITY over the same area.

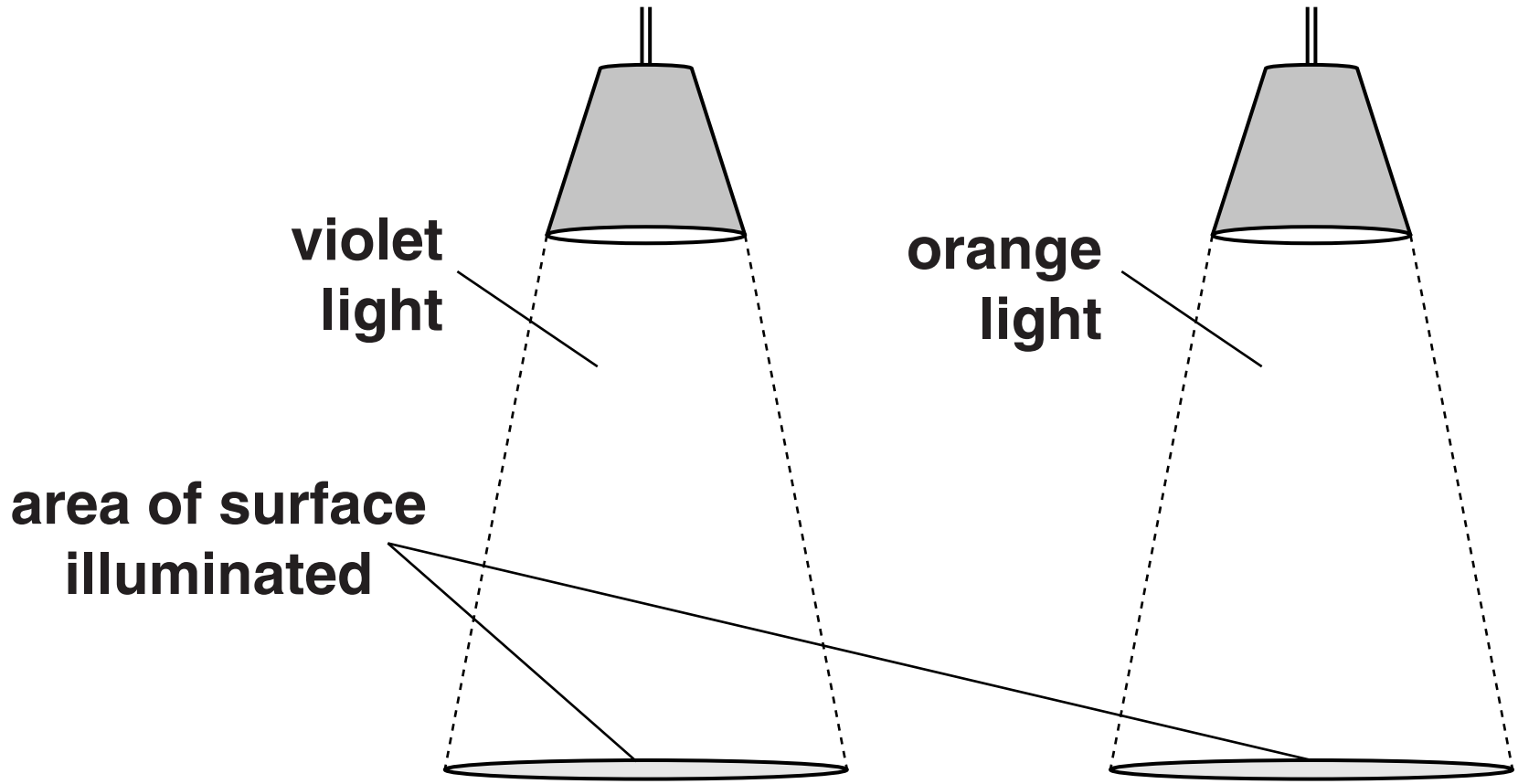
Use information in the table to compare the numbers of photons arriving at each surface each second.
Explain your answer.

_____

_____

_____ [2]

[Total: 5]


violet
light
orange
light
area of surface
illuminated

5 The Sun gives out a lot of ultraviolet radiation. This can damage living cells.

(a) Describe how the Earth's atmosphere helps to protect us against this damage.

_____

_____

_____

_____ **[2]**

(b) We can help prevent ultraviolet damage to our skin by the way we behave in sunny weather. Describe and explain one way we can do this.

_____

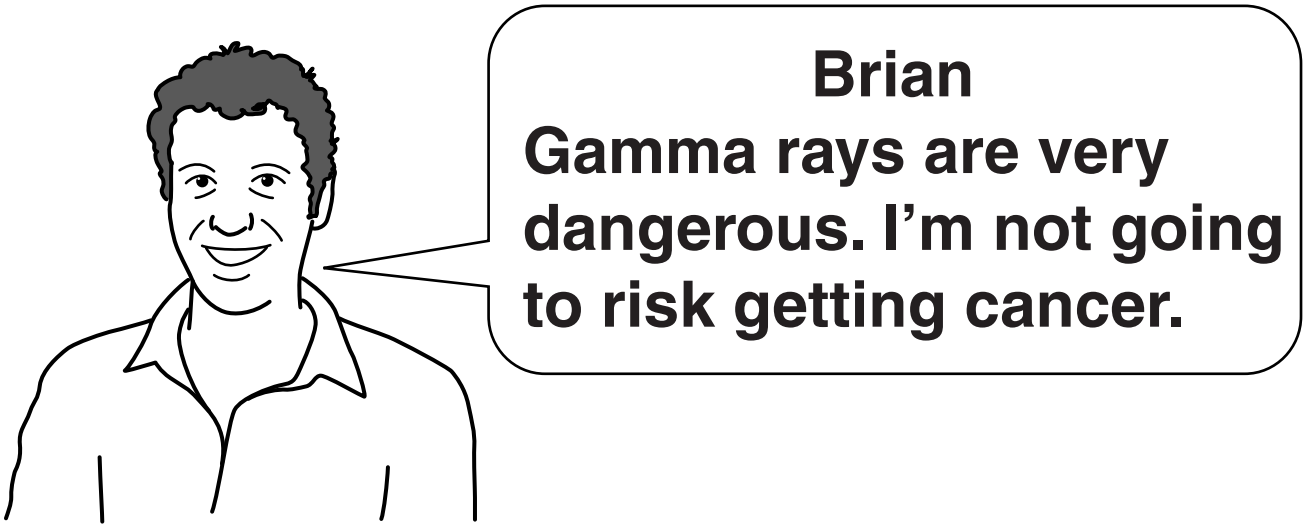
_____

_____

_____ **[2]**

[Total: 4]

6 Brian will not get a microwave oven for his kitchen. He is sure they are dangerous. His ideas are a bit confused.



Explain to Brian why he is wrong, and why microwave ovens are safe to use.

_____

_____

_____

_____ **[2]**

[Total: 2]

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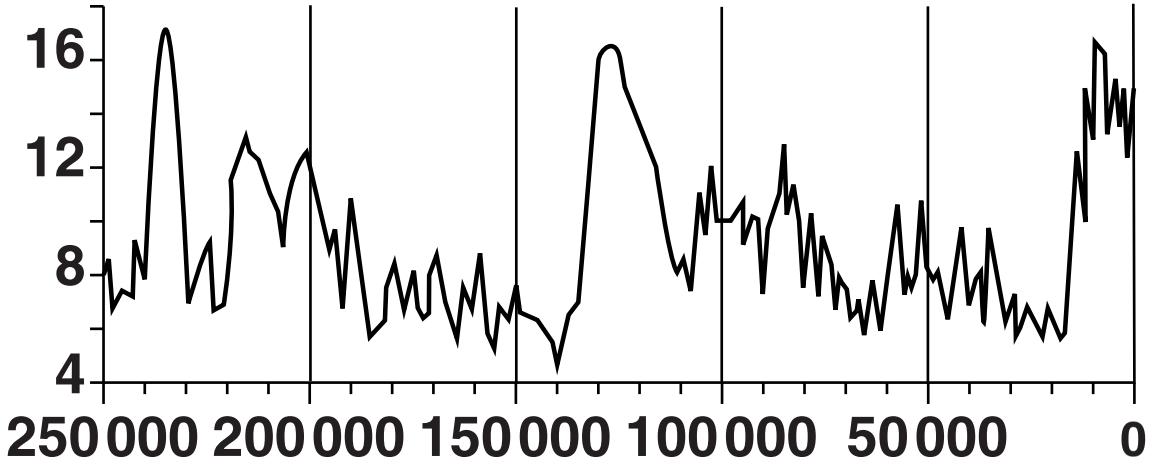
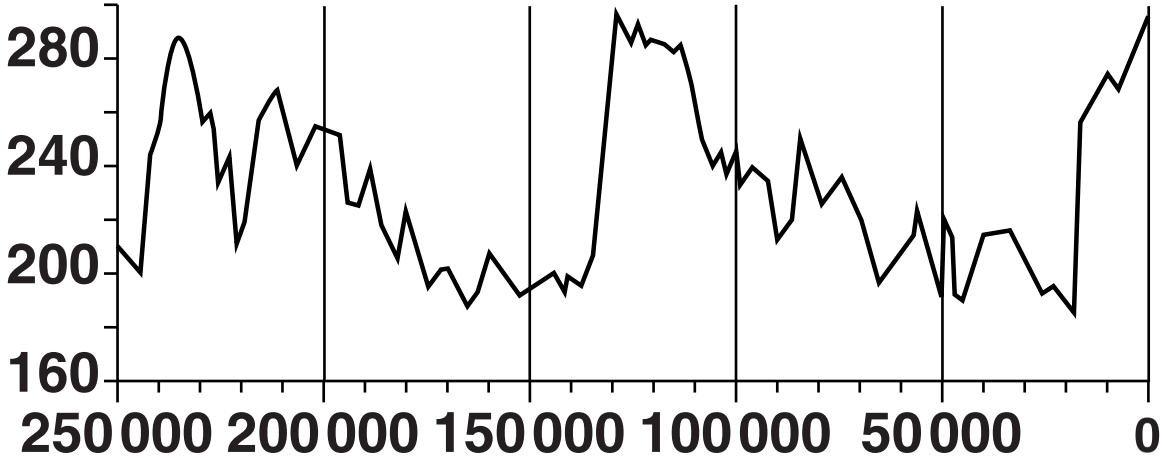
7 The two graphs opposite show changes in the Earth's atmosphere over the past 250 000 years.

average temperature in °C



carbon dioxide concentration in the atmosphere in parts per million



The graphs show that there is a CORRELATION between average temperature and carbon dioxide concentration.

How can you tell there is a correlation, and what is the CAUSE of this correlation?

The quality of written communication will be assessed in your answer.

[6]

[Total: 6]

8 This question is about storing digital images.

(a) Which of these units is used to measure the amount of information in a digital image?

Put a (ring) around the correct unit.

byte

cm^3

hertz

watt

[1]

(b) **People who work with digital images use computers.**
Explain why computers are used to work with these images.

_____

_____

_____

_____ **[2]**

[Total: 3]

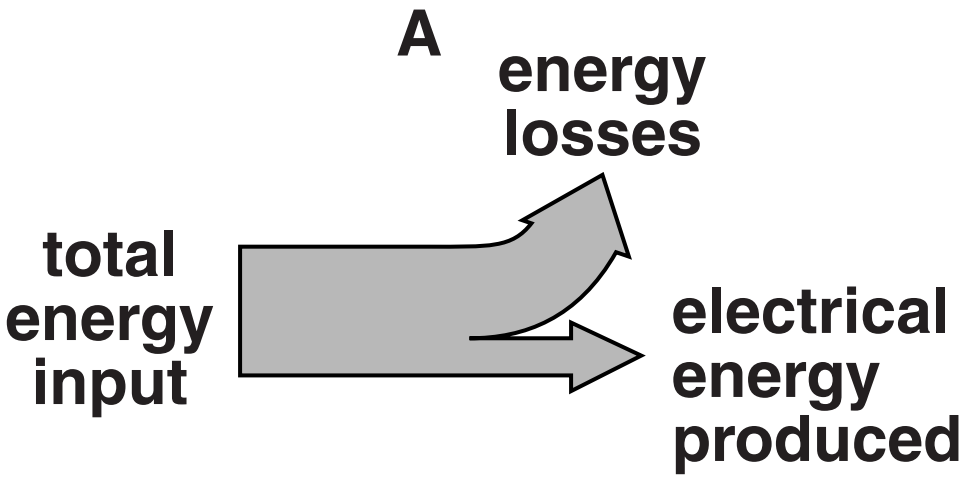
9 (a) Which one of these power stations produces greenhouse gases when it is working?

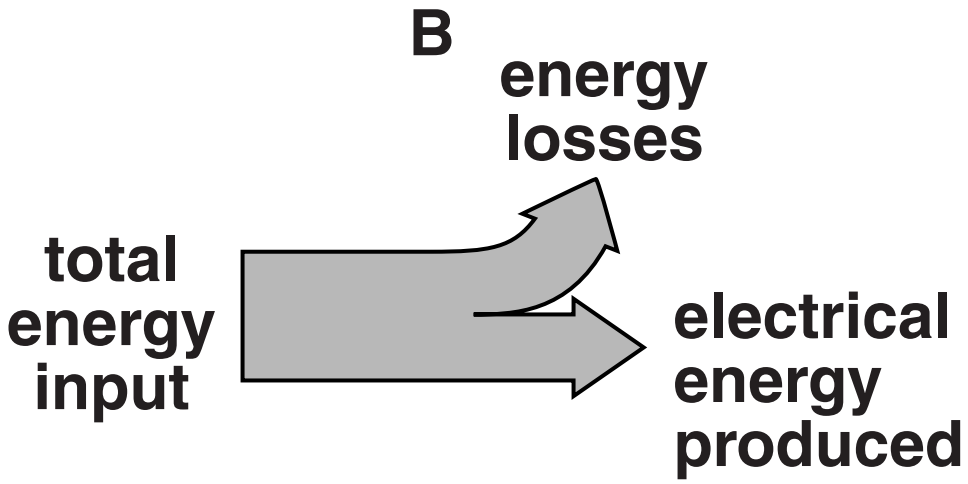
Put a tick (✓) in the box next to the correct answer.

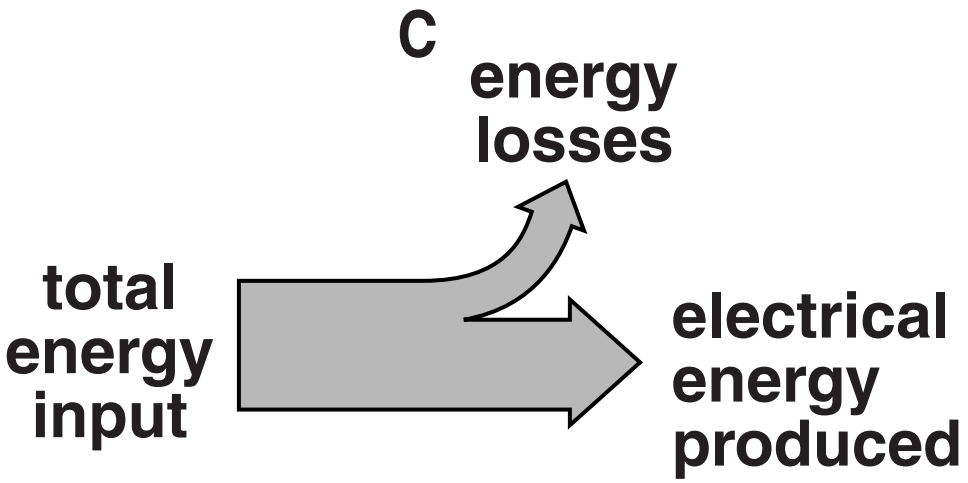
coal burning power station	☐
hydroelectric power station	☐
nuclear power station	☐
wind farm	☐

[1]

(b) The Sankey diagrams below show the energy transfers in three different power stations.







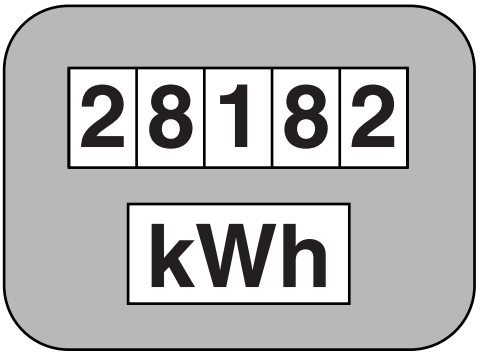
Some of the statements below are true, and some are false.
Put a tick (✓) in the correct box after each statement.

	TRUE	FALSE
In each power station, total energy input = total energy output.	☐	☐
Modern power stations are more than 100% efficient.	☐	☐
Power station A is more efficient than power station B.	☐	☐
Power station B has an efficiency of about 50%.	☐	☐
Power station C is the most efficient of the three.	☐	☐

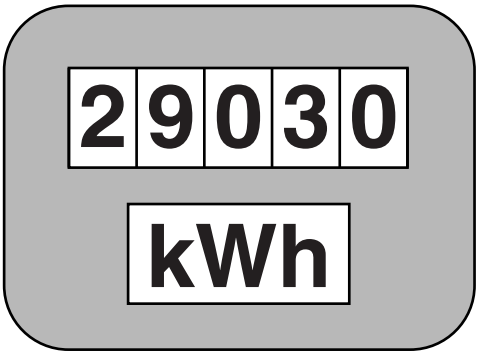
[3]

[Total: 4]

10 The Robinson family have an electricity meter.
The diagram shows their meter on two different dates.



6 January



6 February

(a) Use the meters to find the number of kilowatt hours of energy transferred between 6 January and 6 February.
Show your working clearly.

energy transferred = _____ kWh [1]

(b) Between 6 July and 6 August, the Robinson's electricity bill showed that they used much fewer kilowatt hours than in (a).
Suggest and explain ONE reason for this.

_____

_____

_____ **[2]**

[Total: 3]

11 An old fridge works for 24 hours a day, every day of the year.
The power used is 150 watts.

(a) (i) Calculate the number of kilowatt hours of energy transferred in three months.
Assume that three months = 2000 hours.
Show your working.

number of kilowatt hours = _____ [3]

(ii) How much does it cost to run this fridge for three months?
1 kilowatt hour costs 15 p.

cost = £_____ [1]

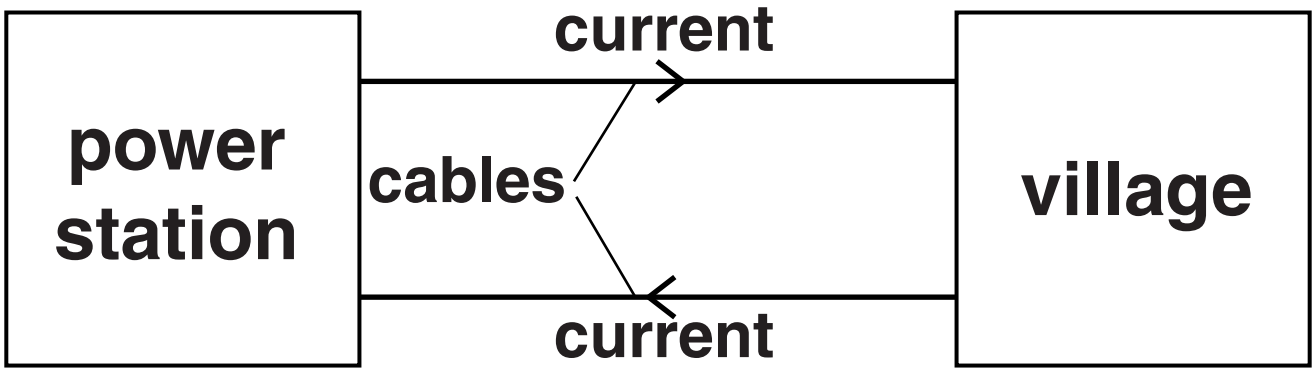
(b) A modern fridge rated A++ uses 20 watts.
This fridge will cost much less to use than the old one.
Suggest why.

_____

_____ [1]

[Total: 5]

12 The diagram shows a small village being supplied by electricity from a power station.



The power station produces 100 000 W of electrical power.

The power station could transfer the energy at 250 V or at 2500 V.

The table below shows what happens in each case.

Power produced at power station in W	Power station voltage in V	Power wasted in heating cables in W	Power delivered to village in W
100 000	250	32 000	68 000
100 000	2500	320	99 680

Use information from the table to decide which voltage should be used. Give reasons for your answer.

_____

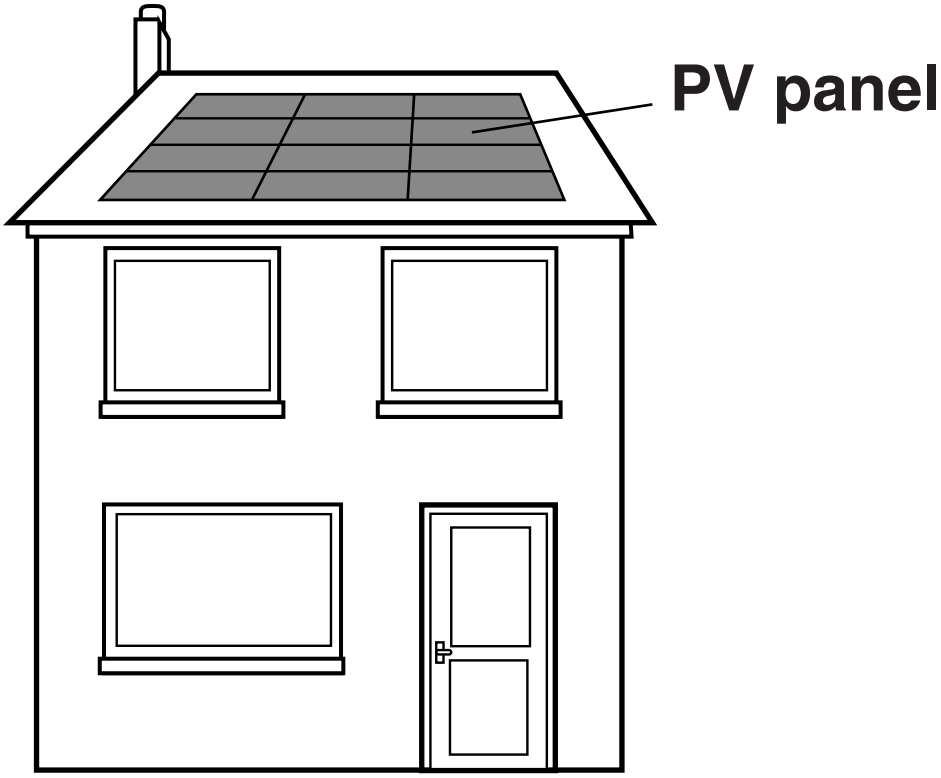
_____

_____

_____ **[2]**

[Total: 2]

13 **Many house-owners are putting sets of photovoltaic (PV) panels on their roofs to generate electricity during daylight. The panels work best if the roof used is facing south.**



The data about the type of PV panel shown in the diagram are given in the table.

size of one panel (m × m)	**1.5 × 0.8**
average daily energy output of one panel (kWh)	**0.6**
cost per panel	**£200**

A family needs about 24 kWh of electricity per day, averaged out over the winter and the summer.

This family has decided to fit 12 panels on their roof to provide their energy needs throughout the year.

Discuss the advantages and disadvantages of fitting these panels to their roof.

The quality of written communication will be assessed in your answer.

[6]

[Total: 6]

END OF QUESTION PAPER