Paper Reference(s) **5PH1H/01**

Edexcel GCSE

Physics/Science
Unit P1: Universal Physics
Higher Tier

Wednesday 5 June 2013 – Afternoon

Time: 1 hour plus your additional time allowance

INSTRUCTIONS TO CANDIDATES
Write your centre number, candidate number, surname, initials and your signature in the boxes below. Check that you have the correct question paper.

Centre No.							
Candidate No.							
Surname							
Initial(s)							
Signature							
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Q41943A

PEARSON

- **Use BLACK ink or ball-point pen.**
- **Answer ALL questions.**
- **Answer the questions in the spaces provided – there may be more space than you need.**

MATERIALS REQUIRED FOR EXAMINATION
Ruler, calculator

ITEMS INCLUDED WITH QUESTION PAPERS
Nil

INFORMATION FOR CANDIDATES
- **The total mark for this paper is 60.**
- **The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.**
- **Questions labelled with an ASTERISK (*) are ones where the quality of your written communication will be assessed – you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.**

ADVICE TO CANDIDATES
- **Read each question carefully before you start to answer it.**
- **Keep an eye on the time.**
- **Try to answer every question.**
- **Check your answers if you have time at the end.**

FORMULAE

You may find the following formulae useful.

wave speed = frequency × wavelength $\quad v = f \times \lambda$

$$\text{wave speed} = \frac{\text{distance}}{\text{time}} \qquad v = \frac{x}{t}$$

electrical power = current × potential difference $\quad P = I \times V$

cost of electricity = power × time × cost of 1 kilowatt-hour

$$\text{power} = \frac{\text{energy used}}{\text{time taken}} \qquad P = \frac{E}{t}$$

$$\text{efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}} \times 100\,\%$$

$$\frac{\text{primary voltage}}{\text{secondary voltage}} = \frac{\text{number of turns on primary coil}}{\text{number of turns on secondary coil}} \qquad \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

THEORIES AND OBSERVATIONS

1 During the twentieth century red-shift and CMB radiation were discovered.

They have provided scientists with data to test theories of the origin of the Universe.

(a) (i) Complete the following sentence. (1 mark)

CMB is an abbreviation for

_____

(ii) State which theory about the origin of the Universe is supported by the existence of CMB. (1 mark)

_____

_____

(Question continues on next page)

(iii) There is a red-shift in the light received from some galaxies.
State what is meant by red-shift. (1 mark)

(iv) Some galaxies show greater red-shift than others.
Explain what this suggests about the Universe. (2 marks)

(Question continues on next page)

(b) Stars have different stages in their evolution.

(i) Which of these gives the next stages in the evolution of the Sun? (1 mark)

Put a cross (☒) in the box next to your answer.

☐ A white dwarf then black hole

☐ B neutron star then white dwarf

☐ C red giant then supernova

☐ D red giant then white dwarf

(Question continues on next page)

(ii) **Modern telescopes can provide us with more data than the telescopes used 100 years ago. Explain what additional data can be collected and processed using modern telescopes.**
(2 marks)

(TOTAL FOR QUESTION 1 = 8 MARKS)

(Questions continue on next page)

INVESTIGATING ELECTRIC MOTORS

2 Some students investigate the efficiency of electric motors.

(a) (i) The students find that one electric motor has an efficiency of 60%.

Explain in terms of energy what is meant by an efficiency of 60%. (2 marks)

(Question continues on next page)

(ii) The students use some motors to lift weights.

The students measure the input power and output power of two motors.

Complete the sentence by putting a cross (☒) in the box next to your answer. (1 mark)

The power of a motor is the rate at which it transfers

☐ A current

☐ B energy

☐ C voltage

☐ D charge

(Question continues on next page)

(iii) The first motor has a power rating of 20 W.

The motor is used for 15 s.

Calculate the energy supplied to the motor.
(2 marks)

energy supplied to the motor = _____ J

(Question continues on next page)

(iv) In the second motor, the useful output power was 18 W when the input power was 24 W. Calculate the efficiency of this motor. (2 marks)

efficiency = _____ %

(Question continues on next page)

(b) One of the students states that all of the energy supplied to a motor is transferred into other forms.

Complete the following sentence by putting a cross (☒) in the box next to your answer. (1 mark)
This statement is one example of the idea of

☐ A renewable energy

☐ B conservation of energy

☐ C non-renewable energy

☐ D sustainable energy

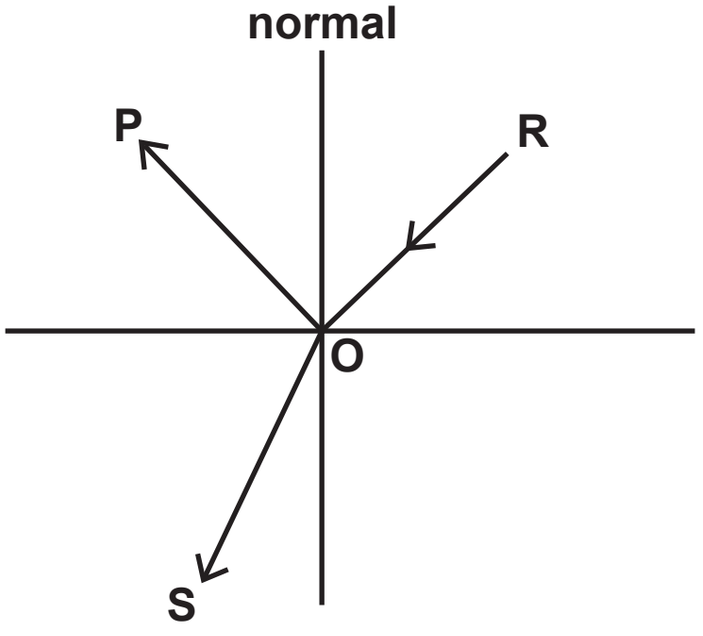
(TOTAL FOR QUESTION 2 = 8 MARKS)

(Questions continue on next page)

REFRACTION, TELESCOPES AND THE SOLAR SYSTEM

3 When light strikes a glass surface it can be both refracted and reflected.

(a) The diagram shows the possible paths for a ray of light which strikes a surface at the point O.



(Question continues on next page)

(i) Which of the lines show the possible path of a ray of light passing from air into glass? (1 mark)

Put a cross (☒) in the box next to your answer.

☐ A POS

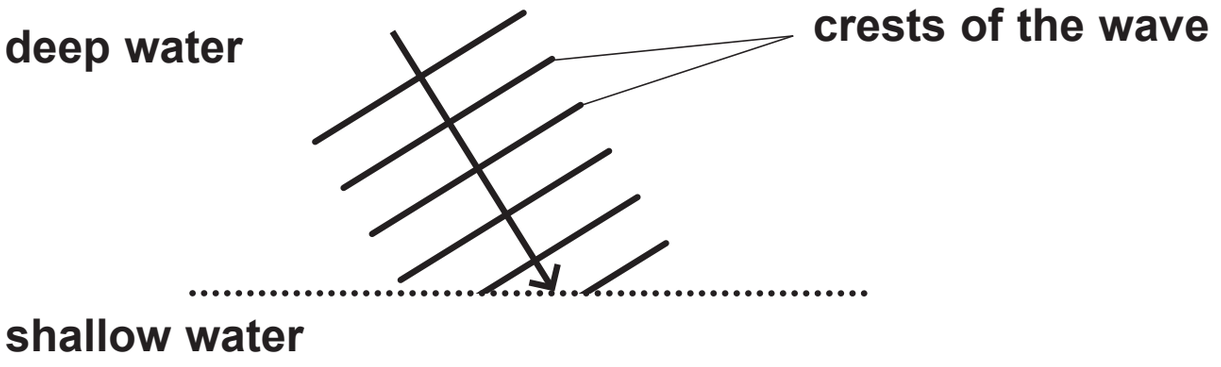
☐ B POR

☐ C ROP

☐ D ROS

(Question continues on next page)

(ii) The diagram shows a water wave going from deep water into an area of much shallower water. The wave is refracted at the boundary between deep water and shallow water.



Which row of the table is correct for what happens when the wave is refracted? (1 mark)

Put a cross (☒) in the box next to your answer.

	speed	direction
☐ A	stays the same	changes
☐ B	stays the same	stays the same
☐ C	changes	changes
☐ D	changes	stays the same

(Question continues on next page)

(b) In 1610 Galileo used a refracting telescope to observe the planet Jupiter.

(i) Explain how a refracting telescope produces a magnified image of Jupiter. (3 marks)

(Question continues on next page)

(ii) In 1610, the geocentric model of the Solar System was commonly accepted.

Explain how Galileo's observations contradicted the geocentric model. (3 marks)

(Question continues on next page)

(c) Light travels the 150 million km from the Sun to the Earth in about 500 s.

It takes about 2100 s for light to reach the Earth from Jupiter.

Using this information, calculate the approximate distance of Jupiter from the Earth. (2 marks)

distance of Jupiter
from the Earth = _____ million km

(TOTAL FOR QUESTION 3 = 10 MARKS)

(Questions continue on next page)

EARTHQUAKES

4 (a) Complete the sentence by putting a cross (☒) in the box next to your answer. (1 mark)

Waves from an earthquake are

- ☐ **A** transverse waves only
- ☐ **B** electromagnetic waves only
- ☐ **C** both transverse and electromagnetic waves
- ☐ **D** both transverse and longitudinal waves

(Question continues on next page)

(b) The Earth's surface is made up of many tectonic plates.
The interior of the Earth is a source of thermal energy.

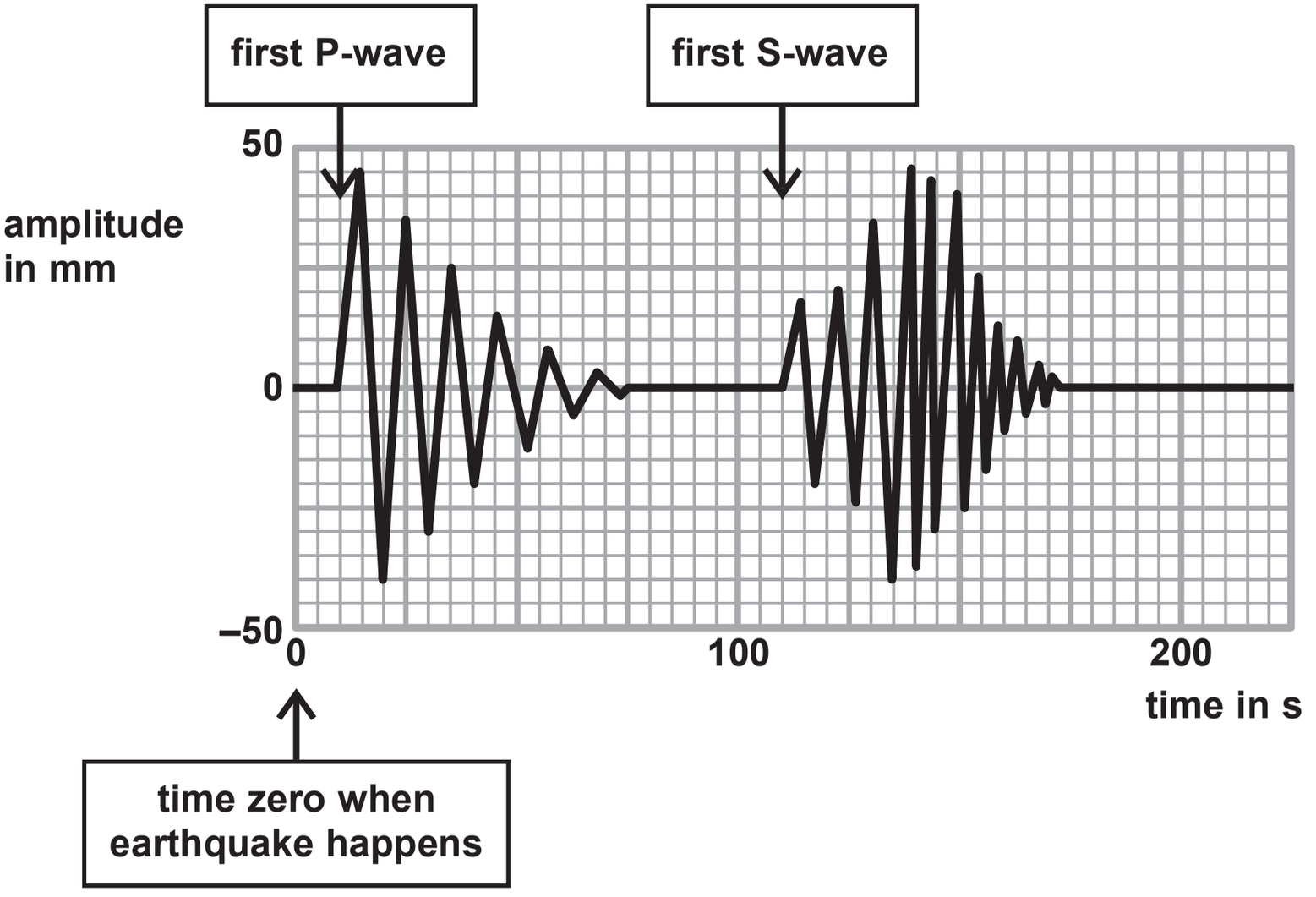
Describe how this thermal energy can cause earthquakes. (3 marks)

You may draw a labelled diagram to help with your answer.

(Continue your answer on next page)

(Question continues on next page)

(c) The chart shows the arrival of earthquake waves at an earthquake monitoring station.



(Question continues on next page)

The S − P time (S minus P time) for earthquake waves is the time difference between the arrival of the first P wave and the first S wave.

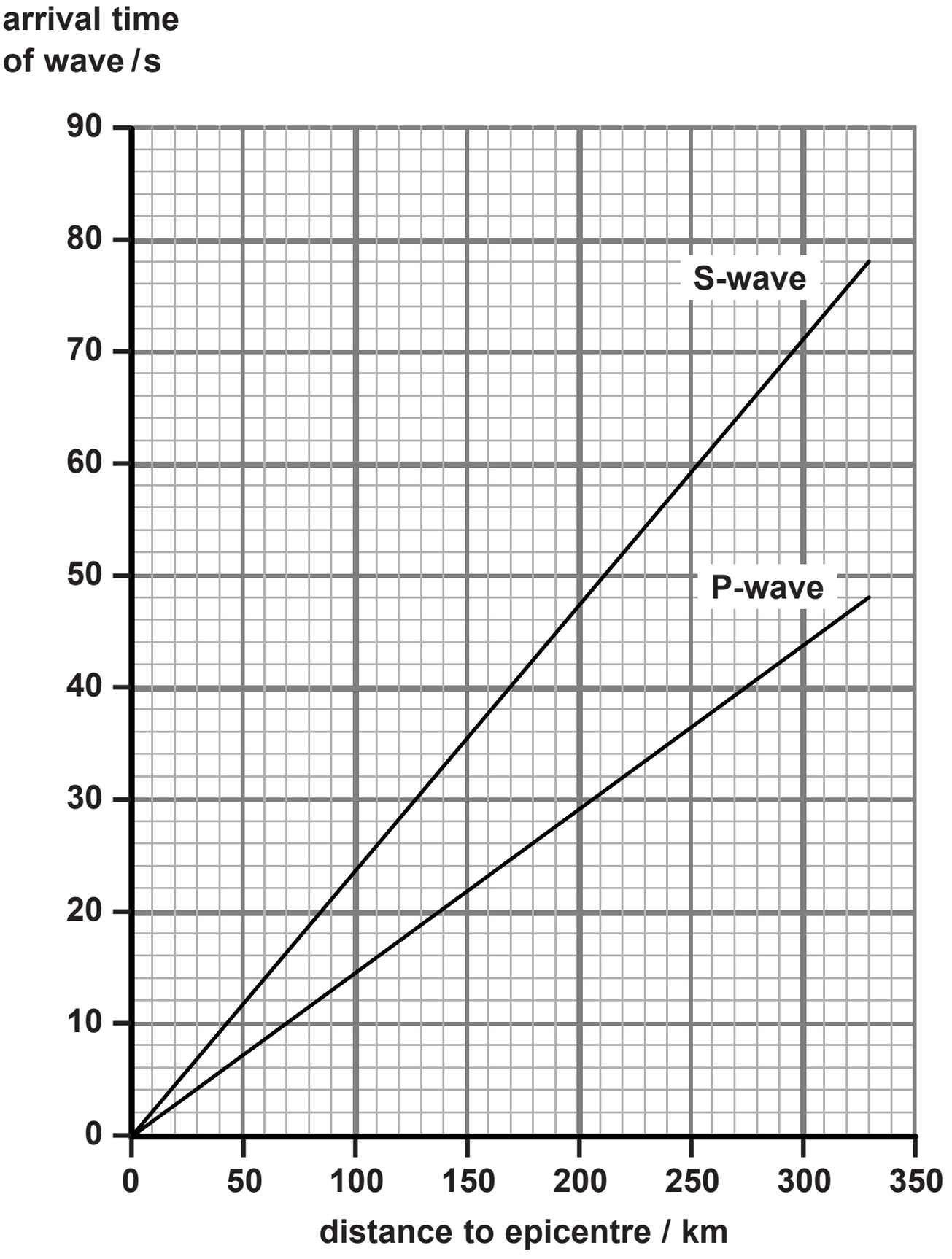
Use the chart to estimate the S − P time for the earthquake waves shown. (2 marks)

S − P time = _____ seconds

(Question continues on next page)

(d) The location of an earthquake is known as an epicentre.
The S − P time for earthquake waves can be used to estimate the distance between the monitoring station and the epicentre.
The graph on page 25 shows how the arrival times of S and P waves are related to their distances from the epicentre of an earthquake.

(Question continues on next page)



(Question continues on next page)

The S − P time for a particular earthquake was 20 seconds.
Use the S − P time to estimate the distance between the monitoring station and the epicentre of this earthquake. (2 marks)

distance to epicentre of earthquake = _____ km

(Question continues on next page)

(e) Many earthquakes and volcanoes are linked to the production of infrasound waves.

Describe what is meant by INFRASOUND WAVES.
(2 marks)

(TOTAL FOR QUESTION 4 = 10 MARKS)

(Questions continue on next page)

ELECTROMAGNETIC SPECTRUM

5 The electromagnetic spectrum is continuous. Different regions of the spectrum have different properties.

(a) (i) Name an electromagnetic wave that is also an ionising radiation. (1 mark)

_____

(ii) Genuine banknotes contain a special ink. This ink is invisible under normal light.

Suggest why the ink glows when ultraviolet radiation is shone on it. (2 marks)

_____

_____

_____

_____

_____

_____

(Question continues on next page)

(b) An electromagnetic wave has a frequency of 7×10^9 Hz.
The speed of the wave is 3×10^8 m/s.
Calculate the wavelength of the wave. (3 marks)

wavelength = _____ m

(Question continues on next page)

*(c) Radiation from different regions of the electromagnetic spectrum can affect the human body in many ways.

Discuss the different ways in which excessive exposure to electromagnetic radiations of various frequencies may cause damage to the human body. (6 marks)

(Continue your answer on next page)

(TOTAL FOR QUESTION 5 = 12 MARKS)

(Questions continue on next page)

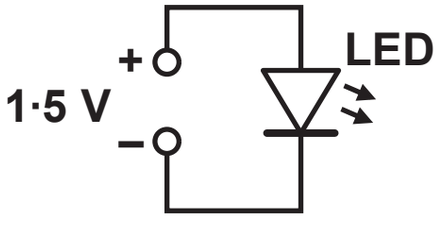
USING LIGHT EMITTING DIODES (LEDs)

6 (a) What is the name of the device used to change the size of an alternating voltage? (1 mark)

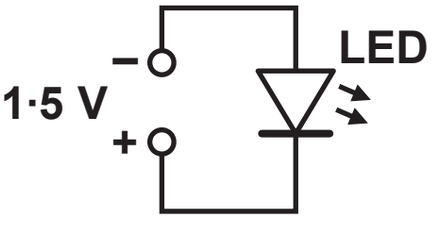
_____

_____

(b) A light emitting diode (LED) can only emit light when connected correctly to a potential difference.



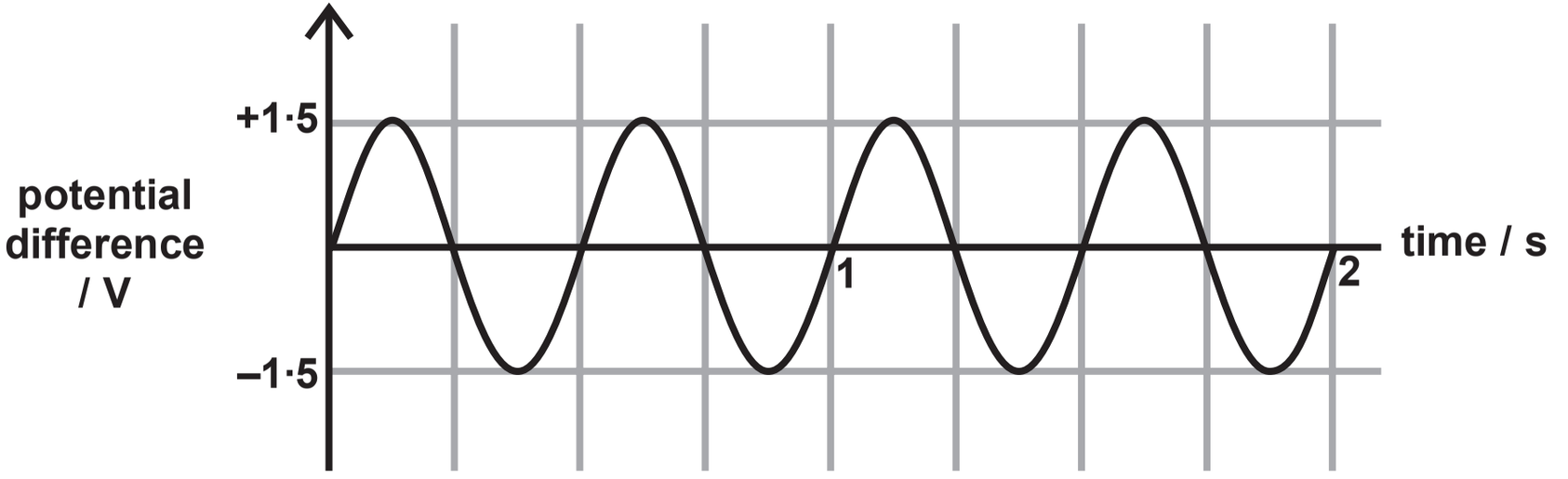
LED emits light



LED does NOT emit light

(Question continues on next page)

Use this information to suggest what happens when this alternating voltage is connected across the LED. (2 marks)



(Question continues on next page)

(Turn over)

(c) A LED lamp has a power rating of 3 W.
The voltage across the lamp is 12 V.
Calculate the current in the lamp. (3 marks)

current in the lamp = _____ A

(Question continues on next page)

*(d) Some research has been carried out into replacing fluorescent lamp fittings with LED fittings.

The data in the table is taken from the report of a trial using LEDs to light stairwells and corridors in a large building.

total energy saved each year by using LEDs	3 000 kW h
LED fitting cost	£2 000
CO_2 saving each year by using LEDs	1·6 tonnes
change in lighting levels by using LEDs	200%
average price of electrical energy	14 p / kW h
average lifetime of LED fittings	50 000 hours
average lifetime of fluorescent fittings	10 000 hours

Use the information to discuss the benefits of replacing fluorescent fittings with LED fittings.
(6 marks)

(Continue your answer on next page)

(Continue your answer on next page)

(TOTAL FOR QUESTION 6 = 12 MARKS)

TOTAL FOR PAPER = 60 MARKS

END