# Physics Unit P1

## *'Universal Physics'*

Study and Revision Pack (Higher Paper)



Name: _____

Form: _____

# P1 Overview

There are 6 topics in the Physics P1 Unit (Universal Physics).

Complete these questions and check your answers using the mark scheme I have uploaded on to the VLE.

Use this booklet, in addition to the P1 Formulas and Equations booklet to prepare you for the exam.

Wishing you all the best in your exams….

Mr Jones

# Overview and assessment tracking

Please use the table below to keep track of your revision. The smarter you work the better results.

| | Revision complete? | Questions completed? | Marks in first try | % in first try | Marks in second try | % in second try |
|---|---|---|---|---|---|---|
| P1.1 | | | | | | |
| P1.2 | | | | | | |
| P1.3 | | | | | | |
| P1.4 | | | | | | |
| P1.5 | | | | | | |
| P1.6 | | | | | | |

Use the grade boundaries below as a guide to the grade you are achieving:

| % | Grade |
|---|---|
| 90 | A* |
| 80 | A* |
| 70 | A |
| 60 | B |
| 50 | C |
| <50 | D |

## FORMULAE

You may find the following formulae useful

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

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

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

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

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

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

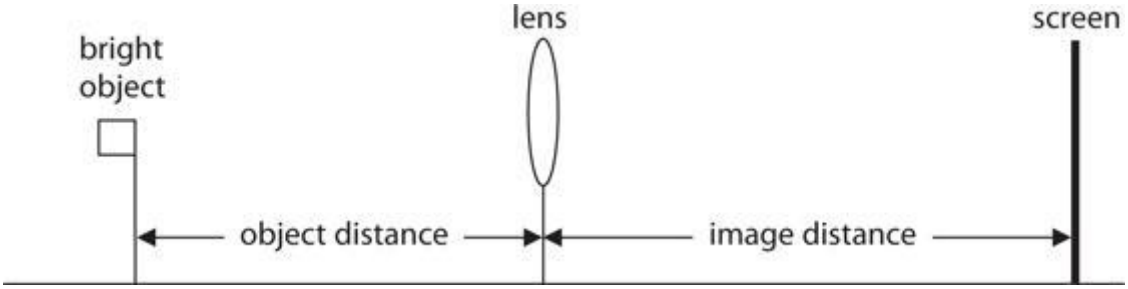
$$\frac{\text{primary voltage}}{\text{secondary voltage}} = \frac{\text{number of turns on primary coil}}{\text{number of turns on secondary coil}} \qquad \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

# P1.1 Specification statements

| | P1 Specification | Current RAG | Revised ✓ | | |
|---|---|---|---|---|---|
| | | | 1 | 2 | 3 |
| **Topic 1: Visible light and the Solar System** | 1.1 Describe how ideas about the structure of the Solar System have changed over time, including the change from the geocentric to the heliocentric models and the discovery of new planets | | | | |
| | 1.2 Demonstrate an understanding of how scientists use waves to find out information about our Universe, including: | | | | |
| | a) the Solar System | | | | |
| | b) the Milky Way | | | | |
| | 1.3 Discuss how Galileo's observations of Jupiter, using the telescope, provided evidence for the heliocentric model of the Solar System | | | | |
| | 1.4 Compare methods of observing the Universe using visible light, including the naked eye, photography and telescopes | | | | |
| | 1.5 Explain how to measure the focal length of a converging lens using a distant object | | | | |
| | 1.6 *Investigate the behaviour of converging lenses, including real and virtual images* | | | | |
| | 1.7 *Investigate the use of converging lenses to:* | | | | |
| | a) *measure the focal length using a distant object* | | | | |
| | *b) investigate factors which affect the magnification of a converging lens (formulae are not needed)* | | | | |
| | 1.8 Explain how the eyepiece of a simple telescope magnifies the image of a distant object produced by the objective lens (ray diagrams are not necessary) | | | | |
| | 1.9 Describe how a reflecting telescope works | | | | |
| | 1.10 Recall that waves are reflected and refracted at boundaries between different materials | | | | |
| | 1.11 **Explain how waves will be refracted at a boundary in terms of the change of speed and direction** | | | | |
| | 1.12 Describe that waves transfer energy and information without transferring matter | | | | |
| | 1.13 Use the terms of frequency, wavelength, amplitude and speed to describe waves | | | | |
| | 1.14 Differentiate between longitudinal and transverse waves by referring to sound, electromagnetic and seismic waves | | | | |
| | 1.15 Use both the equations below for all waves:<br>Wave speed (m/s) = frequency (hertz, Hz) × wavelength (m) $v = f \times \lambda$<br>Wave speed (m/s) = distance (m)/time (s) $v = \frac{x}{t}$ | | | | |

## P1.1 Exam Questions- 56 marks, 56 minutes.

**Q1.** A student uses this apparatus to investigate a converging lens.




He sets the object distance at 15.0 cm.

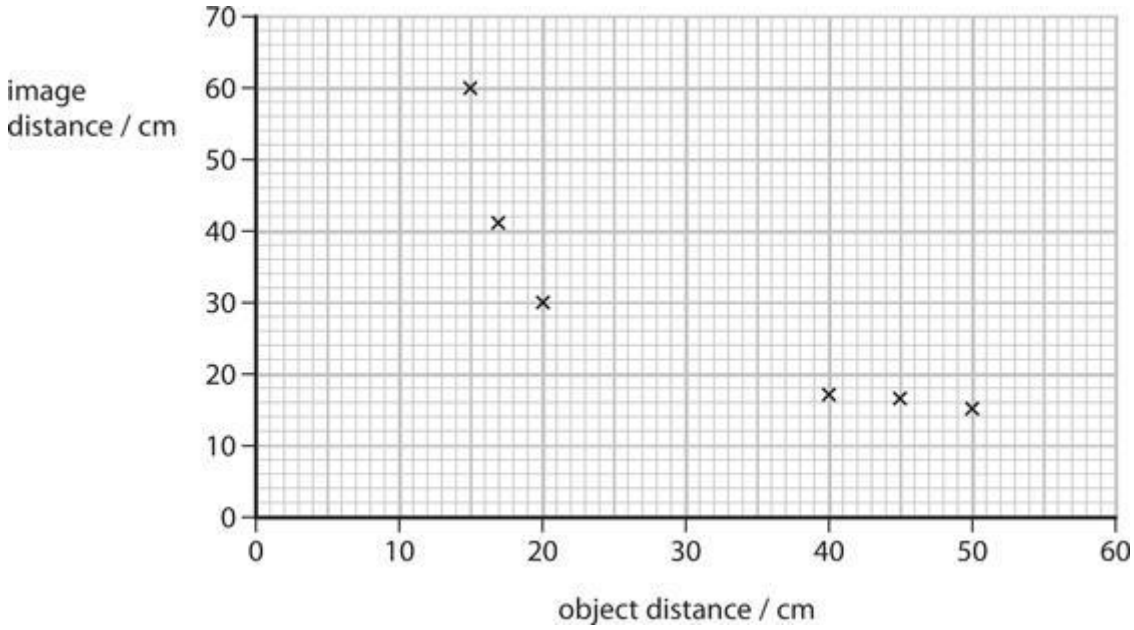
He moves the screen until he can see a clear image and then he measures the image distance.

He repeats this for several other object distances.

The table shows his results.

| object distance / cm | image distance / cm |
|---|---|
| 15.0 | 60.0 |
| 17.0 | 40.8 |
| 20.0 | 30.0 |
| 30.0 | 20.0 |
| 40.0 | 17.1 |
| 45.0 | 16.4 |
| 50.0 | 15.8 |

He plots a graph of image distance against object distance.




(i) Add to the graph the point for the object distance of 30.0 cm.

**(1)**

(ii) Draw the curve of best fit.

**(1)**

(iii) Describe how the image distance changes as the object distance changes.

**(2)**

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(iv) The focal length of this lens is 12 cm.

The student takes the lens and holds it 6 cm away from an object.

Describe the image the student sees when he looks through the lens.

**(2)**

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**Q2. Refracting telescope**

The photograph shows the refracting telescope used by Galileo to observe the planets.

Gianni Tortoli/Science Photo Library

(a) (i) Galileo used his telescope to observe the visible light from planets.

State **two** other examples of telescopes that are used to observe planets or stars.

**(2)**

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(ii) When a ray of light enters a glass block, the ray refracts.

What does **refracts** mean?

**(1)**

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

A converging lens refracts light to produce an image of a distant object on a screen.

The image on the screen is

**(1)**

☒ **A** magnified

☒ **B** virtual

☒ **C** upside down

☒ **D** the right way up

(c) More recent telescopes use two converging lenses, as shown in the photograph.


Lens A produces a real image of the planet.

Describe the purpose of lens B.

**(2)**

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(d) Galileo used his telescope to observe the planet Jupiter and its moons.

Explain why Galileo's observations contradicted the scientific ideas about the solar system that were most popular at that time.

**(2)**

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**Q3.** * Describe the similarities and differences between refracting telescopes and reflecting telescopes.

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**Q4. Using lenses**

(a) Sunita prepares some equipment for a class practical.

She measures the focal length of different lenses.

She uses a metre rule, some white card and the light from a distant window.

Describe how she could measure the focal length of a lens using this equipment.

**(2)**

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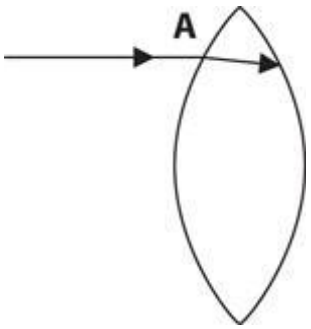
(b) The diagram shows the path of a ray of light through a converging lens.




(i) The ray of light has changed direction at **A**.

State the name of this effect.

**(1)**

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(ii) Complete the diagram to show the path of the ray after it has left the lens.

**(1)**

(c) Some students use two lenses to make a simple telescope.

They use the telescope to look at a tree.


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

(i) The objective lens

☒ **A** forms an image outside the telescope

☒ **B** gathers incoming light to form an image

☒ **C** forms a magnified image

☒ **D** forms an image the right way up

(ii) The eyepiece lens makes this first image

**(1)**

☒ **A** magnified

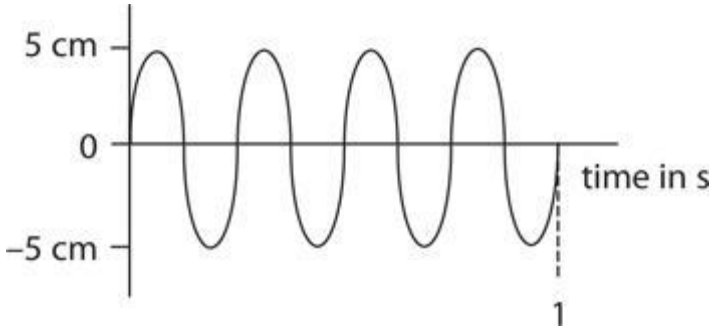
☒ **B** nearer to the eye

☒ **C** real

☒ **D** the right way up

**Q5.** State the amplitude of this sound wave.

**(1)**




amplitude =.....

**Q6.** The velocity of the waves in deep water is 25 m/s.

The wavelength is 120 m.

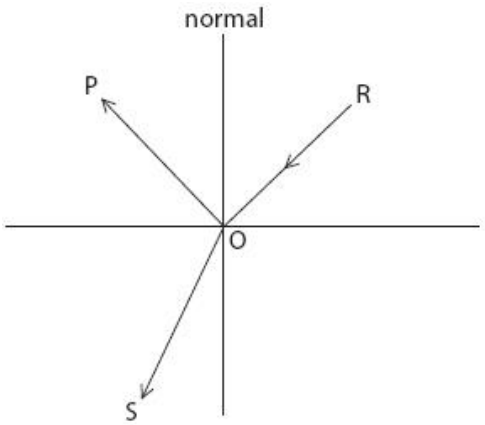
Calculate the frequency of the waves.

**(3)**

frequency = ..... Hz

**Q7.**
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.

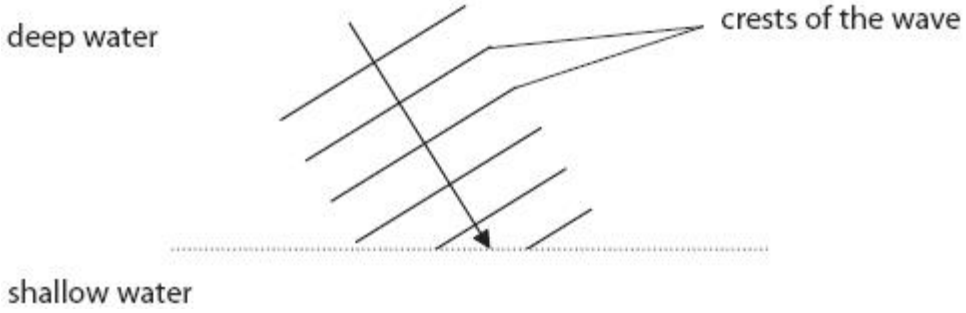



(i) Which of the lines show the possible path of a ray of light passing from air into glass?
Put a cross ( ☒ ) in the box next to your answer.

**(1)**

☒ **A** POS
☒ **B** POR
☒ **C** ROP
☒ **D** ROS

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

**(1)**

| | speed | direction |
|---|---|---|
| ☒ **A** | stays the same | changes |
| ☒ **B** | stays the same | stays the same |
| ☒ **C** | changes | changes |
| ☒ **D** | changes | stays the same |

(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)**

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(ii) In 1610, the geocentric model of the Solar System was commonly accepted.
Explain how Galileo's observations contradicted the geocentric model.

**(3)**

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(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.

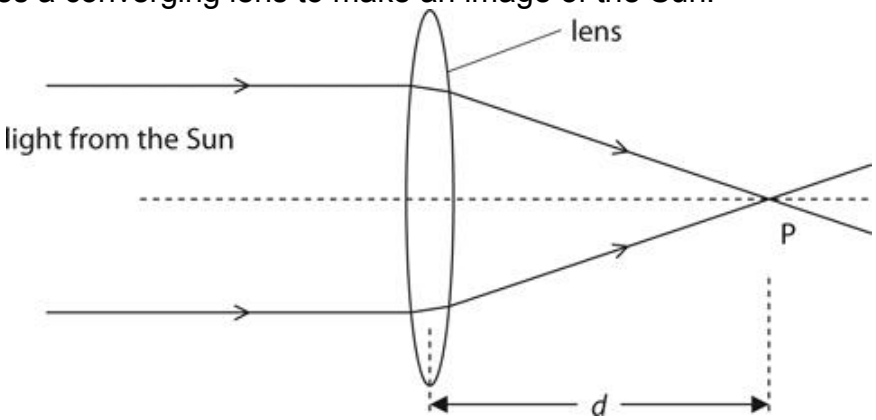
**(2)**

distance of Jupiter from the Earth =. . . . . .million km

**(Total for Question = 10 marks)**

**Q8. Using the Sun**

(a) A student uses a converging lens to make an image of the Sun.




(i) Complete the sentence by putting a cross (☒) in the box next to your answer.
The lens forms a real image of the Sun at P, where the light rays cross.
The distance *d* is the

**(1)**

- ☐ **A** focal point
- ☐ **B** focal length
- ☐ **C** object length
- ☐ **D** object distance

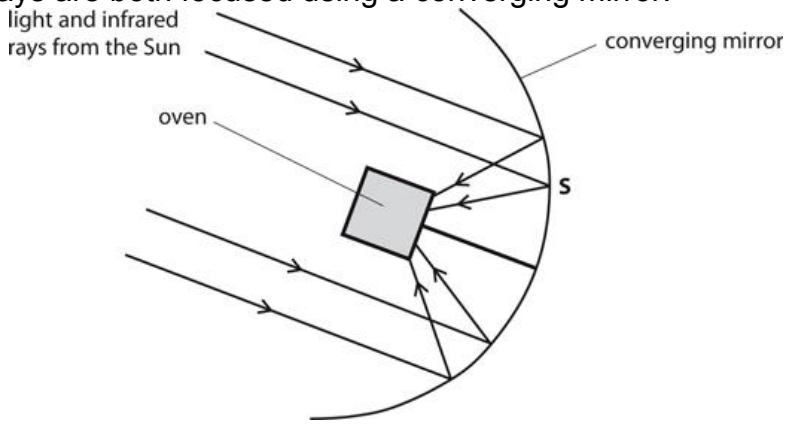
(ii) Radiation from the Sun includes some infrared waves.
The lens bends infrared waves less than it does ordinary light.

Label, with an **R**, a place on the diagram where the infrared rays could cross.

**(1)**

(b) In some countries, infrared rays from the Sun are used to cook food.

Light and infrared rays are both focused using a converging mirror.




(i) Which of the following is transferred by the waves from the Sun to the food?

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

**(1)**

- ☐ **A** information
- ☐ **B** matter
- ☐ **C** sound energy
- ☐ **D** thermal energy

(ii) State what happens to the rays at **S**.

**(1)**

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(iii) Explain why the light rays and infrared rays converge towards the same point.

**(2)**

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(iv) The infrared waves travel at a speed of 300 000 km/s.

They take 500 s to travel from the Sun to the Earth.
Calculate the distance between the Earth and the Sun.

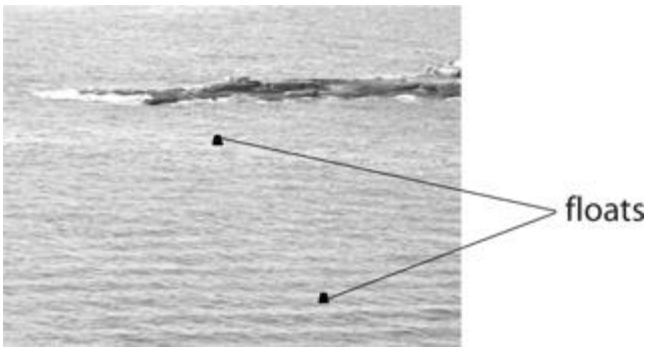
**(3)**

distance = ..... km

**(Total for Question is 9 marks)**

**Q9.**
The photograph shows a wave in a bay.

The wave was made by a passing boat.




(a) Which of these best describes what is transferred by the water wave?
Put a cross (☒) in the box next to your answer.

**(1)**

- ☒ **A** energy only
- ☒ **B** water only
- ☒ **C** both water and energy
- ☒ **D** neither water nor energy

(b) The diagram shows the wave as it passes by the two floats.


(i) The wavelength of the wave is 0.8 m.

Calculate the distance between the floats.

**(2)**

distance =..... m

(ii) The frequency of the wave is 0.4 Hz.

How many complete wavelengths pass each float in 20 s?

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

**(1)**

- ☒ **A** 0.02
- ☒ **B** 0.8
- ☒ **C** 8
- ☒ **D** 50

(iii) A man on the shore observes the wave.

Suggest **one** piece of information the man could gain about the boat by observing the wave that made it.

**(1)**

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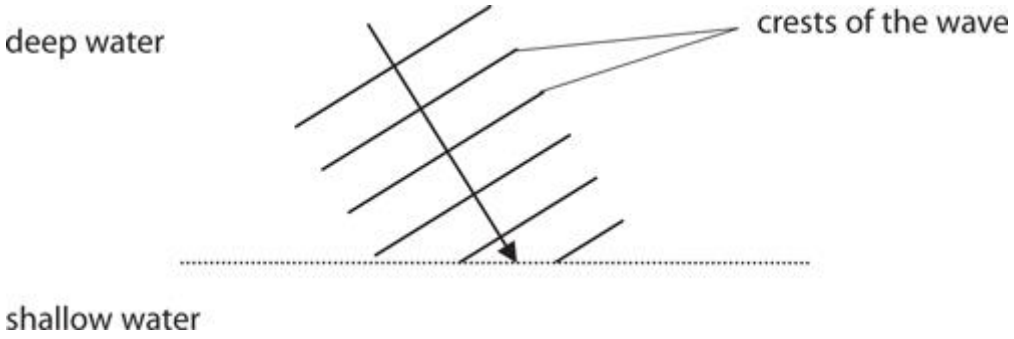
(c) The wave reaches shallow water before it reaches the shore.

Water waves travel more slowly in shallow water.
The diagram shows the wave as it reaches the shallow water




Complete the diagram to show how the wave travels in the shallow water.

**(3)**

**(Total for Question is 8 marks)**

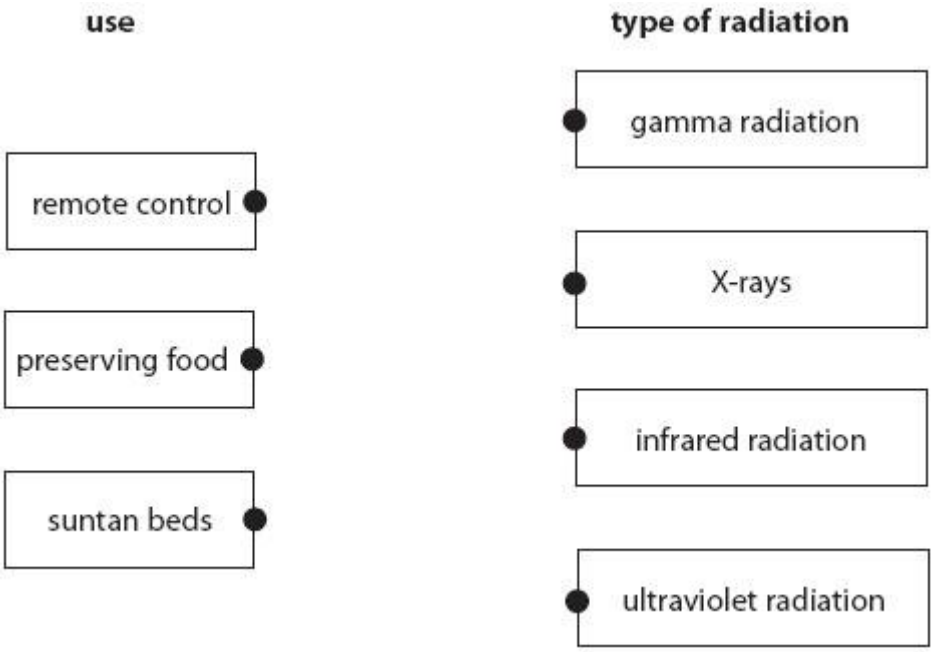
# P1.2 Specification statements

| | P1 Specification | Current RAG | Revised 1✓ | Revised 2✓ | Revised 3✓ |
|---|---|---|---|---|---|
| **Topic 2: The electromagnetic spectrum** | 2.1 Demonstrate an understanding of how Herschel and Ritter contributed to the discovery of waves outside the limits of the visible spectrum | | | | |
| | 2.2 Demonstrate an understanding that all electromagnetic waves are transverse and that they travel at the same speed in a vacuum | | | | |
| | 2.3 Describe the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, X-rays and gamma rays | | | | |
| | 2.4 Demonstrate an understanding that the electromagnetic spectrum is continuous from radio waves to gamma rays, but the radiations within it can be grouped in order of decreasing wavelength and increasing frequency | | | | |
| | 2.5 Demonstrate an understanding that the potential danger associated with an electromagnetic wave increases with increasing frequency | | | | |
| | 2.6 Relate the harmful effects, to life, of excessive exposure to the frequency of the electromagnetic radiation, including: | | | | |
| | a) microwaves: internal heating of body cells | | | | |
| | b) infrared: skin burns | | | | |
| | c) ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions | | | | |
| | d) X-rays and gamma rays: mutation or damage to cells in the body | | | | |
| | 2.7 Describe some uses of electromagnetic radiation: | | | | |
| | a) radio waves: including broadcasting, communications and satellite transmissions | | | | |
| | b) microwaves: including cooking, communications and satellite transmissions | | | | |
| | c) infrared: including cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems | | | | |
| | d) visible light: including vision, photography and illumination | | | | |
| | e) ultraviolet: including security marking, fluorescent lamps, detecting forged bank notes and disinfecting water | | | | |
| | f) X-rays: including observing the internal structure of objects, airport security scanners and medical X-rays | | | | |
| | g) gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment | | | | |
| | 2.8 Recall that ionising radiations are emitted all the time by radioactive sources | | | | |
| | 2.9 Describe that ionising radiation includes alpha and beta particles and gamma rays and that they transfer energy | | | | |

## P1.2 Exam Questions- 63 marks, 63 minutes

**Q10.** (a) Different types of electromagnetic radiation have different uses.
Draw one straight line from each use to the correct type of radiation.

**(3)**




(b) X-rays from a star travel to a space telescope in orbit around the Earth.
Explain why visible light from the same star takes the same time to reach the telescope.

**(2)**

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(c) Which of these ionising radiations is from a radioactive source and is also part of the electromagnetic spectrum?

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

**(1)**

☒ **A** alpha particles
☒ **B** beta particles
☒ **C** gamma rays
☒ **D** X-rays

(d) An X-ray of wavelength 2.0 nm has a frequency of $1.5 \times 10^{17}$ Hz.

1.0 nm = $1.0 \times 10^{-9}$ m
Calculate the speed of the wave.

**(2)**

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**(Total for Question is 8 marks)**

**Q11.**

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

(i) All electromagnetic waves are

**(1)**

- ☒ **A** longitudinal and have the same amplitude in a vacuum
- ☒ **B** longitudinal and have the same speed in a vacuum
- ☒ **C** transverse and have the same amplitude in a vacuum
- ☒ **D** transverse and have the same speed in a vacuum

(ii) All electromagnetic waves have both uses and dangers.

Their potential danger increases when

**(1)**

- ☒ **A** frequency decreases and wavelength decreases
- ☒ **B** frequency increases and wavelength decreases
- ☒ **C** frequency decreases and wavelength increases
- ☒ **D** frequency increases and wavelength increases

(b) Some microwaves have a frequency of $1.5 \times 10^{10}$ Hz.

They travel at a speed of $3.0 \times 10^{8}$ m/s.
Calculate their wavelength.

**(3)**

wavelength =..... m

(c) Infrared is used in an electric toaster.

Infrared is also used by a television remote control.

electric toaster

television remote control

Explain why using a television remote control does not burn anyone.

**(2)**

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(d) Gamma rays can cause cancer.
Gamma rays can also be used to treat cancer.
Explain how gamma rays can do both.

**(3)**

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**(Total for Question is 10 marks)**

**Q12.**

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)**

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(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)**

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

**(3)**

wavelength = . . . . . .m

*(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.

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**(Total for Question = 12 marks)**

**Q13.**

(a) Skin cancer can be caused by radiation from the Sun.
Complete the sentence by putting a cross ( ☒ ) in the box next to your answer.

The radiation that causes skin cancer is

**(1)**

- ☒ **A** ultraviolet radiation
- ☒ **B** radio waves
- ☒ **C** microwaves
- ☒ **D** infrared radiation

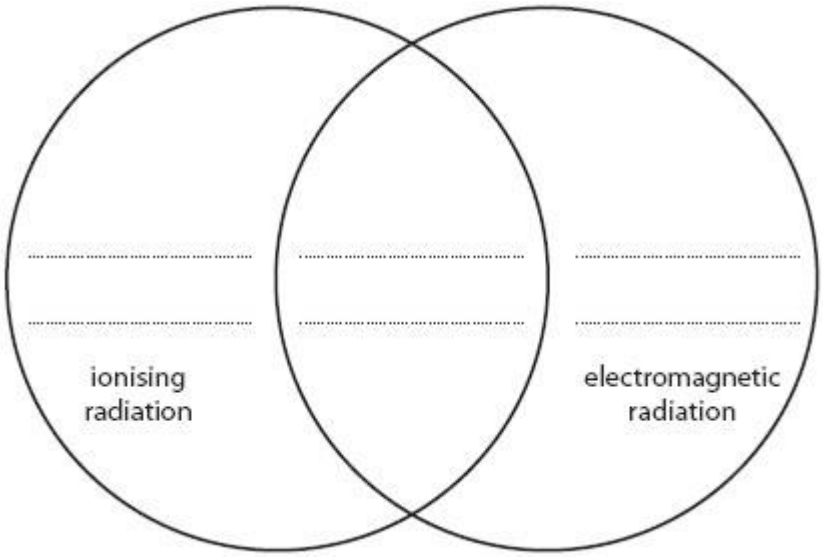
(b) The word box contains the names of three types of radiation.

| gamma rays | infrared radiation | alpha particles |
|---|---|---|

Use this diagram to classify the three types of radiation given in the word box.

Write the name of the radiation in the correct section of the diagram.

**(2)**




(c) Which of these is correct for all electromagnetic waves in a vacuum?

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

**(1)**

- ☒ **A** they have the same frequency
- ☒ **B** they have the same wavelength
- ☒ **C** they are transverse waves
- ☒ **D** they are longitudinal waves

(d) Describe a use of gamma radiation.

**(2)**

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*(e) Herschel and Ritter carried out experiments that contributed to the discovery of infrared and ultraviolet radiation.

Explain how the results of the experiments carried out by Herschel and Ritter led to these discoveries.

**(6)**

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**(Total for Question is 12 marks)**

**Q14. Using microwaves**

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

(i) All electromagnetic waves have the same

**(1)**

- ☐ **A** amplitude in a vacuum
- ☐ **B** frequency in air
- ☐ **C** speed in a vacuum
- ☐ **D** wavelength in air

(ii) In the electromagnetic spectrum, microwaves are between

**(1)**

- ☐ **A** radio waves and infrared waves
- ☐ **B** ultraviolet waves and x-rays
- ☐ **C** visible light and ultraviolet waves
- ☐ **D** x-rays and gamma rays

(b) The microwave spectrum is divided into bands.

| %%% | **Bands in the microwave spectrum** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| name of band | X | K | Q | U | V | E | W | F | D |
| width of band / GHz | 8 – 12 | 12 – 40 | 33 – 50 | 40 – 50 | 50 – 75 | 60 – 90 | 75 – 110 | 90 – 140 | 110 – 170 |

(i) State what **Hz** means.

**(1)**

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(ii) Which band in the microwave spectrum has the shortest wavelength?

**(1)**

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(iii) Microwaves can be used for satellite communications.
State another use for microwaves.

**(1)**

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(iv) Microwaves in the E band can be absorbed by oxygen, carbon dioxide and nitrogen.
Explain why microwaves in the E band are **not** suitable for use in satellite communications.

**(2)**

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(v) Describe how the highlighted bands, Q, E and F, differ from the other bands in the microwave spectrum.

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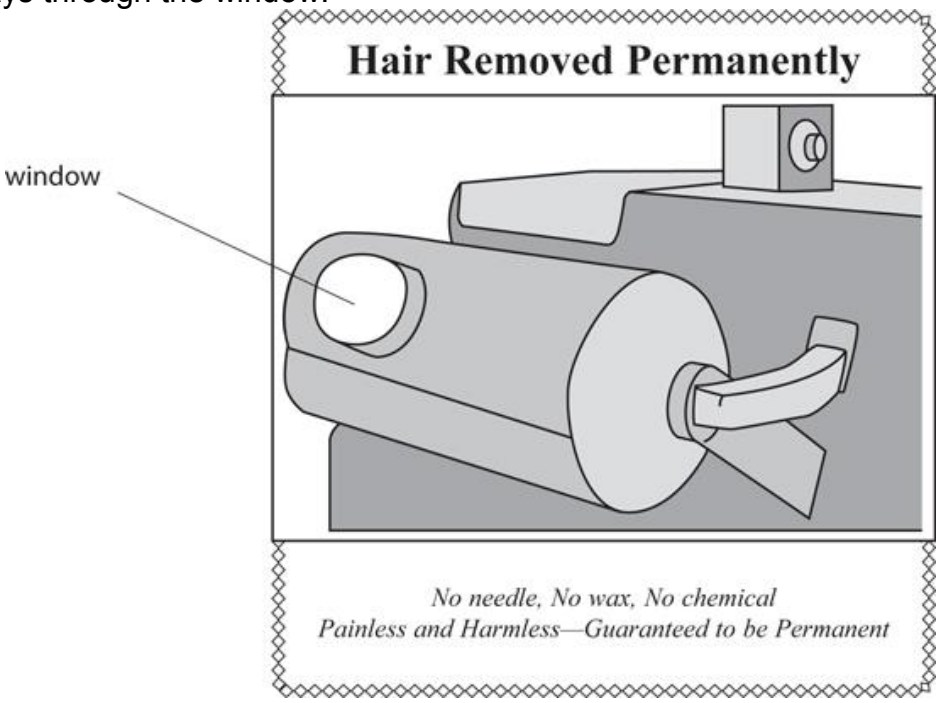
**Q15. Using X-rays**

(a) The device shown in the picture was invented not long after the discovery of X-rays. It emitted X-rays through the window.




In the 1920s, it was used to remove unwanted hair from the arm.
The patient placed her arm in front of the window.
The X-rays destroyed the hair roots.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.
X-rays are

**(1)**

☒ **A** electromagnetic waves with very high frequency
☒ **B** electromagnetic waves with very long wavelength
☒ **C** electromagnetic waves which always have low energy
☒ **D** ionising radiations emitted by radioactive sources

(ii) Some users believed that sunglasses would protect their eyes from the X-rays.
Explain how effective this would be as a precaution.

**(2)**

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(iii) This hair removal device was banned in 1940.
Many people who had used it for a long time had become seriously ill.
State **one** of the effects this machine may have had on them.

**(1)**

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(iv) The device was advertised as 'harmless'.
Suggest why people used this device for many years.

**(2)**

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*(b) There is a hair removal device which is currently available in some specialist clinics.

It uses a low energy infrared laser beam. The makers say that this is much less dangerous than the X-ray device.

By considering the dangers associated with both devices, discuss whether the infrared laser device should be put on general sale to the public.

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# P1.3 Specification statements

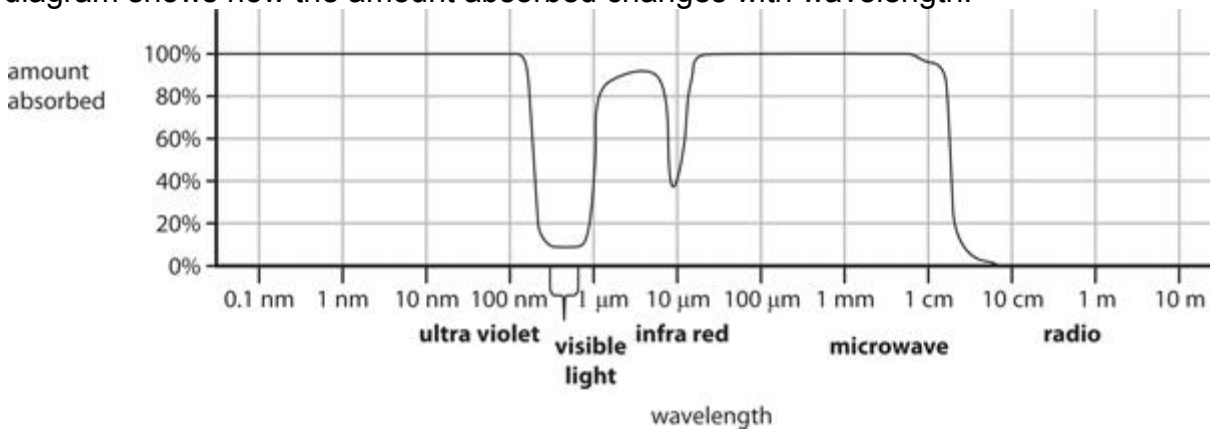
| | P1 Specification | Current | Revised | Revised | Revised |
|---|---|---|---|---|---|
| **Topic 3: Waves and the Universe** | 3.1 Recall that the Solar System is part of the Milky Way galaxy | | | | |
| | 3.2 Describe a galaxy as a collection of stars | | | | |
| | 3.3 Recall that the Universe includes all of the galaxies | | | | |
| | 3.4 Compare the relative sizes of and the distances between the Earth, the Moon, the planets, the Sun, galaxies and the Universe | | | | |
| | 3.5 Describe the use of other regions of the electromagnetic spectrum by some modern telescopes | | | | |
| | 3.6 Describe the methods used to gather evidence for life beyond Earth, including space probes, soil experiments by landers, Search for Extraterrestrial Intelligence (SETI) | | | | |
| | 3.7 Demonstrate an understanding of the impact of data gathered by modern telescopes on our understanding of the Universe, including: | | | | |
| | a) the observation of galaxies because of improved magnification | | | | |
| | b) the discovery of objects not detectable using visible light | | | | |
| | c) the ability to collect more data | | | | |
| | 3.8 *Construct a simple spectrometer, from a CD or DVD, and use it to analyse common light sources* | | | | |
| | 3.9 Explain why some telescopes are located outside the Earth's Atmosphere | | | | |
| | 3.10 **Analyse data provided to support the location of telescopes outside the Earth's atmosphere** | | | | |
| | 3.11 Describe the evolution of stars of similar mass to the Sun through the following stages: | | | | |
| | a) nebula | | | | |
| | b) star (main sequence) | | | | |
| | c) red giant | | | | |
| | d) white dwarf | | | | |
| | 3.12 Describe the role of gravity in the life cycle of stars | | | | |
| | 3.13 **Describe how the evolution of stars with a mass larger than the Sun is different, and may end in a black hole or neutron star** | | | | |
| | 3.14 Demonstrate an understanding of the Steady State and Big Bang theories | | | | |
| | 3.15 Describe evidence supporting the Big Bang theory, limited to red-shift and the cosmic microwave background (CMB) radiation | | | | |
| | 3.16 Recognise that as there is more evidence supporting the Big Bang theory than the Steady State theory, it is the currently accepted model for the origin of the Universe | | | | |
| | 3.17 Describe that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength | | | | |
| | 3.18 **Demonstrate an understanding that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength** | | | | |
| | 3.19 **Describe the red-shift in light received from galaxies at different distances away from the Earth** | | | | |
| | 3.20 **Explain why the red-shift of galaxies provides evidence for the Universe expanding** | | | | |
| | 3.21 **Explain how both the Big Bang and Steady State theories of the origin of the Universe both account for red-shift of galaxies** | | | | |
| | 3.22 **Explain how the discovery of the CMB radiation led to the Big Bang theory becoming the currently accepted model** | | | | |

P1.3 Exam Questions- 48 marks, 48 minutes.

**Q16. Observing the Universe**

(a) The Earth's atmosphere absorbs electromagnetic radiation.

The diagram shows how the amount absorbed changes with wavelength.




(i) How much of the visible light from space is **absorbed** as it passes through our atmosphere?

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

**(1)**

- ☒ **A** 0%
- ☒ **B** 10%
- ☒ **C** 90%
- ☒ **D** 100%

(ii) Large telescopes which collect visible light to explore the Universe are usually placed near the tops of mountains.

Suggest why radio telescopes do not have to be placed high up a mountain.

**(1)**

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(iii) One theory of the origin of the Universe predicted that there should be cosmic background radiation with a wavelength of about 1 mm.

Explain why scientists had to wait until the development of space flight before they could study this radiation in detail.

**(2)**

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(iv) The electromagnetic radiation from most galaxies has a red-shift.

Suggest why, when a galaxy has a very large red-shift, some of its visible light is not detected through the Earth's atmosphere.

**(2)**

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*(b) Scientists believe that the Universe is expanding.

Describe how careful observation of electromagnetic radiation from distant galaxies as well as from the whole of space gave evidence supporting the Big Bang Theory.

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**Q17. Stars and the Universe**

(a) The photograph shows a nebula and many stars.

(i) A nebula is a cloud of gas and dust from which stars are formed.
Describe the energy changes involved when a main sequence star forms from gas and dust.

**(3)**

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(ii) Describe how the mass of a main sequence star will affect what the star finally becomes.

**(3)**

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*b While the origin of stars is well understood, there is still much debate about the origin of the Universe.

Two major theories about the origin of the Universe are the Big Bang and the Steady State theories.

Some evidence supports both theories. Other evidence supports only one theory.
By considering the evidence, discuss why one of these theories is preferred by most scientists.

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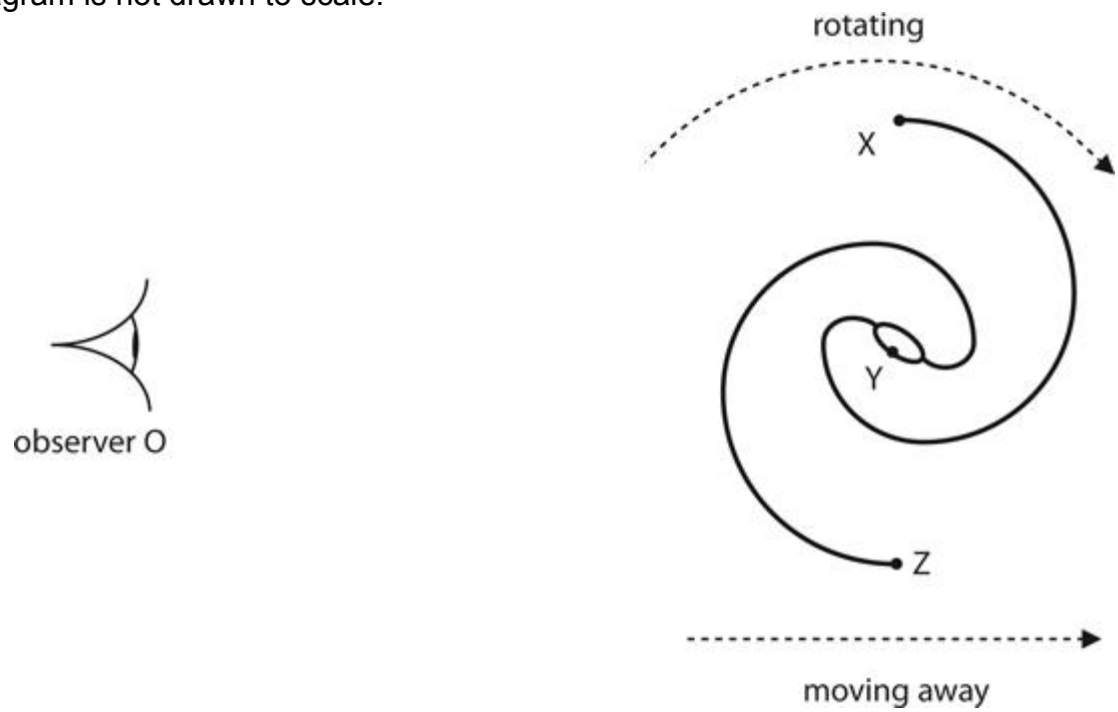
**Q18. Studying stars**

(a) The diagram shows a spiral galaxy and an observer, O.

The spiral galaxy is rotating as well as moving away from O.
The diagram is not drawn to scale.




(i) Light from three stars, X, Y and Z, reaches O.

The light from star Y shows red shift.
Explain why the light received from star Y shows red shift.

**(2)**

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(ii) The light received from each of the three stars, X, Y and Z, shows different amounts of red shift.

Explain these differences.

**(4)**

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*(b) Compare and contrast the future evolution of our Sun with that of a star with a much larger mass.

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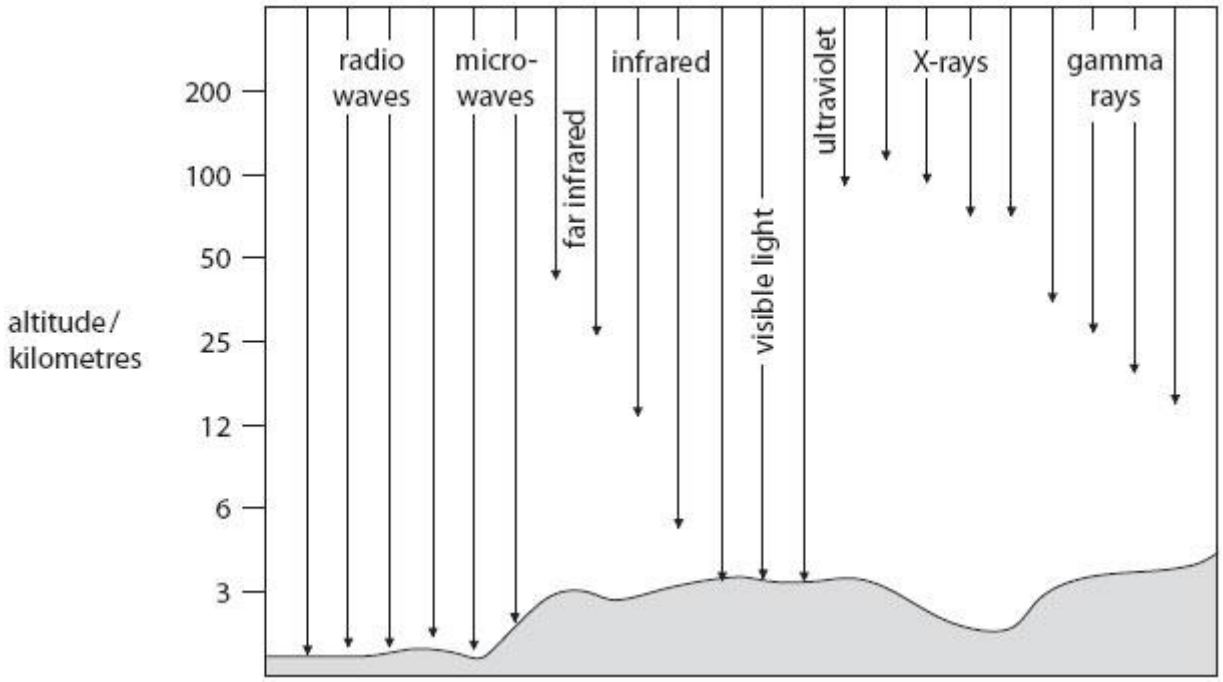
**Q19.**

Not all electromagnetic radiation coming from space reaches the Earth's surface.
The diagram shows how far radiation from each part of the electromagnetic spectrum travels down through the atmosphere.




(a) (i) Name **one** type of radiation that can reach the surface of the Earth from stars.

**(1)**

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(ii) Name **one** type of radiation from stars that cannot be detected at the Earth's surface but can be detected using satellites.

**(1)**

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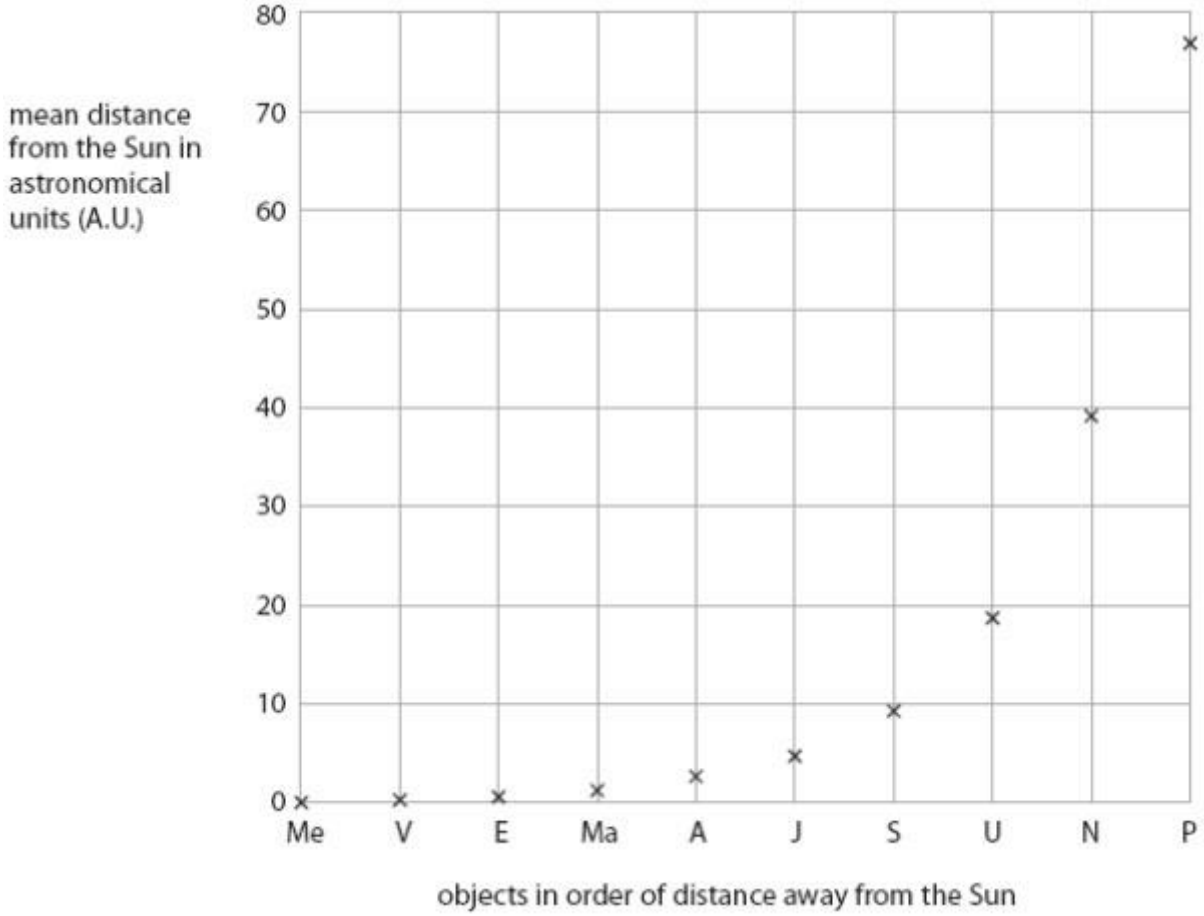
(b) Bode, a scientist, found a rule predicting the distance of objects from the Sun.
The chart shows the mean distances from the Sun predicted by Bode's rule.




[Me – Mercury; V – Venus; E – Earth; Ma – Mars; A – Asteroid Belt; J – Jupiter; S – Saturn; U – Uranus; N – Neptune; P – Pluto]

(i) Read, from the chart, the predicted values for the distance from the Sun to Neptune and from the Sun to Pluto.

**(2)**

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(ii) Bode's rule works well for all objects between Mercury and Uranus.
From scientific measurements, however, the actual mean distance from the Sun to Neptune is 30 A.U.
Some scientists think that Neptune was not part of the original Solar System.
Explain how the predicted value for Neptune supports the view of these scientists.

**(2)**

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*(c) Scientists are using a variety of methods to search for life beyond Earth.
Discuss the problems involved in using these methods.

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**(Total for Question is 12 marks)**

## P1.4 Specification statements

| | P1 Specification | Current RAG | Revised | Revised | Revised |
|---|---|---|---|---|---|
| **Topic 4: Waves and the Earth** | 4.1 Recall that sound with frequencies greater than 20 000 hertz, Hz, is known as ultrasound | | | | |
| | 4.2 Describe uses of ultrasound, including: | | | | |
| | a) sonar | | | | |
| | b) communication between animals | | | | |
| | c) foetal scanning | | | | |
| | 4.3 Calculate depth or distance from time and velocity of ultrasound | | | | |
| | 4.4 Recall that sound with frequencies less than 20 hertz, Hz, is known as infrasound | | | | |
| | 4.5 Describe uses of infrasound, including: | | | | |
| | a) communication between animals | | | | |
| | b) detection of animal movement in remote locations | | | | |
| | c) detection of volcanic eruptions and meteors | | | | |
| | 4.6 Recall that seismic waves are generated by earthquakes or explosions | | | | |
| | 4.7 *Investigate the unpredictability of earthquakes, through sliding blocks and weights* | | | | |
| | 4.8 Explain why scientists find it difficult to predict earthquakes and tsunami waves even with available data | | | | |
| | 4.9 Recall that seismic waves can be longitudinal (P) waves and transverse (S) waves and that they can be reflected and refracted at boundaries between the crust, mantle and core | | | | |
| | 4.10 Explain how data from seismometers can be used to identify the location of an earthquake | | | | |
| | 4.11 **Demonstrate an understanding of how P and S waves travel inside the Earth including reflection and refraction** | | | | |
| | 4.12 Explain how the Earth's outermost layer is composed of (tectonic) plates and is in relative motion due to convection currents in the mantle | | | | |
| | 4.13 Demonstrate an understanding of how, at plate boundaries, plates may slide past each other, sometimes causing earthquakes | | | | |

P1.4 Exam questions – 41 marks, 41 minutes.

**Q20. Earthquakes and seismic waves**

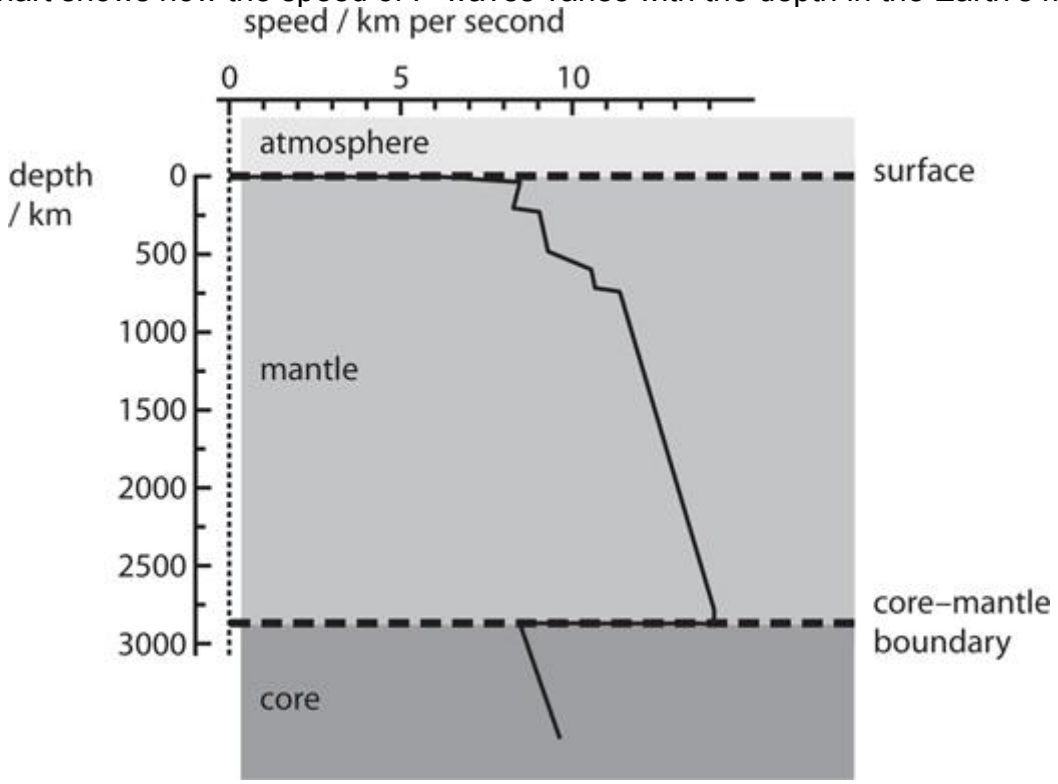
(a) Earthquakes produce seismic waves and infrasound waves.

Which row of the table is correct for these waves?
Put a cross (☒) in a box to show your answer.

**(1)**

| | **seismic waves are** | **infrasound waves are** |
|---|---|---|
| ☒ **A** | longitudinal only | longitudinal and transverse |
| ☒ **B** | longitudinal only | longitudinal only |
| ☒ **C** | longitudinal and transverse | longitudinal and transverse |
| ☒ **D** | longitudinal and transverse | longitudinal only |

(b) The chart shows how the speed of P-waves varies with the depth in the Earth's mantle.




(i) State what happens to a P-wave when it crosses from the mantle into the core.

**(1)**

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(ii) Describe how the speed of a P-wave changes between a depth of 1000 km and 2500 km.

**(2)**

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(iii) The average speed of a P-wave in the mantle is 12 km/s.

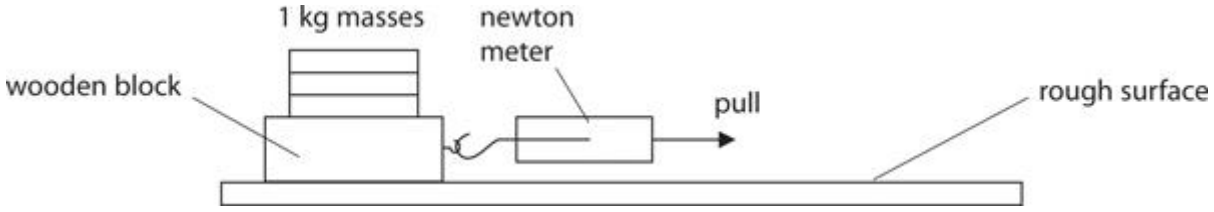
A P-wave travels vertically down from the surface and reflects from the core–mantle boundary back to the surface.

It travels a total distance of 5800 km.
Calculate the total time of travel for the wave.

**(3)**

time = ..... s

(c) A class investigates the force needed to start a wooden block moving on a rough surface.
They use the apparatus shown.




Each student repeats the experiment five times.
A set of results for one student is shown in the table.

| attempt | force needed to start block moving / N |
|---|---|
| 1 | 30 |
| 2 | 57 |
| 3 | 26 |
| 4 | 48 |
| 5 | 39 |

All the students in the class get a similar wide range of results.
Explain what the results show about predicting earthquakes.

**(2)**

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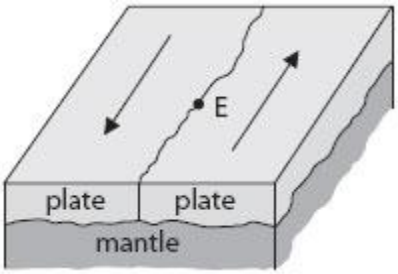
**(Total for Question is 9 marks)**

**Q21.**

(a) The diagram shows part of the boundary between two tectonic plates.




(i) Complete the sentence by putting a cross ( ☒ ) in the box next to your answer.
The plates are being steadily pushed in opposite directions by

**(1)**

☒ **A** convection currents in the mantle
☒ **B** reflection of waves from the Earth's core
☒ **C** tsunami waves in the ocean
☒ **D** volcanic eruptions on the surface

(ii) An earthquake occurs.

Its epicentre is at the place marked E on the diagram.
Describe what happens at the plate boundary to cause this earthquake.

**(2)**

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(b) The earthquake causes seismic waves.

(i) S waves are one type of seismic wave. They travel at 0.65 km/s.

There is a seismometer 80 km away from point E.
Show that it takes about 2 minutes for the S waves from the earthquake to reach the seismometer.

**(2)**

(ii) P waves are another type of seismic wave.
They travel about 10 times more quickly than S waves.
Describe how scientists can use seismometer records of P and S waves to locate the epicentre.

**(3)**

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(iii) Seismic waves have a frequency of about 15 Hz.
P waves have a much smaller amplitude than S waves.
Some people claim that animals can detect an earthquake before people are aware of it.
Suggest an explanation for this.

**(2)**

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**(Total for Question is 10 marks)**

**Q22. Infrasound and earthquakes**

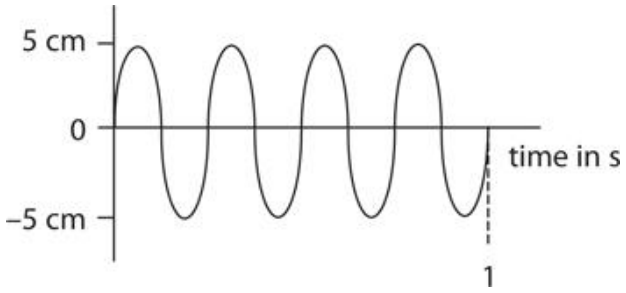
(a) Which row of the table is correct for both infrasound radiation and infrared radiation?
Put a cross (☒) in the box next to your answer.

**(1)**

| %%% | **infrasound** | **infrared** |
|---|---|---|
| ☒ A | transverse | transverse |
| ☒ B | transverse | longitudinal |
| ☒ C | longitudinal | transverse |
| ☒ D | longitudinal | longitudinal |

(b) State the amplitude of this sound wave.

**(1)**




amplitude =.....

(c) Describe how infrasound differs from ultrasound.

**(2)**

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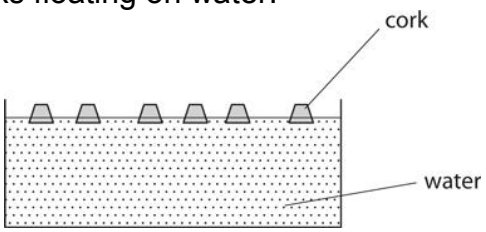
(d) Earthquakes are sometimes caused when plates in the Earth's crust move.
The diagram shows some corks floating on water.




Explain how this model of corks on water could be used to demonstrate what causes the Earth's plates to move.
You may add to the diagram to help with your answer.

**(3)**

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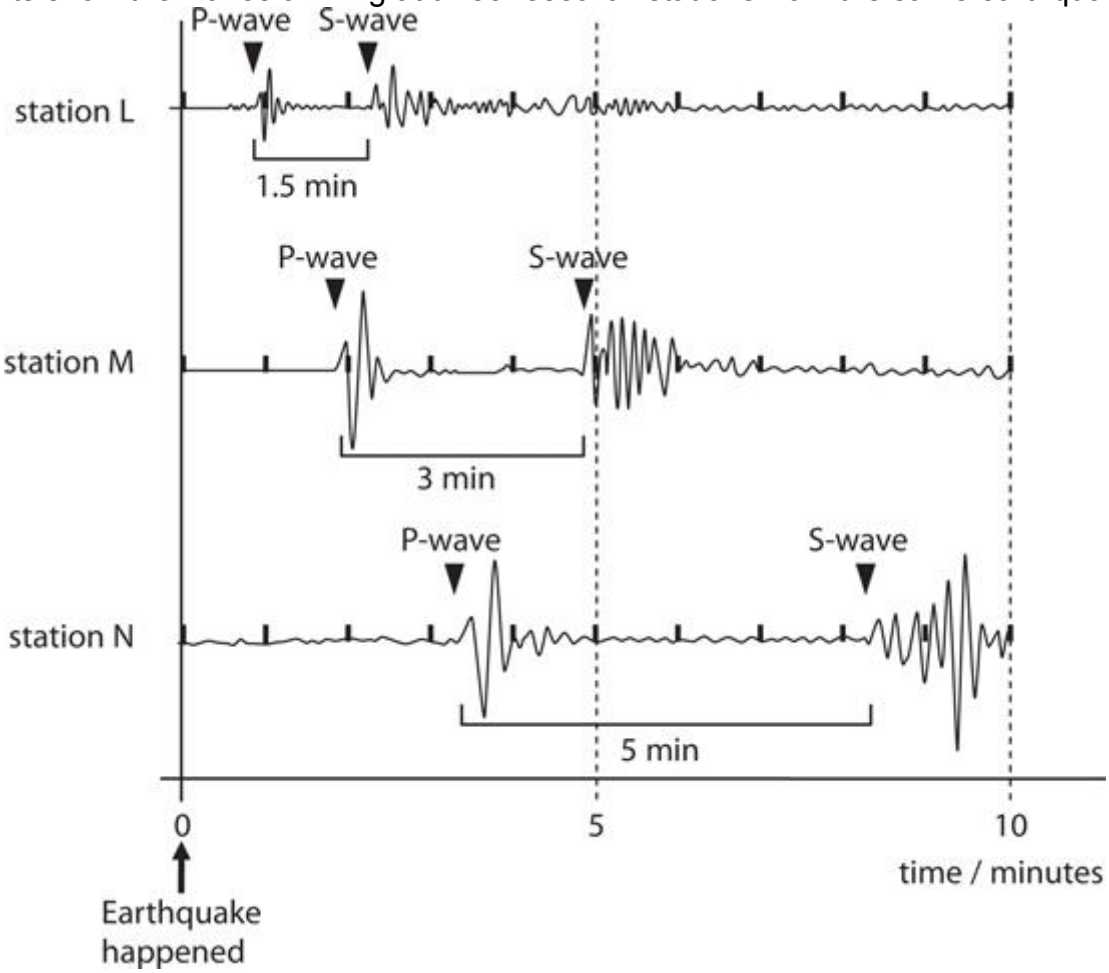
(e) The movement of the Earth's plates can cause earthquakes.
The charts show the waves arriving at three research stations from the same earthquake.




A student suggested that the time between the arrival of the P-wave and the S-wave was proportional to the distance of the station from the earthquake.
Use the charts to evaluate whether this is correct or not.

**(3)**

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**(Total for Question = 10 marks)**

**Q23.**

Ultrasound has many different applications.

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

Ultrasound is used for

**(1)**

- ☒ **A** cooking
- ☒ **B** communication between animals
- ☒ **C** communication with satellites
- ☒ **D** detecting forged bank notes

(ii) Explain why ultrasound rather than X-rays are used for foetal scanning.

**(2)**

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(b) An ultrasound wave vibrates 30 000 times a second.

(i) State the frequency of the wave.

**(1)**

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(ii) Describe the motion of particles in a material when this ultrasound wave passes through.

**(2)**

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*(c) Explain how sonar is used by deep sea fishermen to detect the depth of a shoal of fish below the surface of the sea.

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**(Total for Question is 12 marks)**

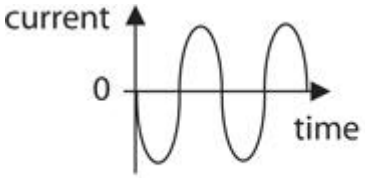
## P1.5 Specification statements

| | P1 Specification | Current | Revised | Revised | Revised |
|---|---|---|---|---|---|
| **Topic 5: Generation and transmission of electricity** | 5.1 Describe current as the rate of flow of charge and voltage as an electrical pressure giving a measure of the energy transferred | | | | |
| | 5.2 Define power as the energy transferred per second and measured in watts | | | | |
| | 5.3 Use the equation:<br>electrical power (watt, W) = current (ampere, A) × potential difference (volt, V)<br>$P = I \times V$ | | | | |
| | 5.4 *Investigate the power consumption of low-voltage electrical items* | | | | |
| | 5.5 Discuss the advantages and disadvantages of methods of large scale electricity production using a variety of renewable and non-renewable resources | | | | |
| | 5.6 Demonstrate an understanding of the factors that affect the size and direction of the induced current | | | | |
| | 5.7 *Investigate factors affecting the generation of electric current by induction* | | | | |
| | 5.8 Explain how to produce an electric current by the relative movement of a magnet and a coil of wire | | | | |
| | a) on a small scale | | | | |
| | b) in the large-scale generation of electrical energy | | | | |
| | 5.9 Recall that generators supply current which alternates in direction | | | | |
| | 5.10 Explain the difference between direct and alternating current | | | | |
| | 5.11 Recall that a transformer can change the size of an alternating voltage | | | | |
| | 5.12 **Use the turns ratio equation for transformers to predict either the missing voltage or the missing number of turns** | | | | |
| | 5.13 Explain why electrical energy is transmitted at high voltages, as it improves the efficiency by reducing heat loss in transmission lines | | | | |
| | 5.14 Explain where and why step-up and step-down transformers are used in the transmission of electricity in the National Grid | | | | |
| | 5.15 Describe the hazards associated with electricity transmission | | | | |
| | 5.16 Recall that energy from the mains supply is measured in kilowatt-hours | | | | |
| | 5.17 Use the equation: cost =<br>power (kilowatts, kW) × time (hour, h) × cost of 1 kilowatt-hour (p/kW h) | | | | |
| | 5.18 Demonstrate an understanding of the advantages of the use of low-energy appliances | | | | |
| | 5.19 Use data to compare and contrast the advantages and disadvantages of energy-saving devices | | | | |
| | 5.20 Use data to consider cost-efficiency by calculating payback times | | | | |
| | 5.21 Use the equation: power (watt, W) =<br>energy used (joule, J) / time taken (second, s)<br>$P = E/t$ | | | | |

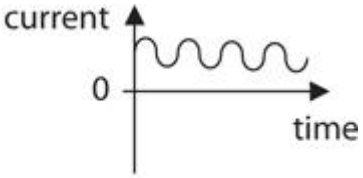
P1.5 Exam Questions – 67 marks, 67 minutes.

**Q24. Distribution of electricity**

(a) Scientists say that graph 1 shows an alternating current while graph 2 shows a direct current.




graph 1




graph 2

The two graphs differ in several ways.
State the difference between the currents which makes one alternating and the other direct.

**(1)**

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(b) A transformer is 100% efficient.
It has 200 turns on the primary coil and 3000 turns on the secondary coil. The input voltage is 55 V.

(i) Show that the output voltage is about 800 V.

**(3)**

(ii) Calculate the current in the secondary coil when the current in the primary coil is 0.50 A.

**(2)**

current in secondary coil =..... A

*(c) The diagram shows how electricity produced at a power station is transmitted to distant houses.


Transformers R and S are not 100% efficient.

By using transformers, energy losses in the transmission lines are reduced.

Explain how this reduction is achieved, even though some energy is wasted in the transformers themselves.

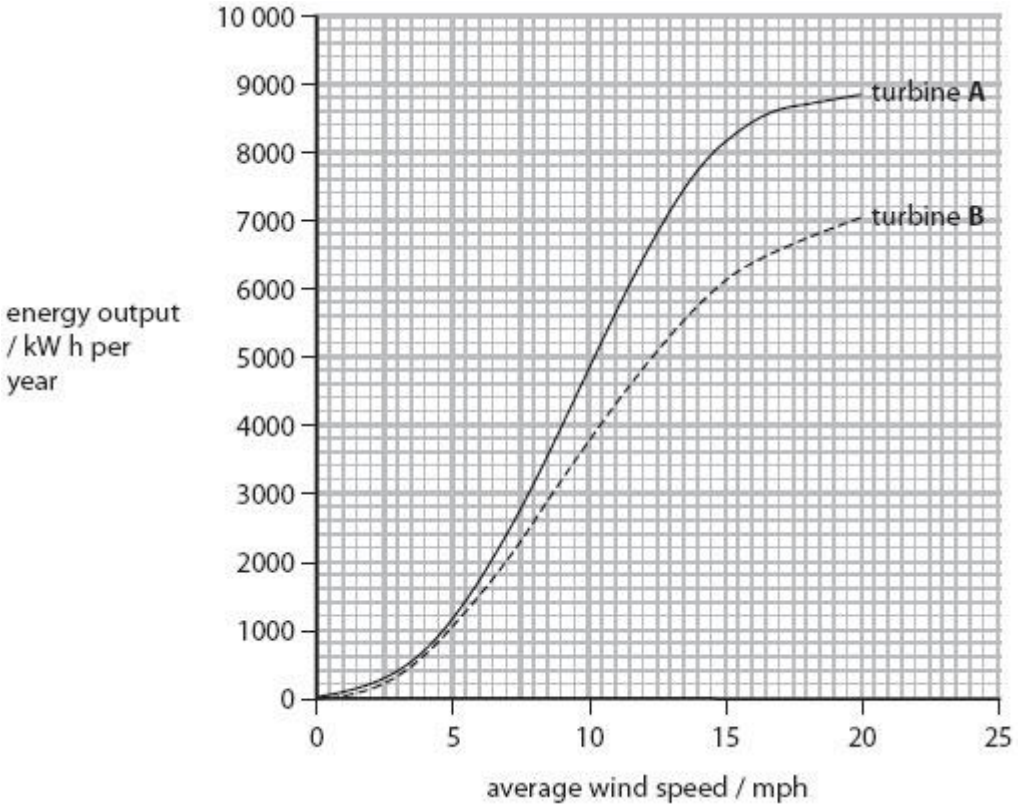
**(6)**

**Q25.**

(a) Eric owns a small farm where chicks are hatched from eggs.

He is considering generating his own electricity to heat and light a barn rather than using electricity from the National Grid.

This graph shows how the energy output varies with wind speed for two different wind turbines, **A** and **B**.




The average wind speed at Eric's farm is 13 mph.
The total heating and lighting in the barn requires 6000 kW h of electrical energy each year.

(i) Use the data in the graph to recommend the best turbine for Eric's barn.

**(1)**

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(ii) Eric pays 14p per kW h for electrical energy supplied by the National Grid.

Calculate how much he could expect to save each year by using the energy from this wind turbine to heat and light the barn.

**(2)**

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(iii) Eric looks at the cost of installing the turbine.
State how he should work out the payback time.

**(1)**

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(iv) The chicks need to be kept warm at all times.
Eric uses halogen lamps to provide heat and light for most of the day.
Eric thinks about changing his halogen lamps for energy saving lamps.
Suggest why this might not actually be a benefit.

**(2)**

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*(b) There are several large-scale energy resources which are suitable alternatives to fossil fuels in some situations.

Two of these alternatives are hydro-electric power and solar power.
Compare hydro-electric power with solar power as energy resources for the large-scale generation of electricity.

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**(Total for Question is 12 marks)**

**Q26. Generating electricity**

The photographs show two different methods of generating electricity.

Photograph A shows a wind-powered generator on the roof of a house.

Photograph B shows the inside of an oil-fired power station which is connected to the National Grid.

photograph A

photograph B

(a) The table shows some information about the wind-powered generator.

| | |
|---|---|
| cost (including installation) | £2500 |
| electrical energy produced in one year | 900 kWh |

Electricity from the National Grid costs 15 p per kWh.
Calculate the payback time for the wind-powered generator.

**(3)**

payback time = ..... years

(b) Transformers are used on a small scale in the home and on a large scale in the National Grid.

(i) The transformer for an electric toothbrush charger steps down the mains voltage to 9.0 V.

The mains voltage is 230 V.
The transformer has 690 turns on its primary coil.
Calculate the number of turns on the secondary coil.

**(3)**

number of turns = .....

*(ii) The National Grid transmits electricity around the country.

Explain how using transformers makes the transmission of electrical energy more efficient.

**(6)**

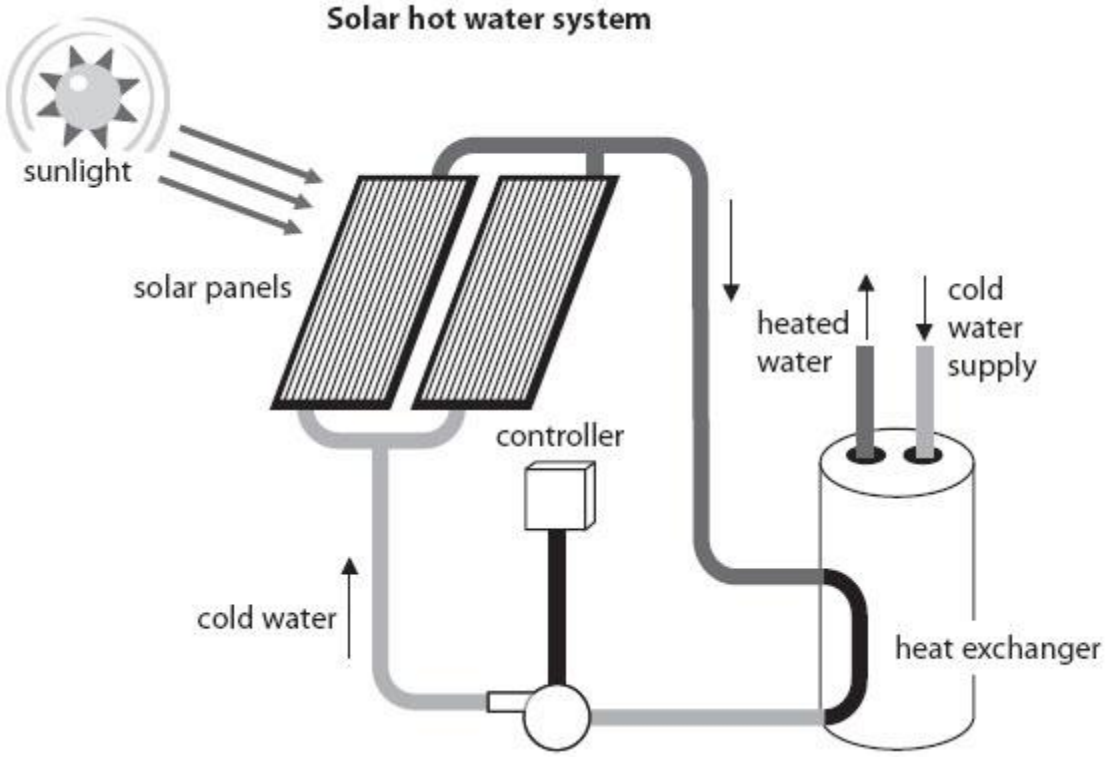
**Q27.**

There are two types of solar panels.

One type of solar panel uses the Sun's energy to heat water.
The other type uses solar cells to produce electricity.

(a) The diagram shows solar panels in a system used to heat water for a house.

Cold water goes into the panels and is heated by energy from the Sun.




(i) Complete the sentence by putting a cross ( ☒ ) in the box next to your answer.
The solar heating panels are painted black because

**(1)**

☒ **A** black is a good absorber of heat
☒ **B** black is a good conductor of heat
☒ **C** black is a good radiator of heat
☒ **D** black is a good reflector of heat

(ii) On one sunny day no hot water is used in the house.

The water in the panels reaches a constant temperature even though the water is still absorbing energy from the Sun.
Explain why the temperature of the water in the panels becomes constant.

**(3)**

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(b) The photograph shows a solar farm which uses many thousands of solar cells to generate electricity.

(i) Which energy transfer takes place in a solar cell?
Put a cross ( ☒ ) in the box next to your answer.

**(1)**

- ☒ **A** chemical to electrical
- ☒ **B** electrical to light
- ☒ **C** electrical to chemical
- ☒ **D** light to electrical

(ii) A large solar farm has 21 700 solar panels and generates 5.0 MW of power.

1.0 MW = $1.0 \times 10^6$ W
Calculate the average power each panel produces.

**(2)**

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(iii) The solar farm receives 25 MW of power from the Sun to generate 5 MW of electrical power.
Calculate the efficiency of the solar farm.

**(2)**

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**(Total for Question is 9 marks)**

**Q28.**

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

**(1)**

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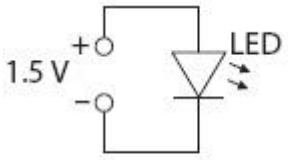
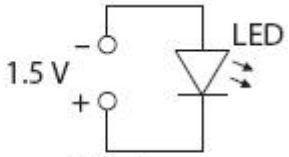
(b) A light emitting diode (LED) can only emit light when connected correctly to a potential difference.

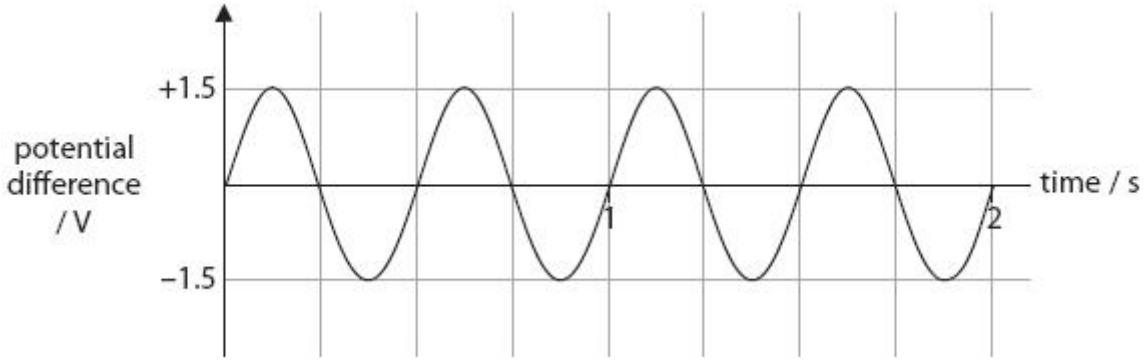



LED emits light




LED does **not** emit light

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

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(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)**

current in the lamp =. . . . . .A

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

photo of stairwell with fluorescent fitting

photo of stairwell with LED fitting

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)**

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**(Total for Question = 12 marks)**

**Q29.**

A small notebook computer has a power rating of 40 W.
The computer is connected to the mains supply through a step-down transformer.
The mains supply is a.c.

(a) (i) How much energy is supplied to the computer each second?
Put a cross ( ☒ ) in the box next to your answer.

**(1)**

☒ **A** 0.025 J
☒ **B** 4.0 J
☒ **C** 40 J
☒ **D** 240 J

(ii) Sketch an alternating current on the axes shown.

**(1)**


(b) The step-down transformer has:

- 2400 turns on the primary coil
- 200 turns on the secondary coil
- a primary voltage of 230 V.

Calculate the voltage output of the secondary coil.

**(3)**

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(c) (i) Explain how transformers are used to improve the efficiency of power transmission in the National Grid.

**(3)**

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(ii) Explain why flying a kite near power lines could be a danger to the person flying the kite.

**(2)**

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**(Total for Question is 10 marks)**

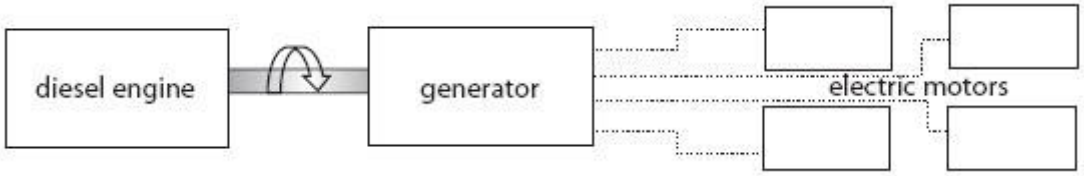
## P1.6 Specification statements

| | P1 Specification | Current RAG | Revised 1✓ | Revised 2✓ | Revised 3✓ |
|---|---|---|---|---|---|
| **Topic 6: Energy and the future** | 6.1 Demonstrate an understanding that energy is conserved | | | | |
| | 6.2 Describe energy transfer chains involving the following forms of energy: thermal (heat), light, electrical, sound, kinetic (movement), chemical, nuclear and potential (elastic and gravitational) | | | | |
| | 6.3 Demonstrate an understanding of how diagrams can be used to represent energy transfers | | | | |
| | 6.4 Apply the idea that efficiency is the proportion of energy transferred to useful forms to everyday situations | | | | |
| | 6.5 Use the efficiency equation:<br>*efficiency = (useful energy transferred by the device)/(total energy supplied to the device)* x 100% | | | | |
| | 6.6 Demonstrate an understanding that for a system to be at a constant temperature it needs to radiate the same average power that it absorbs | | | | |
| | 6.7 *Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed* | | | | |

P1.6 Exam Questions – 40 marks, 40 minutes.

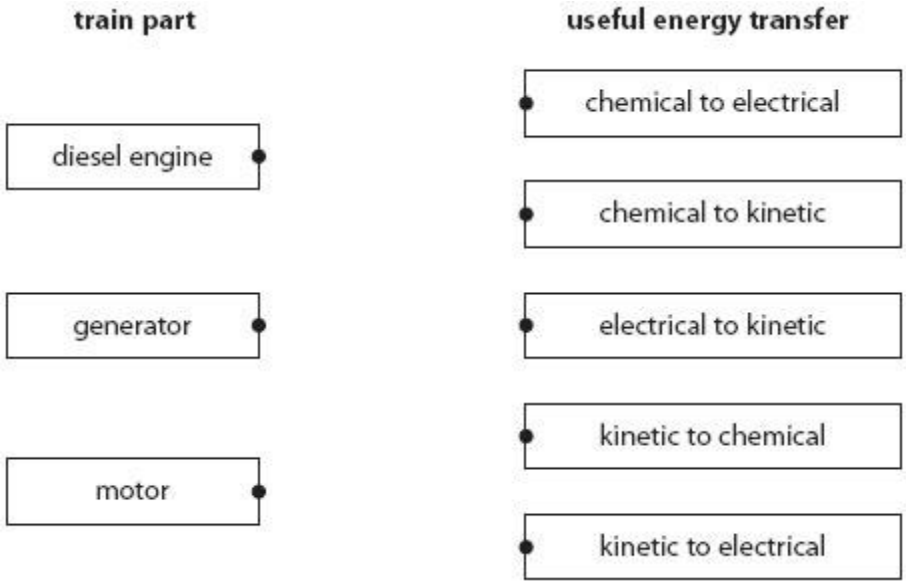
**Q30.**

(a) A train is powered by a diesel engine.
The diesel engine is used to turn a generator.
The generator provides electricity for electric motors which drive the wheels.




(i) Draw one straight line from each train part to its useful energy transfer.

**(3)**




(ii) State **one** example of a non-useful energy transfer in the motor.

**(1)**

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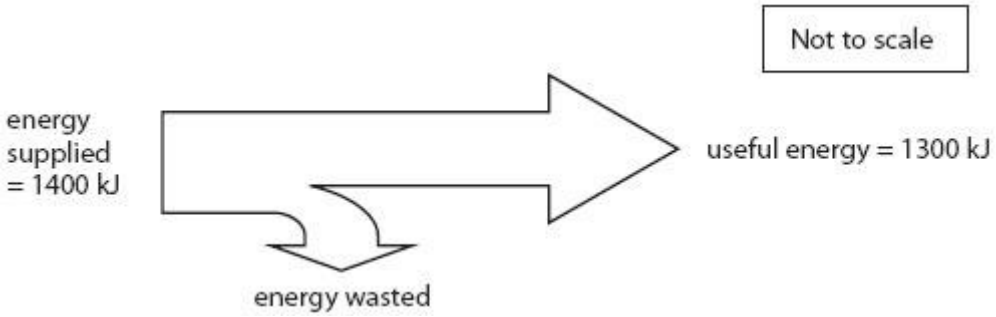
(b) The diagram represents the energy transfer in one second in the generator.




(i) Calculate the amount of energy wasted in one second in the generator.

**(1)**

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(ii) Calculate the efficiency of the generator.

**(2)**

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(c) The electric motors which drive the wheels are painted black.
Suggest why the motors are painted black.

**(1)**

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**(Total for Question is 8 marks)**

**Q31. Energy transfers**

Some students carry out investigations with an electric motor.

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

The students read the statement: 'All the energy supplied to the motor eventually ends up as thermal energy in the surroundings.'

This statement best describes the idea of

**(1)**

- ☒ **A** renewable energy
- ☒ **B** energy efficiency
- ☒ **C** sustainable energy sources
- ☒ **D** conservation of energy

(b) The students use the electric motor to lift a weight.

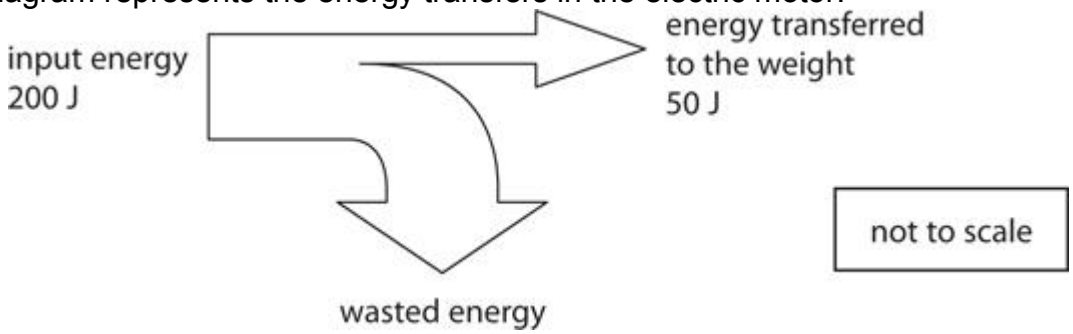
The current in the motor is 0.5 A.
The potential difference (voltage) across the motor is 6 V.

Calculate the input power to the motor.
State the unit.

**(3)**

input power = ..... unit = .....

(c) The diagram represents the energy transfers in the electric motor.




(i) How much energy is wasted?

**(1)**

wasted energy = ..... J

(ii) Calculate the efficiency of the motor.

**(2)**

efficiency = .....

(d) The case of the motor is painted black.

Give a scientific reason why the case of the motor is painted black.

**(1)**

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**Q32.**

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)**

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

**(1)**

☒ **A** current
☒ **B** energy
☒ **C** voltage
☒ **D** charge

(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)**

energy supplied to the motor =. . . . . .J

(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)**

efficiency =.... . . . . .%

(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.

This statement is one example of the idea of

**(1)**

- ☒ **A** renewable energy
- ☒ **B** conservation of energy
- ☒ **C** non-renewable energy
- ☒ **D** sustainable energy

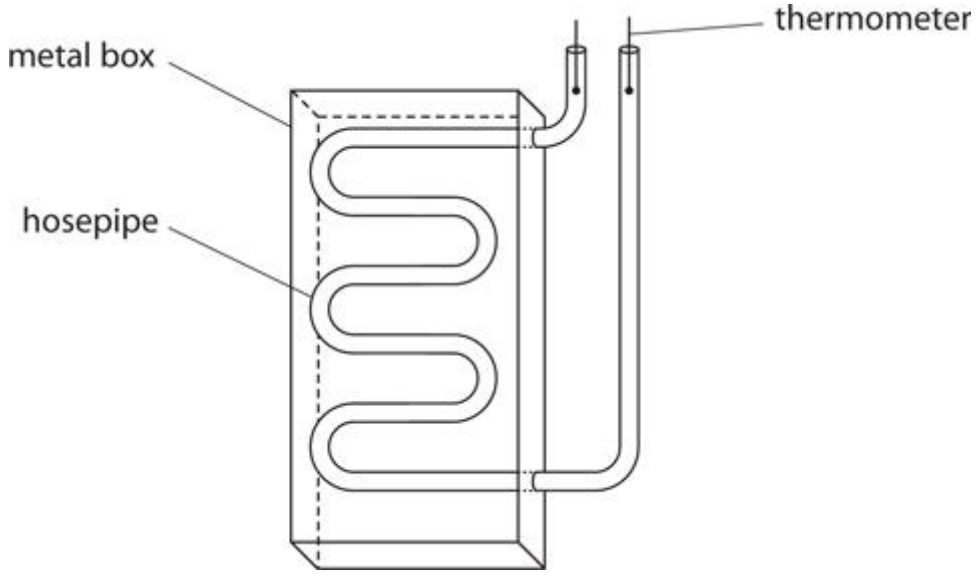
**(Total for Question = 8 marks)**

**Q33. Solar heater**

A student makes a solar water heater using a hosepipe.

He paints the hosepipe black and fills it with water.

He coils the hosepipe and fixes it into an open metal box as shown.




The student puts a thermometer in each end of the hosepipe.

The Sun shines on the hosepipe and heats the water.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.
The hosepipe is painted black because blackened surfaces are

**(1)**

- ☒ **A** good emitters of radiation
- ☒ **B** poor emitters of radiation
- ☒ **C** good absorbers of radiation
- ☒ **D** poor absorbers of radiation

(b) At first, the temperature of the water in the pipe increases.

After a while, the temperature becomes constant.

(i) Suggest **two** changes to the box which would increase the constant temperature reached.

**(2)**

1 .....

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2 .....

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(ii) Explain why the water reaches a constant temperature.

**(3)**

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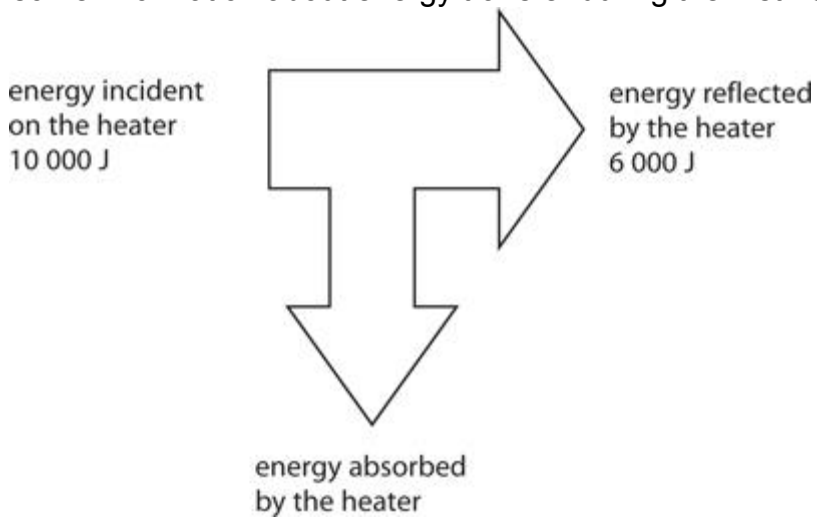
(c) Some of the solar energy incident on the solar water heater is reflected.

The rest is absorbed.

The diagram gives some information about energy transfer during the first 200 s.




Calculate the power absorbed by the heater.

**(2)**

power =..... W

**Q34. Using energy**

The photograph shows a treadmill in a gym.

The display on the treadmill indicates how much energy the boy is 'burning'.

(a) The boy is running on a horizontal surface.

Which of these energy transfers best describes the energy 'burn'?
Put a cross (☒) in the box next to your answer.

**(1)**

- ☐ **A** chemical energy to electrical energy
- ☐ **B** chemical energy to kinetic energy
- ☐ **C** electrical energy to chemical energy
- ☐ **D** electrical energy to gravitational potential energy

(b) The rollers on the treadmill are powered by an electric motor.
The motor is connected to a 230 V mains supply.
The current in the motor is 3.50 A.
Show that the power input to the motor is about 800 W.

**(2)**

(c) Not all of the 800 W is used to turn the rollers.

150 W is wasted.

(i) Calculate the power used to turn the rollers.

**(1)**

power = ..... W

(ii) Calculate the efficiency of the motor.

**(2)**

efficiency = .....

(d) Most of the wasted power is thermal.
The motor runs at a steady speed.
The motor begins to warm up.
Explain what happens to the temperature of the motor as the motor continues to run.

**(2)**

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## Top ten tips

Tip 1: Plan your revision

Create a realistic and well-presented timetable which you will adhere to. Include exam dates and deadlines for coursework. Add in sports/social/family commitments. Show it to your parents; get them to add in dates you might not know about.

If you have a block of exams, plan for them. If you have three exams in three days, you will need to be prepared to walk into the last exam before you walk into the first. For block exams create one page revision reminder notes which allow you to review the whole course in a short space of time.

Give priority to the exams which are worth the most to you, or you need to spend the most time on.

Tip 2: get a revision guide for your course

Tip 3: print off all the past papers AND mark schemes possible. Use half the papers during revision, and half to test your knowledge throughout.

Tip 4: Contact your teacher so they can help when you get stuck (a lot)

Tip 5: get the right environment:

- no distractions (no music, Facebook, tv, family and friends)
- not too hot (cold temperature keeps your body awake open a window if necessary)
- comfortable
- space or organisation (don't get your papers all muddled up)
- paper to write notes
- pens/pencils

Tip 6: Segment your revision of a subject. Don't try to revise all of the subject at once. Select one section, revise it, learn it, and find all the questions you can on that knowledge to test it.

Tip 7: Revise smart. Don't revise for more than your brain can cope with. You need to be aware of when it has stopped going in. I always found around 40-50 mins hard-core revision was the most useful time. Then take short useful breaks, use a different part of your brain, try doing something physical (don't get onto blackops as you won't get off it again). Take 10 minute breaks.

Tip 8: Nap!, believe it or not, you will boost the amount you can learn in one day by 30%+ just by taking short naps (10-20 mins). Set an alarm though! This is because what you have learnt goes from your long term to your short term memory

Tip 9: Don't think you know it, test it. Doing questions is the only way of testing your application of knowledge. This is easier in some subjects than others. Science and Maths there is no excuse for not doing loads of practise questions. Mark those questions using answers, check you have answer before even attempting questions as it will be useless otherwise.

Tip 10: follow my previous nine tips