Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCSE in Physics (1PH0)
Higher

Resource Set Topic C – Test 2: Waves, Light and the Electromagnetic Spectrum

Questions

(Public release version)

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Additional Assessment Materials, Summer 2021
All the material in this publication is copyright
© Pearson Education Ltd 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

2 (a) A student investigates what happens when light travels from air to glass.

Figure 2 shows some of the apparatus used in the investigation.

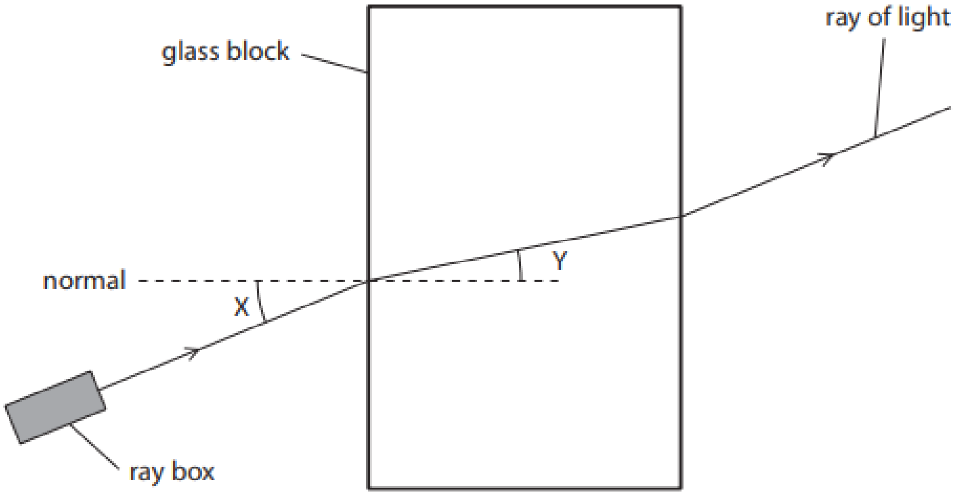


Figure 2

(i) In Figure 2, angle Y is the angle of

(1)

☐ **A** deflection

☐ **B** incidence

☐ **C** reflection

☒ **D** refraction

(ii) Figure 3 is a graph of the student's results.

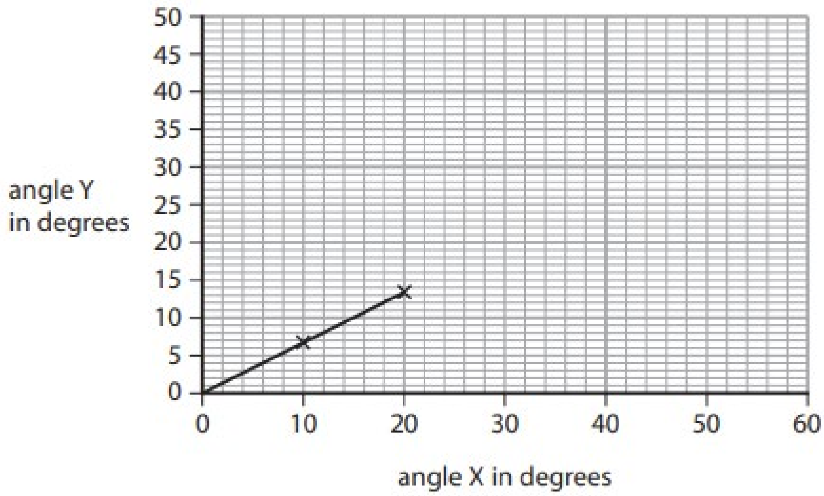


Figure 3

Use the graph to calculate a value for

$$\frac{\text{angle Y}}{\text{angle X}}$$

(2)

$\frac{13}{20} = 0.65$

$\frac{\text{angle Y}}{\text{angle X}} =$ 0.65

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

Repeat the experiment over many angles larger than 20 degrees and add those reading to the graph.

(b) The speed of light is 3.0×10^8 m/s.

The wavelength of yellow light is 5.8×10^{-7} m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

$$\text{frequency} = \frac{\text{speed}}{\text{wavelength}}$$

(3)

$= \frac{3 \times 10^8}{5.8 \times 10^{-7}} = 5.17 \times 10^{14}$

$\approx 5.2 \times 10^{14}$

frequency = 5.2×10^{14} unit Hz

5 (a) Figure 7 shows a tuning fork.

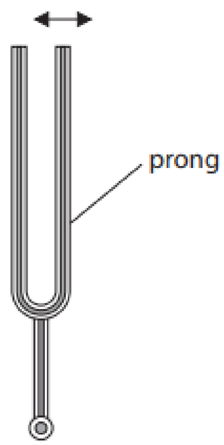


Figure 7

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 7.

Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

The prong causes the air particles to vibrate parallel to the direction in which the wave travels producing a longitudinal wave.

(b) The following descriptions describe waves from different parts of the electromagnetic spectrum.

Complete each description by adding the name of the wave.

Use the name of each wave only once. Each description refers to a different part of the electromagnetic spectrum.

(4)

Description 1

used in cooking

used in short-range communication

typical wavelength 900 nm

name of wave Infrared wave

Description 2

used in cooking

used in communication

typical wavelength 150 mm

name of wave Microwave

Description 3

used in communication

produced by oscillations in electrical circuits

typical wavelength 150 m

name of wave Radio wave

Description 4

used in medical scanning

is emitted by the nucleus of an atom

typical wavelength 2.0×10^{-3} nm

name of wave Gamma wave

(c) When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.

Explain, in terms of speed, why the light behaves like this.

(3)

Different colors of light have different wavelengths and hence travel at different speeds. Due to this the colors refract at different amounts at the boundary, causing white light to split into the separate colors that it is created of.

8 (a) A student investigates how different surfaces radiate energy as they cool.

Figure 9 shows some of the apparatus used in a part of the investigation.

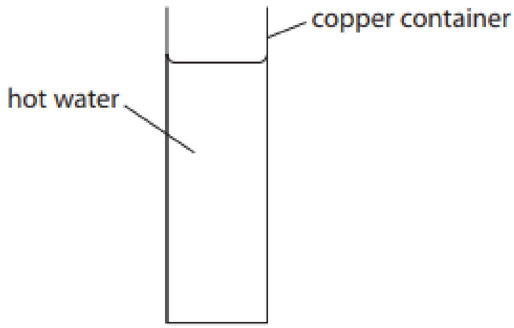


Figure 9

Describe how the student could collect data to show how the rate of cooling of the container and water change with time.

(2)

Use a thermometer to measure the initial temperature and temperatures at regular intervals over time.

(b) Figure 10 is a graph of intensity against wavelength for the electromagnetic radiation emitted by a halogen lamp.

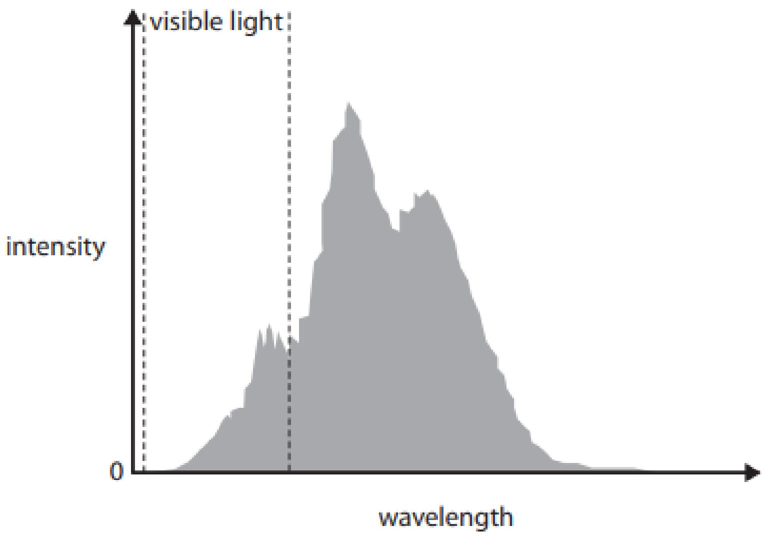


Figure 10

Describe how the intensity of the radiation varies with wavelength in Figure 10.

(2)

Intensity increases non-linearly and comes to a maximum after wavelength corresponding to visible light spectrum.

(c) Figure 11 is a graph of temperature against time for a halogen lamp for the first 120 ms after it has been switched on.

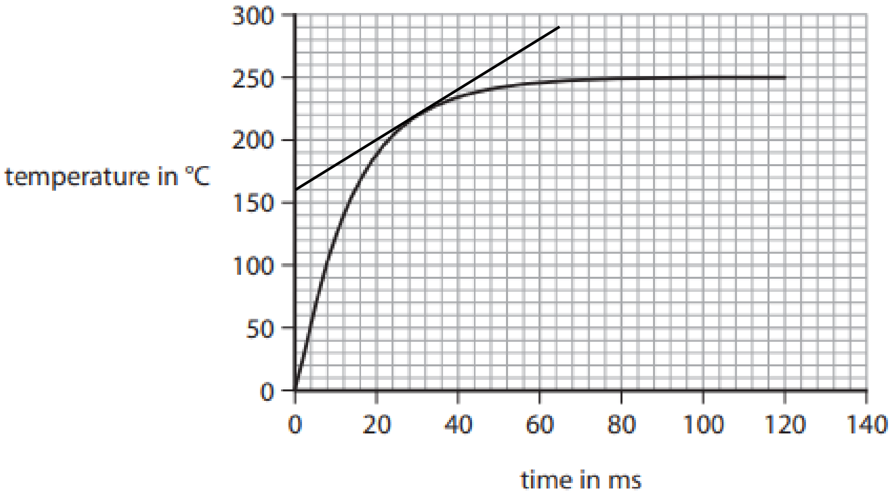


Figure 11

(i) Calculate the gradient of the graph at a time of 30 ms.

State the unit.

(4)

$$\frac{280-160}{60} = \frac{12\not{0}}{6\not{0}}$$

gradient = 2 unit °C /ms

(ii) Explain why the temperature of the lamp rises and then remains at a constant value.

(3)

The temperature increases because the rate of energy supplied is greater than the rate of energy radiated by the lamp. As the time increases, the rate of energy radiated from the lamp becomes equal to the rate at which energy is supplied. Hence the temperature remains constant.

2 (a) Which colour of visible light has the longest wavelength?

(1)

- ☐ **A** blue
- ☐ **B** green
- ☒ **C** red
- ☐ **D** yellow

(b) Some television remote controls use infrared radiation and other remote controls use radio waves.

Explain why an infrared remote control may not switch on the television from behind an armchair but a radio wave remote control always will.

(2)

Infrared needs a direct line of sight and is easily absorbed by materials (eg: the armchair).

(c) Figure 2 is a diagram of a water wave.

A cork is floating on the water.

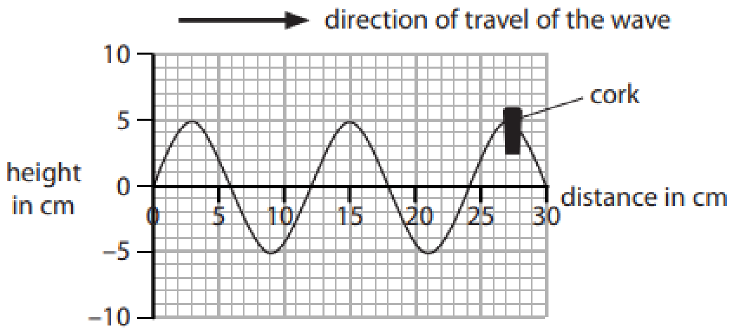


Figure 2

(i) Use the scale on the diagram to measure the wavelength of the wave.

(2)

$\frac{30}{2.5} = 12$

wavelength = 12 cm

(ii) Describe the motion of the cork.

You should include how the cork moves relative to the direction of travel of the wave.

(2)

The cork oscillates perpendicular to the direction of motion of the wave.

(d) A different water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.

Calculate the wave speed.

(2)

$v = f\lambda$

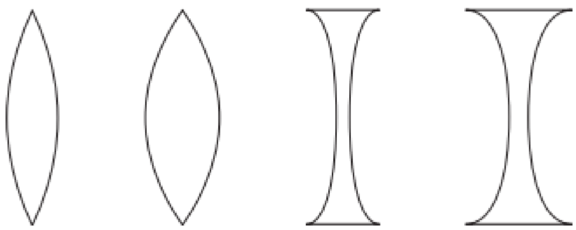
$= 1.5 \times 0.25$

$= 0.375$

wave speed = 0.375 m/s

4 (a) (i) Which lens is a converging lens with the greatest power?

(1)



☐ **A** ☒ **B** ☐ **C** ☐ **D**

(ii) The equation that relates the power of a lens to the focal length of the lens is

$$\text{power (in dioptres)} = \frac{1}{\text{focal length (in metres)}}$$

The power of a lens is 5 dioptres.

Use the equation to calculate the focal length of the lens in cm.

(2)

$$5 = \frac{1}{\left(\frac{L}{100}\right)}$$

$$\frac{L}{100} = \frac{1}{5}$$

$$L = \frac{1}{5} \times 100 = 20$$

focal length = 20 cm

(b) Figure 3 shows a semicircular glass block.

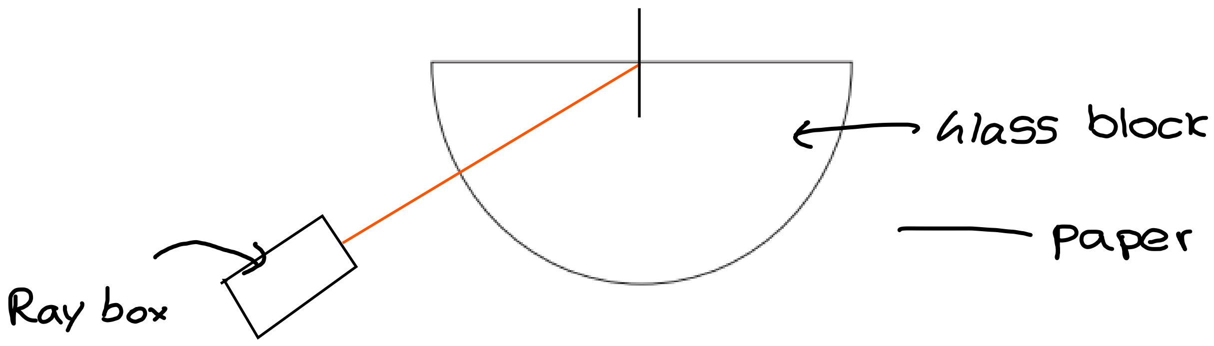


Figure 3

Describe how a student could use the semicircular glass block and other apparatus to determine the critical angle for a glass-air boundary.

You should add to the diagram in Figure 3 to help with your answer.

(4)

Keep the block on paper and draw round its outline. Use a ruler to measure the length of the flat side and mark the mid-point with a cross. Draw a normal line through this cross. Use a ray box to direct the incident ray through the curved surface towards the mid-point, and change the angle of incidence until the refracted ray passes parallel to the flat side of the block. Mark the entry point of the incident ray on the curved surface with a cross, then remove the block, join the crosses to draw the path of the ray, and measure the incident angle between this line and the normal. This is equal to the critical angle

9 (a) Some sunglasses have photochromic lenses.

Photochromic lenses are clear when the lenses are indoors but they darken in bright sunlight to reduce the effects of the sunlight.

Photochromic lenses react to ultraviolet light.

Suggest a benefit of making the lenses go dark with ultraviolet light.

(1)

Protect eyes from ultraviolet radiation.

(b) Radio waves from Jupiter take 40 minutes to reach Earth.

Light waves from the Sun take 8 minutes to reach Earth.

Calculate how many times further it is from Earth to Jupiter than from Earth to the Sun.

State the property of electromagnetic radiation that is used in your answer.

(2)

$$s = \frac{d}{t}$$

Jupiter $3 \times 10^8 = \frac{d_J}{40 \times 60}$

Sun $3 \times 10^8 = \frac{d_S}{8 \times 60}$

$$\frac{d_J}{d_S} = \frac{3 \times 10^8 \times 40 \times 60}{3 \times 10^8 \times 8 \times 60}$$

$$= \frac{40}{8}$$

5 times

property All electromagnetic waves travel at equal speeds in a vacuum (space)

(c) Ultraviolet waves cover a range of frequencies.

Scientists divide this range into three types, UVA, UVB and UVC.

The table in Figure 14 shows the frequency range for each type.

type	frequency range in Hz
UVA	7.5×10^{14} to 9.4×10^{14}
UVB	9.4×10^{14} to 10×10^{14}
UVC	10×10^{14} to 30×10^{14}

Figure 14

Figure 15 is a diagram about the effect that the Earth's atmosphere has on three types of ultraviolet radiation.

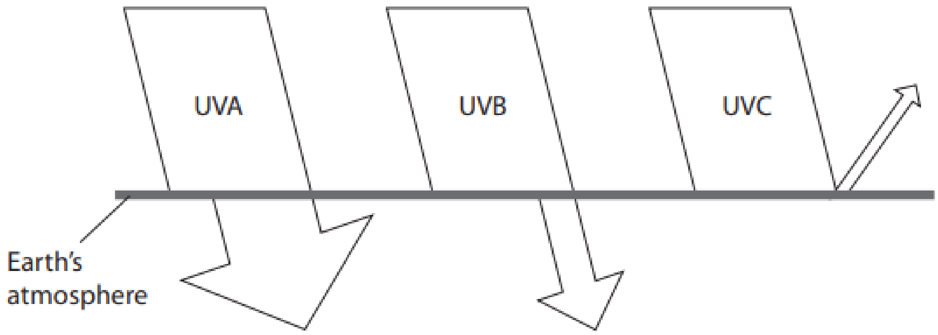


Figure 15

Describe how the effects change with **wavelength**, using information from Figure 14 and Figure 15.

The width of the arrows drawn indicates the amount of radiation that is involved.

Calculations are **not** required.

(4)

UVA is lightly absorbed while UVB is mostly absorbed but some UVB are transmitted. However, UVC is mostly absorbed and not transmitted through the atmosphere. A trend is seen where higher wavelengths are absorbed less and are mostly transmitted through.

*(d) Radio waves and gamma radiation are at opposite ends of the electromagnetic spectrum.

Compare how these two electromagnetic radiations are produced.

(6)

Radio waves are produced by oscillation in electrical circuits due to information in the form of alternating currents. Gamma rays are produced by changes in the nucleus of an atom, which tend to have a lower wavelength and higher frequency than radio waves.

TOTAL FOR PAPER IS 58 MARKS