4.3 Wave Characteristics

Question Paper

Course	DP IB Physics
Section	4. Waves
Topic	4.3 Wave Characteristics
Difficulty	Easy

Time allowed: 60

Score: /43

Percentage: /100

Question 1a

(a)
Outline what is meant by the terms

(i)
Wavefront

[2]

(ii)
Ray

[1]

[3 marks]

Question 1b

(b)
Complete the following sentence by placing a tick (✓) next to the correct answer:

The distance between two consecutive wavefronts is equal to the:

	wavelength
	frequency
	amplitude

[1]

[1 mark]

Question 1c

(c)
On the grid below, draw scale diagrams showing the wavefronts for

(i)
A plane wave with a wavelength of 1 cm.

[2]

(ii)
A circular wave with a wavelength of 1 cm.

[2]

On both diagrams, show with arrows, the direction of propagation.

[4 marks]

Question 1d

(d)
Complete the following sentences by circling the correct word:

The higher the frequency of an oscillation, the **longer / shorter** the wavelength and the **closer / further apart** the wavefronts are **to / from** one another.

The lower the frequency of the oscillation, the **longer / shorter** the wavelength and the **closer / further apart** the wavefronts are **to / from** one another.

[2]

[2 marks]

Question 2a

(a)
Match the terms power and intensity to their correct definitions and SI units.

Power	$J\ s^{-1}$
Intensity	$J\ s^{-1}\ m^{-2}$

The rate of energy transfer per unit area
The rate of energy transfer

[2]

[2 marks]

Question 2b

A point source radiates light waves in all directions. The intensity, *I*, of the waves is related to the power, *P*, by the equation:

$$I = \frac{P}{4\pi r^2}$$

The relationship between the distance from the point source, *r*, and the intensity of the wave are shown to follow an inverse square law.

(b)
Describe what is meant by the term inverse square law in this context.

[2]

[2 marks]

Question 2c

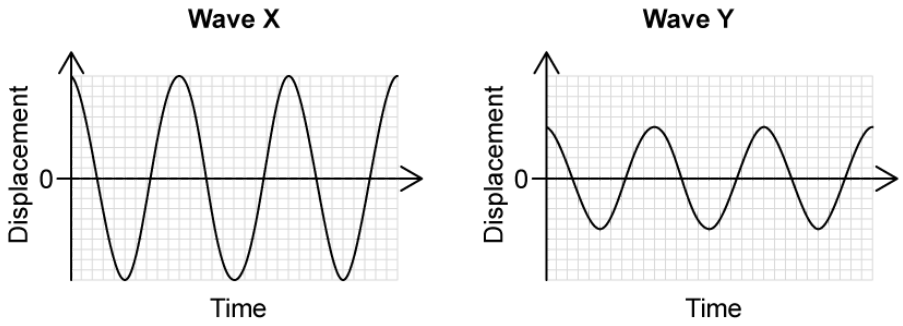
(c)
Describe the relationship between intensity, *I*, and amplitude, *A*.

[2]

[2 marks]

Question 2d

Two students are investigating the relationship between intensity and amplitude. The graphs below show the variation of the displacement of a particle with time when two progressive waves X and Y pass separately through a medium.



The intensity of wave X is I_0. Student 1 says that the intensity of wave Y must be $\frac{I_0}{2}$ but Student 2 thinks it must be $\frac{I_0}{4}$.

(d)
Determine, using the relationship from part (c), which student is correct.

[2]

[2 marks]

Question 3a

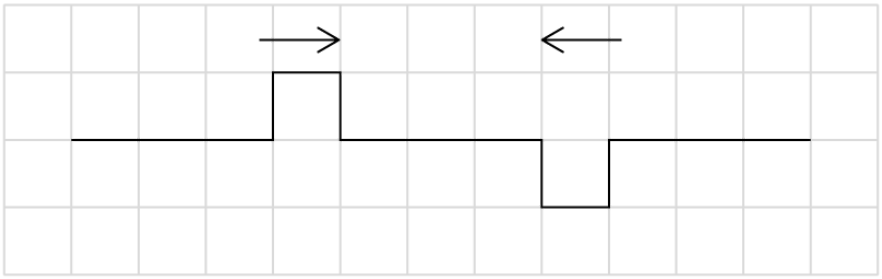
(a)
Outline what is meant by the principle of superposition.

[2]

[2 marks]

Question 3b

Two pulses travel toward one another as shown in the diagram.



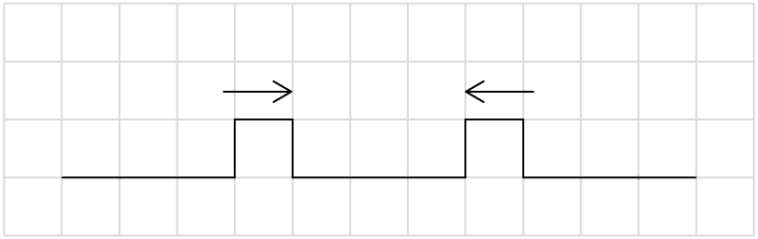
(b)
Sketch the resultant displacement as the pulses superpose.

[1]

[1 mark]

Question 3c

Two pulses travel in opposing directions as shown in the diagram. When the pulses meet, they superpose.



(c)
Draw the resultant peak as the pulses superpose.

[1]

[1 mark]

Question 3d

(d)
Distinguish between the terms constructive interference and destructive interference.

[4]

[4 marks]

Question 4a

(a)
Distinguish between the terms polarised and unpolarised light.

[2]

[2 marks]

Question 4b

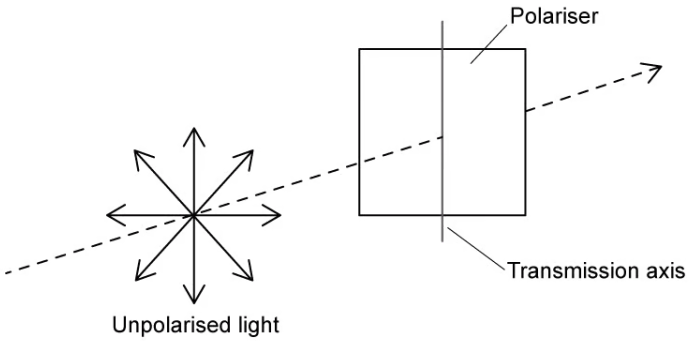
(b)
Outline the reason why a sound wave cannot be polarised.

[2]

[2 marks]

Question 4c

Unpolarised light is passed through a polariser as shown in the diagram.



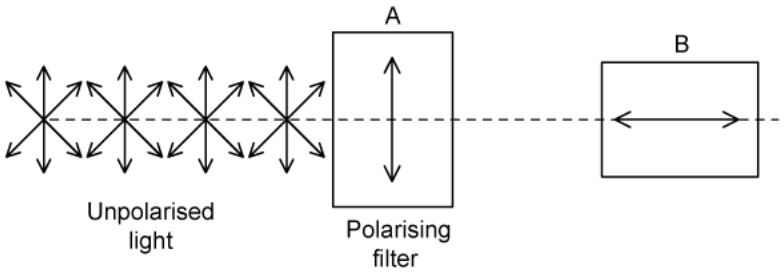
(c)
Draw a double-headed arrow to indicate the resultant orientation of the polarised light.

[1]

[1 mark]

Question 4d

Polarised light is passed through polarising filter A as shown in the diagram.



An identical polarising filter B is placed directly after A at 90°.

(d)
State and explain what happens to the intensity of the light after it is incident on polarising filter B.

[3]

[3 marks]

Question 5a

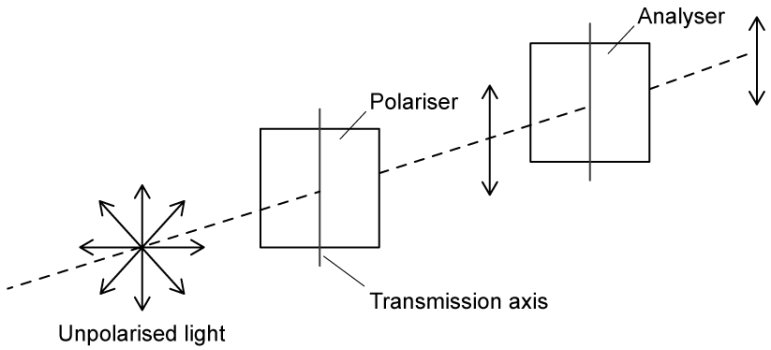
(a)
Outline the change in intensity of the incident unpolarised light as it passes through a polariser.

[1]

[1 mark]

Question 5b

Unpolarised light is passed through a polarising filter as shown in the diagram. A second polarising filter called an analyser is placed in sequence.



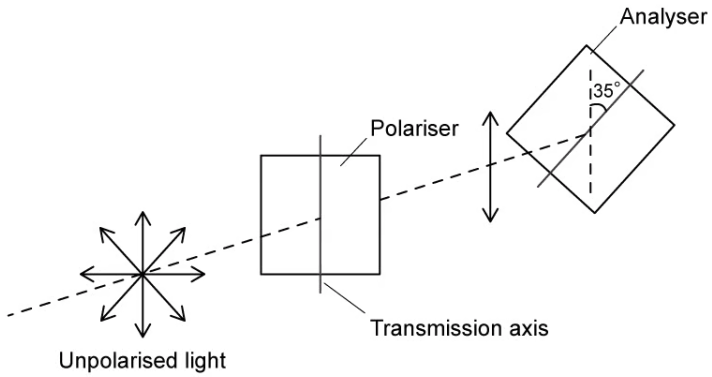
(b)
Compare the intensity of the analysed light to the intensity of the unpolarised light.

[1]

[1 mark]

Question 5c

Unpolarised light with intensity $I_0 = 20\ W\ m^{-2}$ is incident on the polariser. The analyser is rotated so that the transmission axis is at an angle of 35° compared to the vertical axis of the polariser.



(c)
Calculate the intensity of the analysed light.

[3]

[3 marks]

Question 5d

Polaroid sunglasses use polarisation to reduce glare.

(d)
Choose suitable words and phrases to complete the following passage:

When unpolarised light is **reflected / refracted** from smooth non-metallic surfaces, **partial / total** plane polarisation occurs. Light is then polarised in a plane **perpendicular / parallel** to that surface.

Most surfaces around us are horizontal, therefore, most of the **reflected / refracted** light is polarised in the **vertical / horizontal** plane.

Polaroid sunglasses have a vertical transmission axis, which means that only light oscillating in the **vertical / horizontal** plane will be transmitted.

This greatly reduces the glare from **reflective / refractive** surfaces, such as water, allowing the wearer to see objects beneath the surface of the water more clearly.

[4]

[4 marks]