

4.3 Wave Characteristics

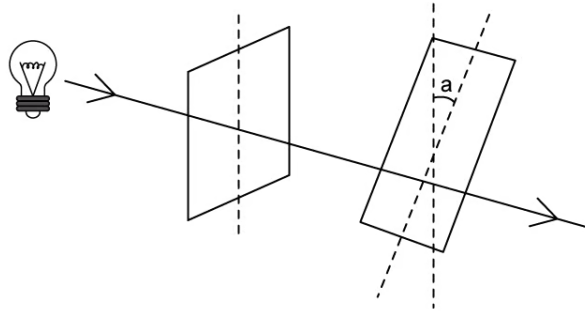
Question Paper

Course	DPIB Physics
Section	4. Waves
Topic	4.3 Wave Characteristics
Difficulty	Medium

Time allowed: 20
Score: /10
Percentage: /100

Question 1

An unpolarised electromagnetic wave passes through 2 polarisers. The second polariser is at a clockwise angle a to the vertical.



When $a = 225^\circ$ what percentage of the unpolarised light is transmitted through both filters?

- A. 25%
- B. 50%
- C. 12.5%
- D. 6.25%

[1 mark]

Question 2

Cinema 3D glasses have polarising lenses aligned 90° from each other. The left eye contains a horizontal polariser and the right lens contains a vertical polariser.



A person stands in front of a mirror and closes their left eye.

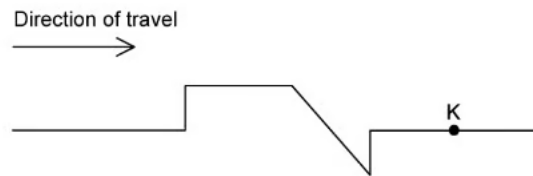
How do the glasses appear in the mirror?

- A. Both lenses black
- B. The left lens is black
- C. The right lens is black
- D. Both lenses are clear

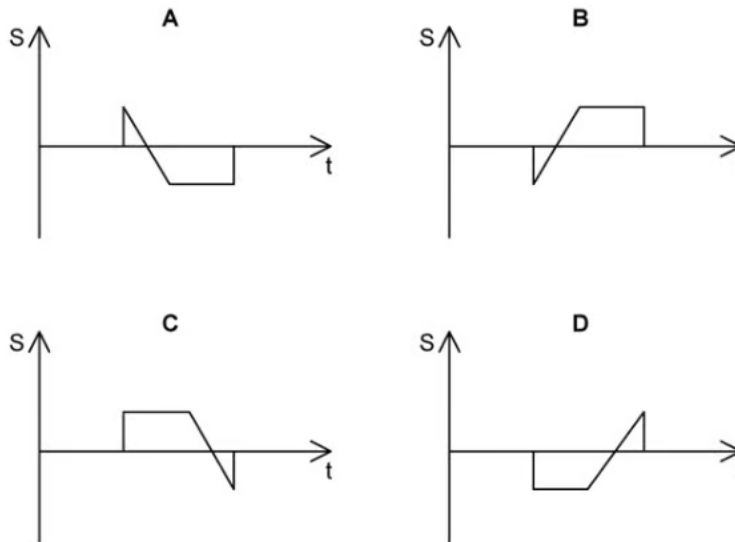
[1 mark]

Question 3

The diagram shows a wave moving along a rope under tension in the direction shown.



Which of the following graphs, **A** to **D**, correctly shows the variation of displacement s with time t of the particle **K** in the rope?



[1 mark]

Question 4

Plane-polarised electromagnetic waves of radio frequency are transmitted by a vertical aerial and have an amplitude A . They are received by a second aerial rotated at angle θ compared to the transmitting aerial.

Which of the following expressions is proportional to the power received by the second aerial?

- A. $A \cos \theta$
- B. $A \cos^2 \theta$
- C. $A^2 \cos^2 \theta$
- D. $A^2 \cos \theta$

[1 mark]

Question 5

A beam of plane-polarised light of intensity I is incident at right-angles to a polariser. The transmitted light has an intensity of $\frac{1}{4}I$.

What is the angle, θ , between the plane of polarisation of the incident light and the polariser?

Use the values in the table to help.

Degrees	0°	30°	45°	60°	90°	180°	360°
Radians	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	π	2π
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	0	0
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	-1	1
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undefined	0	0

A. 30°

B. 45°

C. 60°

D. $\sqrt{\frac{2}{3}}$ °

[1 mark]

Question 6

A wave has frequency f , intensity I and amplitude A . The intensity of a wave is proportional to the square of the frequency.

A second similar wave has frequency $2f$ and amplitude $\frac{1}{3}A$.

Which of the following is an expression for the intensity of the second wave, I_2 ?

A. $\frac{2}{9}I$

B. $\frac{2}{3}I$

C. $\frac{3}{2}I$

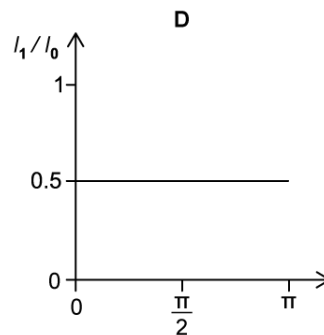
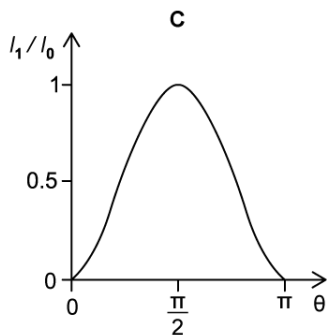
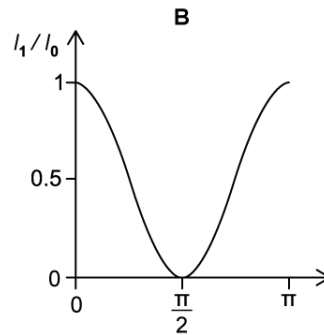
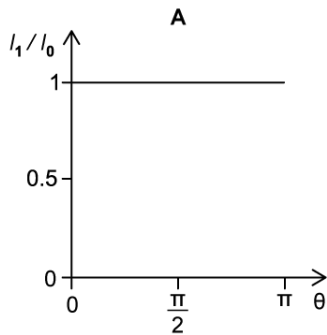
D. $\frac{4}{9}I$

[1 mark]

Question 7

Light from a lamp is incident on a polarising filter that has a horizontal transmission axis. The incident light has intensity I_0 and the transmitted light has intensity I_1 . The filter is rotated by 2π .

Which graph correctly shows the variation of the ratio $\frac{I_1}{I_0}$ with angle θ ?



[1 mark]

Question 8

Identify the pair of statements which are always true for electromagnetic waves

A.	Always travel at the same speed in a vacuum	Always obey the inverse square law
B.	Can undergo plane polarisation	Consist of electric and magnetic fields which have constant amplitude
C.	Have predictable reduction in intensity when passed through a polarising filter	Always travel at the same speed in a vacuum
D.	Consist of electric and magnetic fields which transfer energy	Are always polarised

[1 mark]

Question 9

The intensity of radiation from a star is given by I_0 . The intensity of light at the surface of one of its planets, a distance r from the star is $0.25I_0$. The distance between the star and a second planet is $3r$.

What is the intensity of light from the star on this second planet?

A. $\frac{I_0}{36}$

B. $\frac{I_0}{12}$

C. $\frac{I_0}{9}$

D. $\frac{4I_0}{9}$

[1 mark]

Question 10

Light from the sun reflects off the surface of a pond. Some of the light continues into the water where it is refracted.

Which line in the table gives the correct nature of the reflected and refracted light?

	Reflected	Refracted
A.	unpolarised	completely plane polarised
B.	completely plane polarised	completely plane polarised at right angles to the reflected light
C.	partially plane polarised	unpolarised
D.	completely plane polarised	partially plane polarised

[1 mark]