STEM SMART Phase One, 2022

Physics Week 10 – Wave properties & Phase

https://isaacphysics.org/gameboards#smart_p_1_10

Essential GCSE Physics 38.2

GCSE - Practice (P1)
A Level - Practice (P1)

A musical note has a frequency of $440\,\mathrm{Hz}$. The speed of sound in air is $330\,\mathrm{m/s}$.

Part A Wavelength

What is the wavelength of the sound?

Part B Time period

What is the time period of the sound?

Essential GCSE Physics 38.18

GCSE - Practice (P1)
A Level - Practice (P1)

What is the wavelength of a radio station which sends out radio waves of frequency $1.15\,\mathrm{MHz}$?

Essential Pre-Uni Physics D1.7

GCSE - Challenge (C3)
A Level - Challenge (C1)

Part A Light intensity at $12\,\mathrm{m}$

The light from a bulb shines equally in all directions. If $20\,\mathrm{W}$ of light is given off, what will the intensity be $12\,\mathrm{m}$ from the lamp to 2 significant figures? (Consider the shape of the region illuminated if the light hits this surface after travelling $12\,\mathrm{m}$ in all directions.)

Part B Light intensity at $24\,\mathrm{m}$

What would the answer be at a distance of $24\,\mathrm{m}$, to 2 significant figures?

Essential Pre-Uni Physics D1.8

GCSE - Challenge (C3)
A Level - Challenge (C1)

The Sun is $1.5 \times 10^{11}\,\mathrm{m}$ from the Earth. If the power incident on Earth is approximately $1.0\,\mathrm{kW\,m^{-2}}$, calculate the total power (luminosity) of the Sun. Give your answer in watts.

Essential Pre-Uni Physics D2.1

A Level - Practice (P2)

For each polariser, the angle given is the one for which light is transmitted and is given clockwise from the vertical.

Horizontally polarised light is shone on a polariser that is angled at $35\,^{\circ}$ to the vertical. If the incoming light has amplitude $200\,\mathrm{V\,m^{-1}}$ and intensity $53\,\mathrm{W\,m^{-2}}$, work out:

Part A Amplitude

a) the amplitude of the transmitted light;

Part B Intensity

b) the intensity of the transmitted light.

Essential Pre-Uni Physics D2.2

A Level - Practice (P2)

For each polariser, the angle given is the one for which light is transmitted and is given clockwise from the vertical.

Unpolarised light of intensity $4.0\,\mathrm{W\,m^{-2}}$ is incident on a polariser placed at $15\,^{\circ}$ to the vertical. State the intensity of the transmitted light.

Essential Pre-Uni Physics D3.1

A Level - Practice (P2)

Calculate the values indicated in the table. The speed of sound in air is $330\,\mathrm{m\,s^{-1}}$. All phases should be given as $< 360°$ and path differences should be $<$ 1 wavelength.

Wavelength	Path difference	Phase difference	Fully constructive interference (Y/N)	Fully destructive interference (Y/N)
$320\mathrm{mm}$	$160\mathrm{mm}$	(a)	(b)	(c)

Part A Phase difference

a) What is the phase difference in degrees?

Part B Fully constructive interference

b) Fully constructive interference?

- Yes
- No

Part C Fully destructive interference

c) Fully destructive interference?

- No
- Yes

Essential Pre-Uni Physics D3.5

A Level - Practice (P2)

Calculate the values indicated in the table. The speed of sound in air is $330\,\mathrm{m\,s^{-1}}$. All phases should be given as $< 360°$ and path differences should be $<$ 1 wavelength.

Wavelength	Path difference	Phase difference	Fully constructive interference (Y/N)	Fully destructive interference (Y/N)
$3.00\mathrm{m}$	$31.5\mathrm{m}$	(a)	(b)	(c)

Part A Phase difference

a) Phase difference in degrees?

Part B Fully constructive interference

b) Fully constructive interference?

- Yes
- No

Part C Fully destructive interference

c) Fully destructive interference?

- No
- Yes

Essential Pre-Uni Physics D3.7

A Level - Challenge (C2)

Two aerials are $2.50\,\mathrm{m}$ apart, and both are receiving the same radio signal with a frequency of $125\,\mathrm{MHz}$. The phase difference between them is measured as 114° .

Part A Path difference between aerials

Calculate the path difference between the two aerials.

Part B Bearing of the transmitter from the aerials

The aerial which receives the radio signal first is directly North of the one which receives the signal slightly later. What are the possible bearings of the transmitter from the receiving aerials? You may assume that the transmitter is many kilometres from the receiving aerials, and therefore that the paths of the waves travelling to the two receivers are effectively parallel when measured in the vicinity of the receiving aerials. Give your answer to 3 significant figures.

Essential Pre-Uni Physics D3.8

A Level - Challenge (C2)

Two speakers are set up $13.5\,\mathrm{m}$ apart in an auditorium, pointing at each other. A pure sound of frequency $256\,\mathrm{Hz}$ is being played through them. You may assume that the phase difference of the signals as they arrive at the speakers is 0° . A person is standing on the line joining the speakers, $0.25\,\mathrm{m}$ from the mid point.

The speed of sound in air is $330\,\mathrm{m\,s^{-1}}$.

Part A Phase difference

Calculate the phase difference as it would be detected by the person.

Part B Silence

The person moves to the mid point between the speakers (where the sound is loudest due to constructive interference), and then walks towards one speaker until the sound waves cancel out. How far do they walk until they find this point of near silence?