Advanced Higher Physics

Unit Title: Wave Phenomena

Practice Unit Assessment for Outcomes 1 and 2

Time: 30mins

Read carefully

1 All questions should be attempted.

2 Enter the question number clearly beside your answer to each question.

3 Care should be taken to give an appropriate number of significant figures in the final answers to calculations.

4 The following data should be used when required.

Speed of light in vacuum c	$3{\cdot}00 \times 10^{8}$ m s^{-1}	Planck's constant h	$6{\cdot}63 \times 10^{-34}$ J s
Speed of sound in air	340 m s^{-1}	Mass of electron m_e	$9{\cdot}11 \times 10^{-31}$ kg

Marks

1. (a) A travelling wave is represented by the expression

$$y = 3.5 \sin (62.8t - 1.25x)$$

where x and y are expressed in metres and t in seconds.

(i) Calculate the following for the travelling wave:

(A) the frequency in Hz;

(B) the wavelength.

(ii) The intensity of the wave doubles.

(A) Which of the quantities in the equation changes in value?

(B) Write down the equation which describes the wave with double the intensity.

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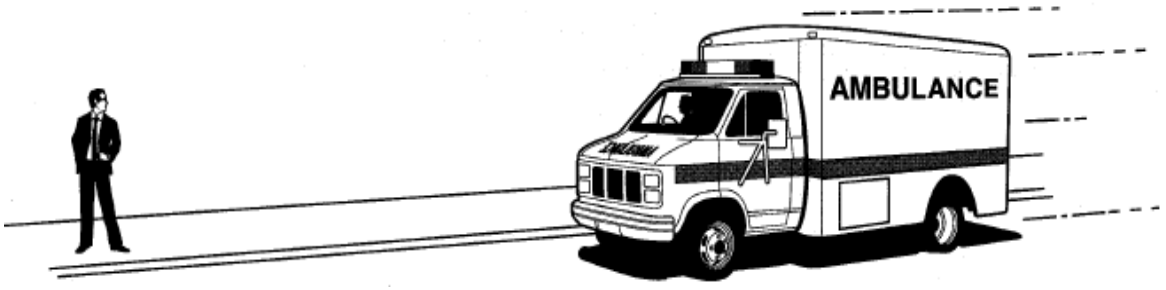
(b) An emergency vehicle, travelling at $22 ms^{-1}$, emits sound of frequency 1020Hz. The vehicle approaches a stationary pedestrian, as shown in the figure below.



The frequency detected by a stationary observer when a sound source moves relative to the observer is given by

$$f = f_s \frac{v}{v \pm v_s}$$

where the symbols have their usual meanings.

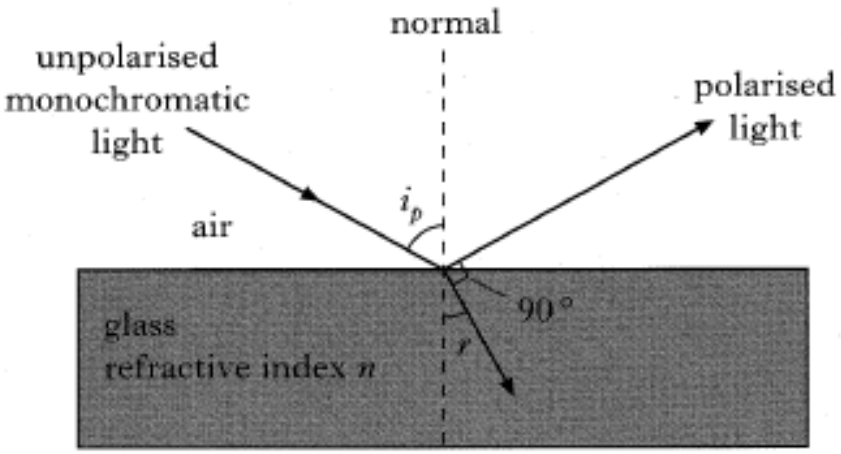
Calculate the frequency heard by the stationary pedestrian as the emergency vehicle approaches. **2**

(9)

Marks

2. (a) State the difference between polarised and unpolarised light

(b) Unpolarised monochromatic light is incident on a glass block of refractive index n at an angle i_p, as shown in the figure below.

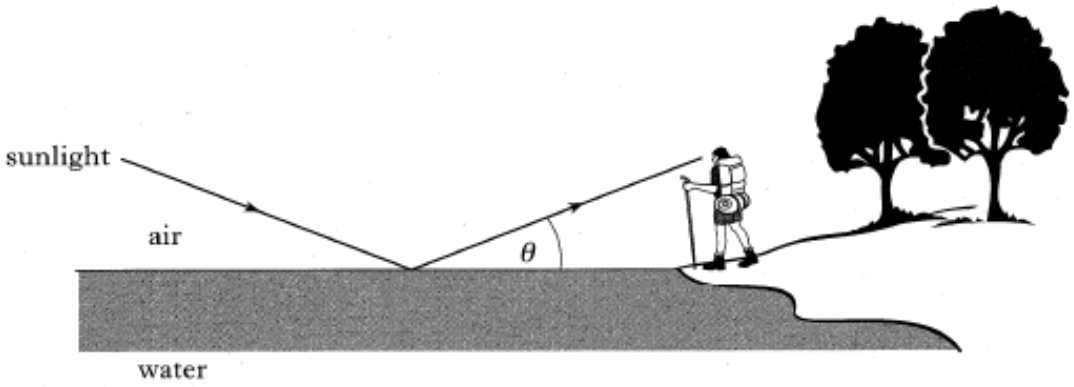


Light is refracted by the glass at an angle r and polarised light is reflected by the glass.

Derive the expression

$n = \tan i_p$ where i_p is known as Brewster's angle **2**

(c) Sunlight is reflected from the surface of a loch as shown in the figure below.



Calculate the angle θ at which the water reflects plane polarised light to the observer on the shore.

2

(5)

Marks

3. (a) Explain, **with the aid of a** diagram, how a thin coating on the surface of a camera lens can make it non-reflecting for monochromatic light at near normal incidence.

(b) Calculate the thickness of a layer of magnesium fluoride required to make the surface of a lens non-reflecting for light of wavelength 500nm.
(n = 1.38 for Magnesium Fluoride)

(c) When white light is incident upon a lens with this coating, a purple hue is observed in the reflected light. Explain how this colour effect is produced.

(6)

TOTAL: 20 Marks

Threshold of attainment for test = 12 marks (11·5 rounded)