

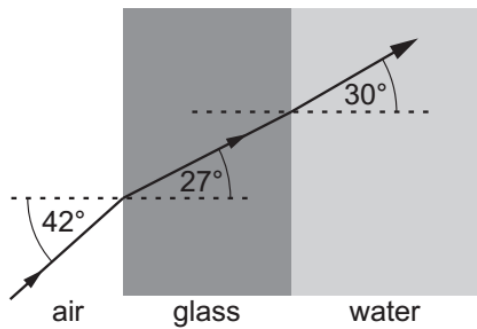
GCE AS Physics B

H157/01 Foundations of physics

Question Set 6

1.

A glass tank contains water. A ray of light travels from the air through the glass into the water as shown.



(a) Show that the speed of light in glass is about two-thirds of that in air. [2]

(b) Without calculation, explain what the diagram shows about the speed of light in water. [2]

2.

Fig. 2.1 shows an aeroplane flying horizontally and towing a flag.

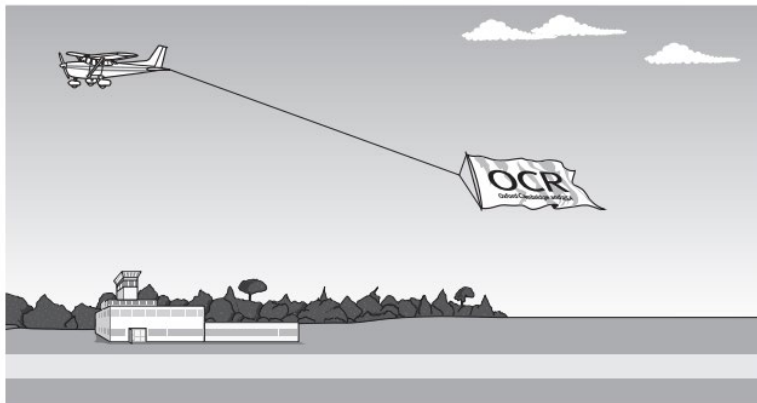


Fig. 2.1

The flag is attached to the aeroplane using a metal cable. **Fig. 2.2** shows that the cable is at an angle of 20° below the line of flight of the aeroplane.

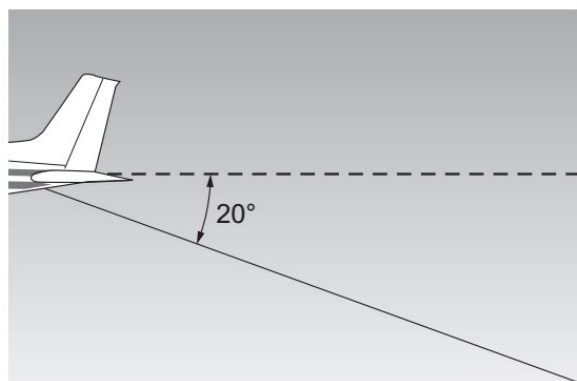


Fig. 2.2

(a) Show that the work done in towing the flag when the aeroplane travels 1 m in the line of flight is about 1.4 kJ. [2]

(b) Calculate the power required for towing the flag.

power = W [1]

(c) The diameter of the metal cable is 12 mm.
The Young modulus of the metal cable is 210 GPa.

(i) Calculate the operating stress in the cable during towing.

stress = Pa [3]

(ii) The breaking stress of the metal is 460 MPa.

Comment on the safety of the procedure. [1]

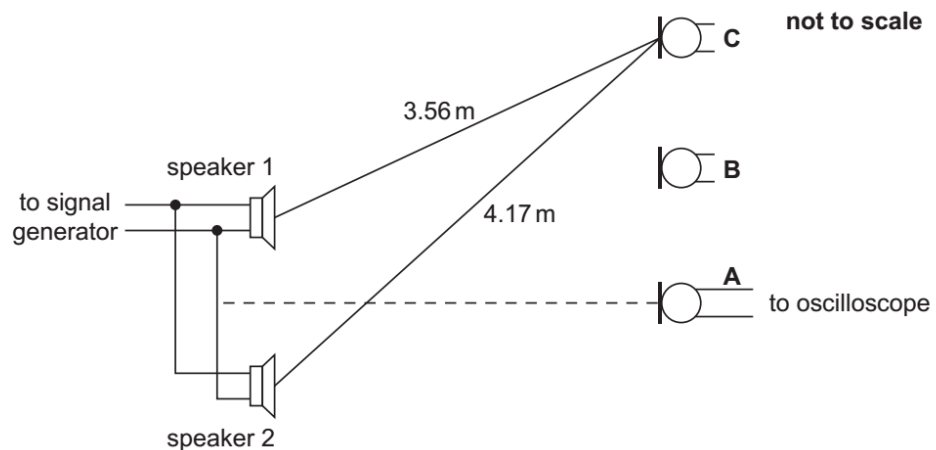
(iii) Calculate the strain in the cable.

strain = [2]

3.

A student is attempting to measure the wavelength of sound waves using interference.

She sets up the apparatus shown. There are **two** identical loudspeakers connected in parallel to a signal generator and a microphone connected to an oscilloscope.



The student finds that a maximum signal is measured with the microphone at position **A**.

She moves the microphone to position **B** where the signal is a minimum.

(a) Suggest one reason why it would be difficult:

(i) to locate position **B** precisely

[1]

(ii) to measure the distance between position **A** and the speakers precisely. [1]

(b) The student continues to move the microphone to position **C** where the signal is again a maximum.

(i) Calculate the wavelength of the sound waves. Show how you arrive at your answer.

wavelength = m [2]

(ii) Another student suggests a method for improving the wavelength measurement.

He suggests using a laser to measure the distance between the speakers and microphone very accurately.

Evaluate this suggestion in terms of the likely effect on the percentage error in the calculated wavelength. [2]

(c) The student measured the frequency of the sound wave at 560 ± 30 Hz. The uncertainties in the distances from each speaker to position **C** are ± 0.02 m.

Calculate the speed of sound in air from this data and your answer in part (b) and make an estimate of the uncertainty. Make your method clear.

speed of sound = \pm ms^{-1} [4]

(d) The student now reverses the connections to speaker 2 but keeps the connections to speaker 1 unchanged.

State and explain the effect this would have on the signal measured by the microphone at positions **A** and **C**. [2]

Total Marks for Question Set 6: 25



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