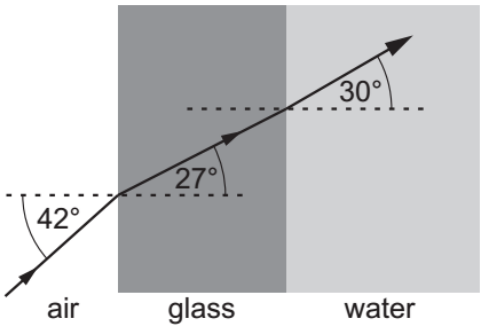
Oxford Cambridge and RSA

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.

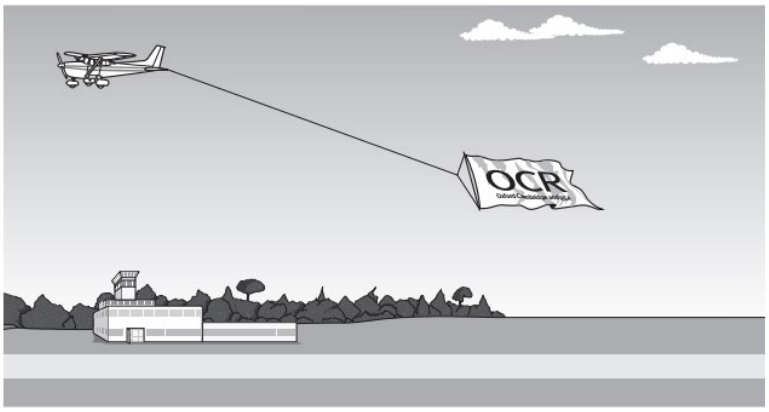


Fig. 2.1

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.

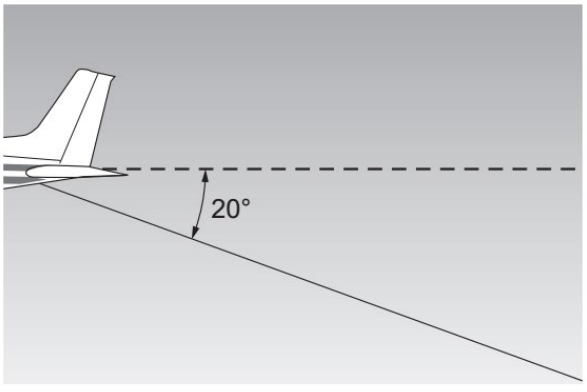


Fig. 2.2

(a) Show that the work done in towing the flag when the aeroplane travels 1 m in the line of flightis 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]**

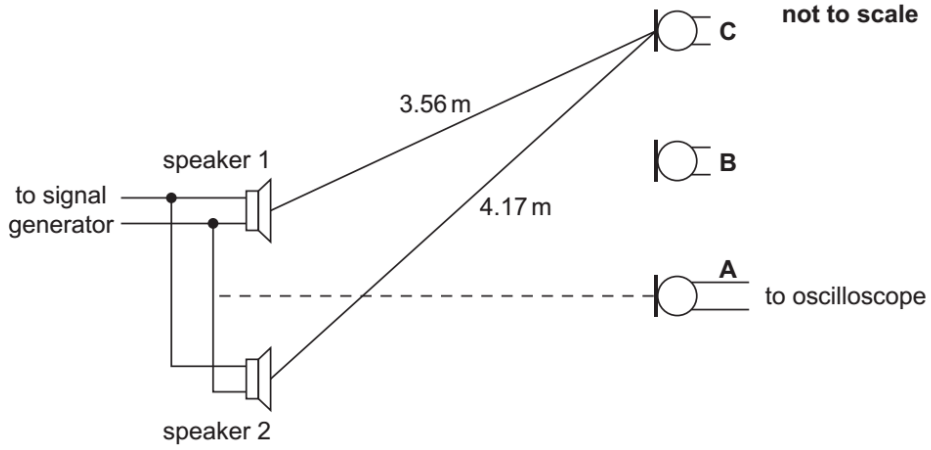
(ii) The breaking stress of the metal is 460 MPa.

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 asignal 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 = ... ±……..…… $m s^{-1}$ **[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