

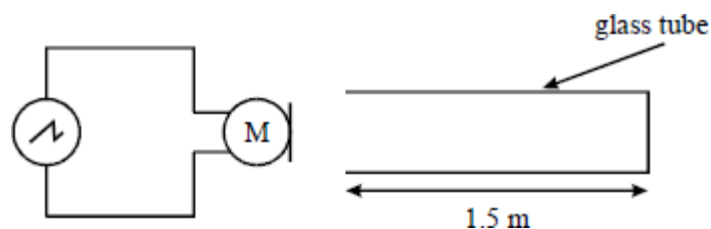
Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

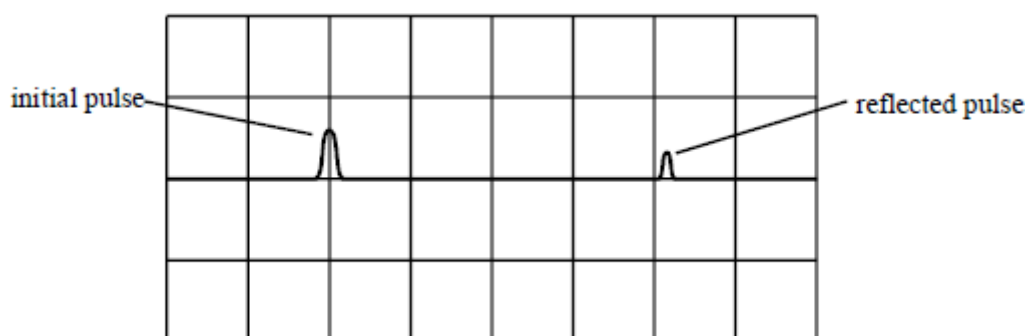
Q1.

- (a) The diagram shows the apparatus required for a simple experiment to measure the speed of sound.



A pulse of sound is sent down a hollow glass tube and is reflected at the sealed end of the tube. A microphone, M, placed at the open end detects the initial pulse and, at a later time, the reflected pulse. The microphone is connected to an oscilloscope which gives a signal when the microphone detects a pulse of sound.

The signal displayed on the oscilloscope screen is shown below.



If the time base of the oscilloscope is set to 2.0 ms per division, estimate the speed of sound in air.

(3)

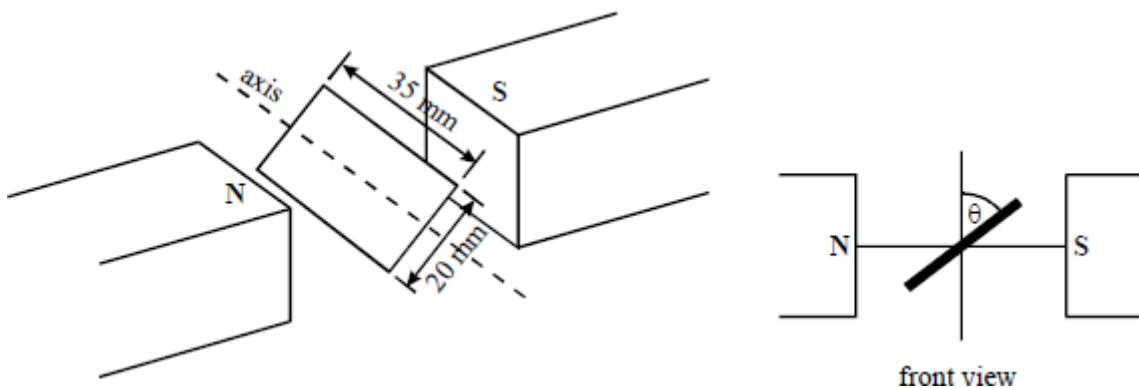
- (b) Describe how the frequency of a sinusoidal alternating (ac) voltage source is measured using an oscilloscope.

Your answer should include a sketch of the trace seen on the oscilloscope screen and explain how the frequency is obtained from this trace.

(5)
(Total 8 marks)

Q2.

A rectangular coil measuring 20 mm by 35 mm and having 650 turns is rotating about a horizontal axis which is at right angles to a uniform magnetic field of flux density $2.5 \times 10^{-3} \text{ T}$. The plane of the coil makes an angle θ with the vertical, as shown in the diagrams.



- (a) State the value of θ when the magnetic flux through the coil is a minimum.

(1)

- (b) Calculate the magnetic flux passing through the coil when θ is 30° .

(2)

- (c) What is the maximum *flux linkage* through the coil as it rotates?

(2)

(Total 5 marks)

Q3.

Protons and pions are produced in a beam from a target in an accelerator. The two types of particles can be separated using a magnetic field.

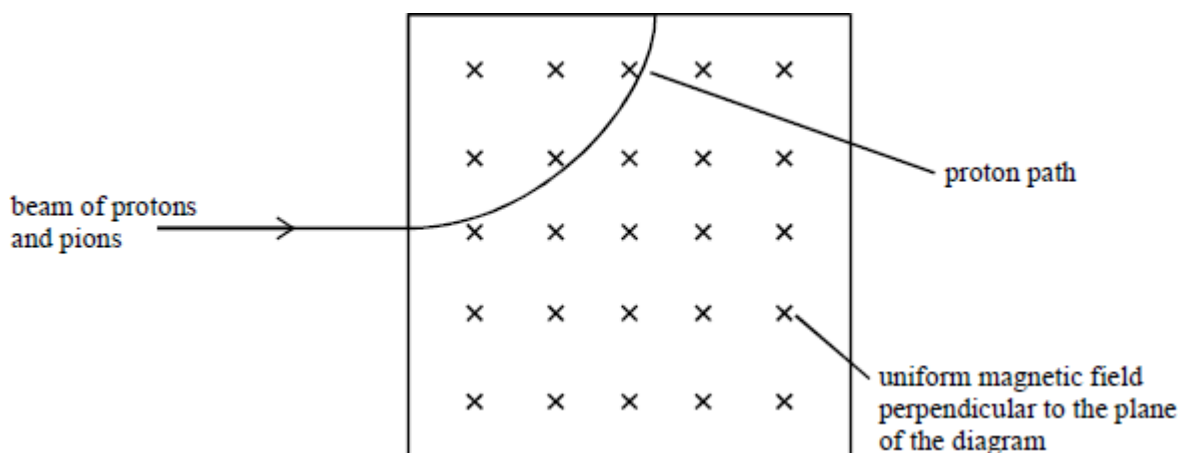
- (a) State the quark composition of

- (i) a proton,

- (ii) a positive pion, π^+

(2)

- (b) A narrow beam consisting of protons and positive pions, all travelling at a speed of $1.5 \times 10^7 \text{ m s}^{-1}$, is directed into a uniform magnetic field of flux density 0.16 T, as shown in the diagram.



- (i) Calculate the radius of curvature of the path of the protons in the field.

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- (ii) Sketch, on the diagram above, the path of the pions from the point of entry into the field to the point of exit from the field.
- (iii) If the magnetic field were increased, how would this affect the paths of the particles?

(7)
(Total 9 marks)