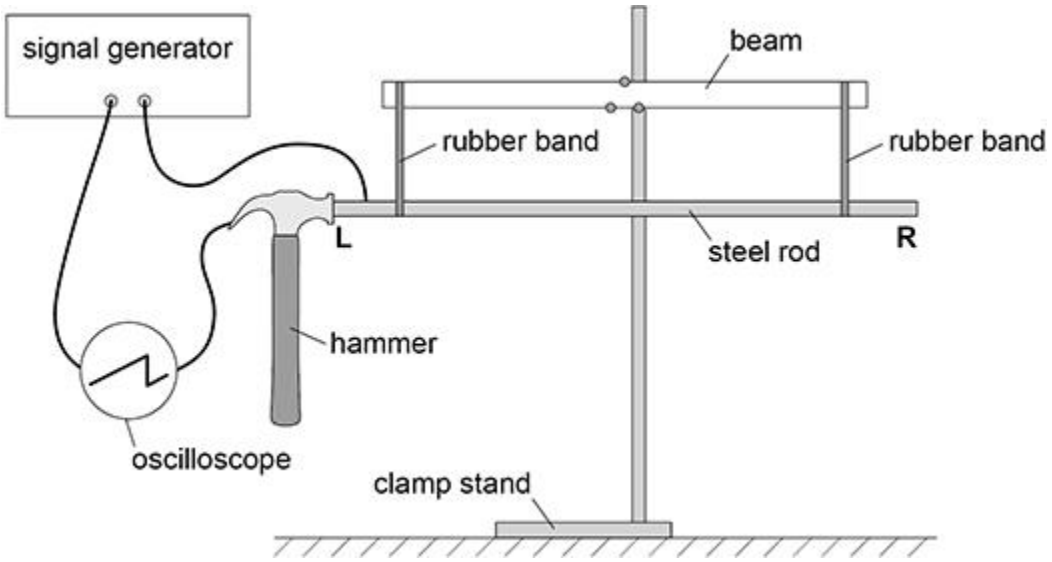
Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

Figure 1 shows apparatus used to measure the speed of sound in a steel rod.

Figure 1

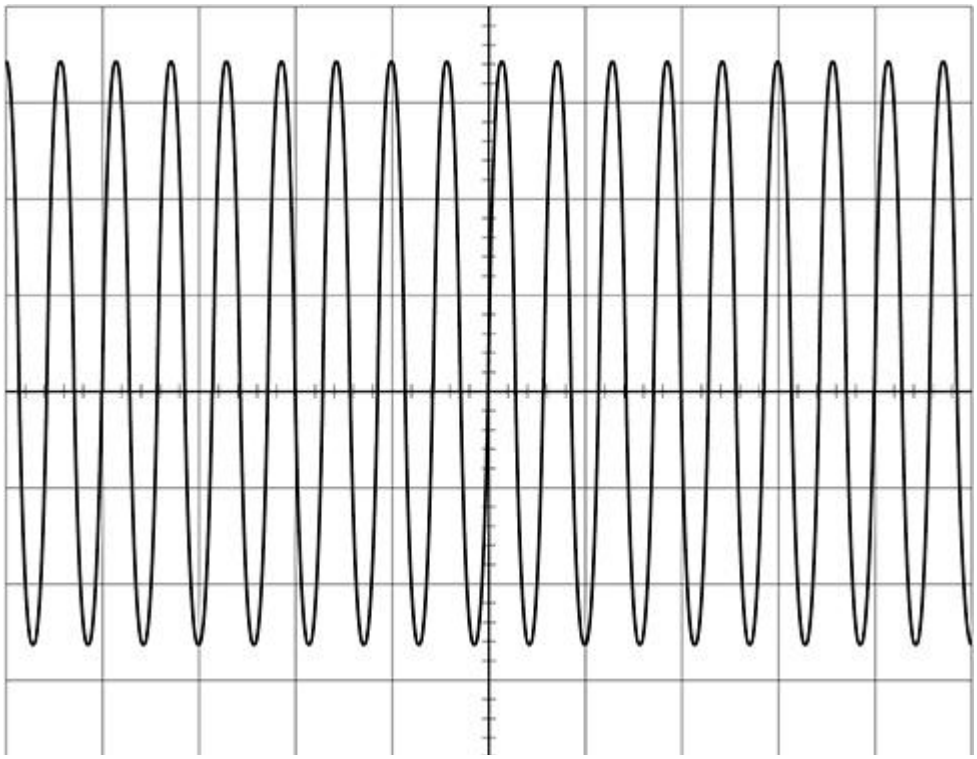


The steel rod is suspended from a beam using rubber bands.
When the hammer is in contact with the end **L** of the steel rod, a circuit is completed and the signal generator is connected to the oscilloscope.

Figure 2 shows the waveform then displayed on the oscilloscope.

Figure 2

Downloaded from www.merit-minds.com



(a) Which control on the oscilloscope should be used to centre the trace vertically on the screen?

Tick (✓) **one** box.

X-shift ☐

Y-gain ☐

Y-shift ☐

(1)

When the hammer hits end **L**, a sound wave travels along the steel rod and is reflected at end **R**.
When the wave returns to **L** the rod bounces away from the hammer and the circuit is broken.

Figure 3 shows the waveform produced by the brief contact between the hammer and **L**.
Note that the waveform has now been centred vertically.

Figure 3

Downloaded from www.merit-minds.com

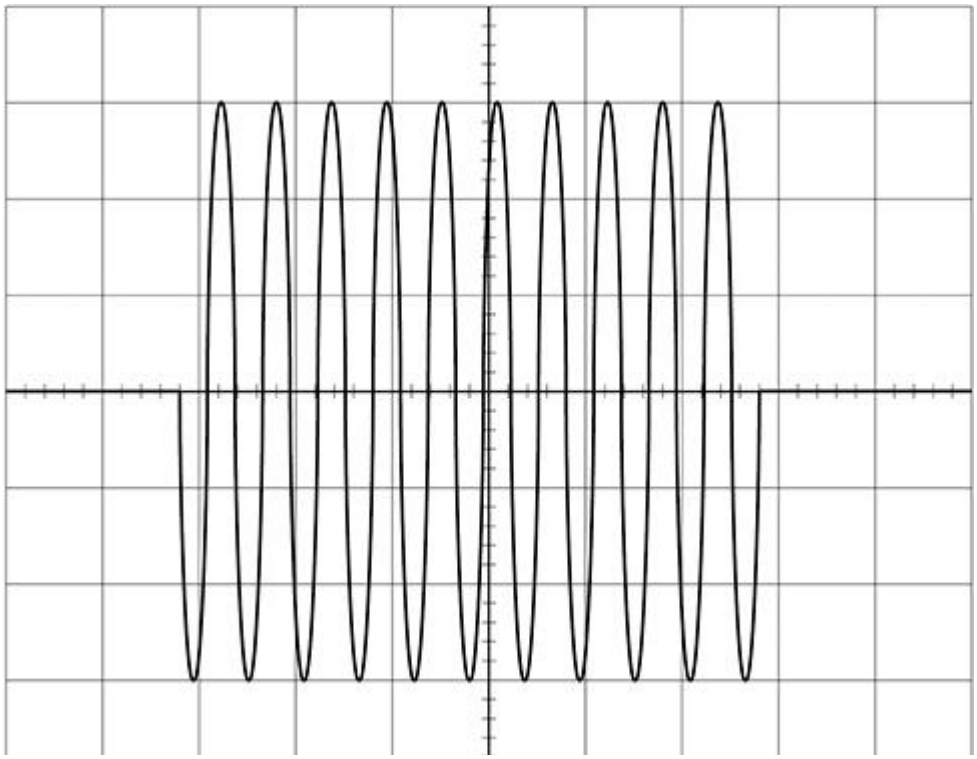
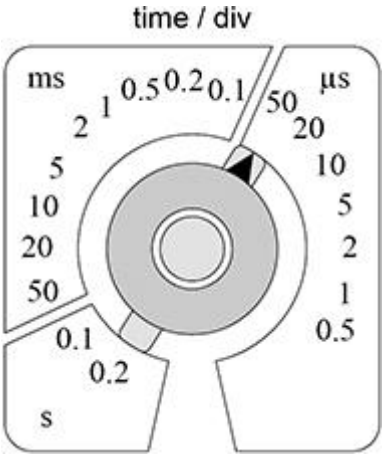


Figure 4 shows the time-base setting of the oscilloscope.

Figure 4



(b) The distance between **L** and **R** in **Figure 1** is 0.870 m.

Deduce the speed of sound in the steel rod.

speed of sound = _____ m s^{-1}

(3)

Downloaded from www.merit-minds.com

(c) A student repeats the experiment using a steel rod of twice the length.

Explain:

- how using the longer rod affects the waveform displayed
- any changes needed to get an accurate result for the speed.

You should include numerical detail.

(4)

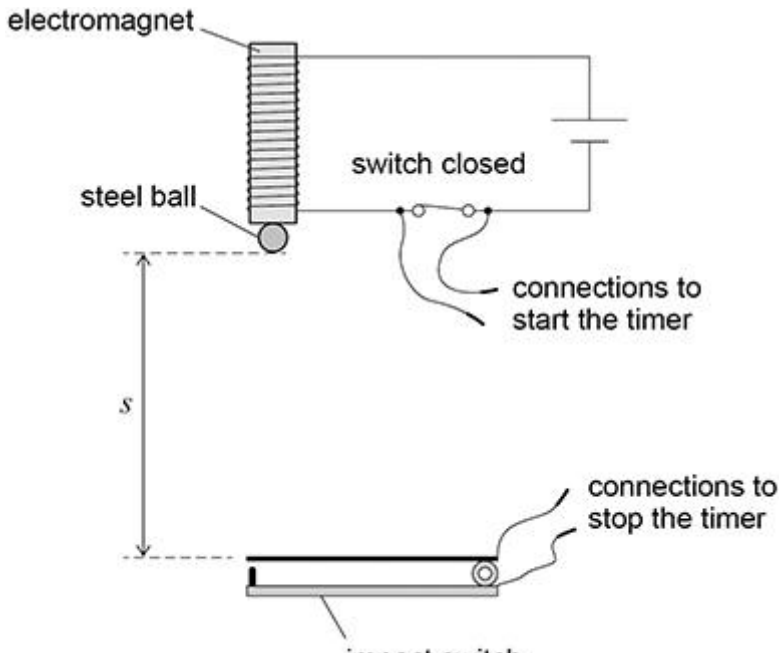
(Total 8 marks)

Q2.

Figure 1 shows apparatus used to determine the acceleration *g* due to gravity by a free-fall method.

Figure 1

Downloaded from www.merit-minds.com



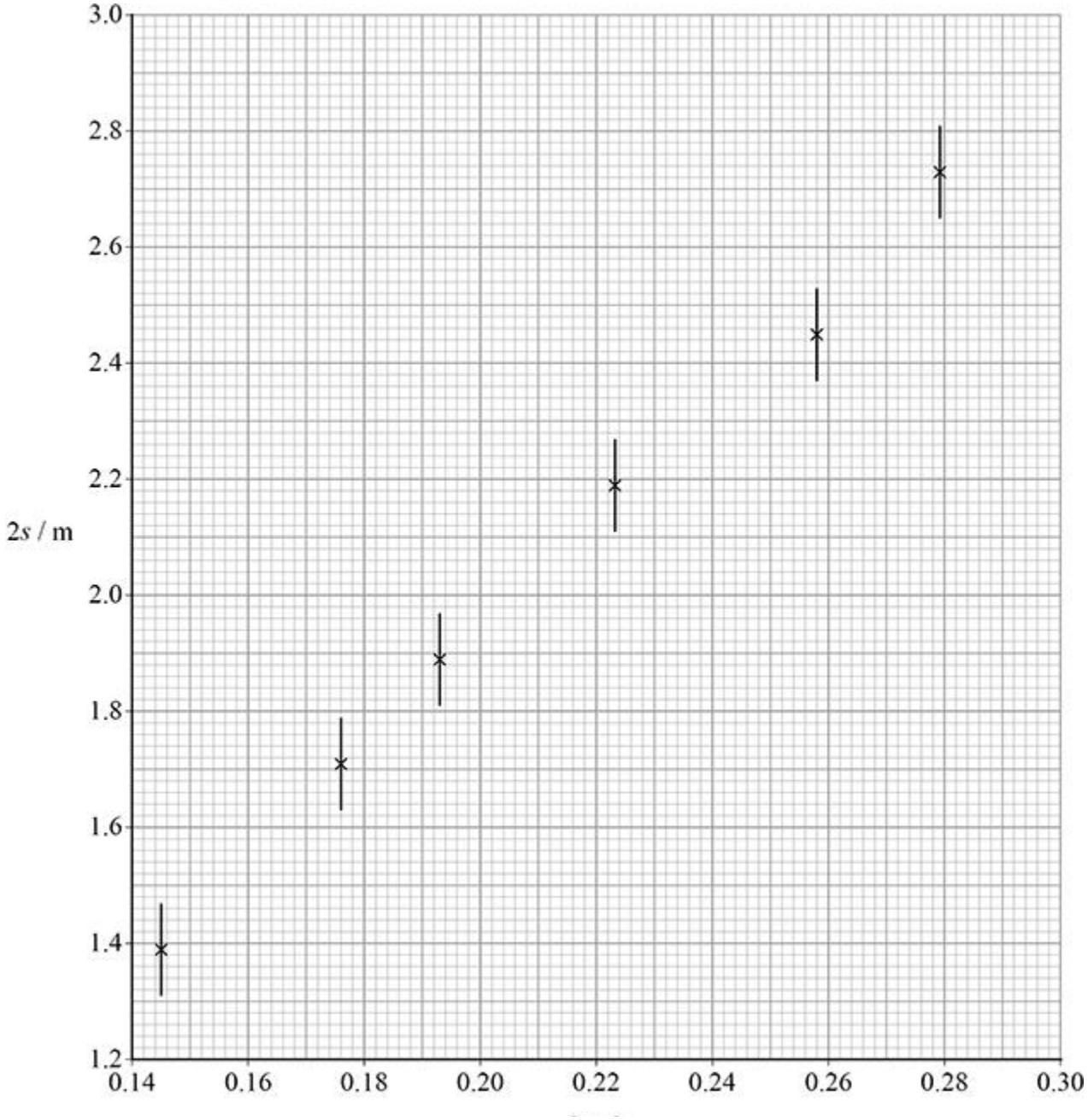
When the switch is opened a timer starts and a steel ball is released from rest.
The ball falls vertically onto an impact switch and this stops the timer.
The timer displays the time t for the ball to fall through the vertical distance s shown in **Figure 1**.

A student obtains values of t for different values of s.

The student plots the graph of $2s$ against t^2 shown in **Figure 2**.

Figure 2

Downloaded from www.merit-minds.com



(a) The student has used an absolute uncertainty in s to draw the vertical error bars in **Figure 2**.

Deduce the student's absolute uncertainty in s.

absolute uncertainty in s = _____ m

(1)

(b) Determine

- the maximum gradient G_{max} of a straight line that passes through all the error bars
- the minimum gradient G_{min} of a straight line that passes through all the error bars.

Downloaded from www.merit-minds.com

G_{max} = _____

G_{min} = _____

(3)

(c) It can be shown that $2s = gt^2$.

Determine a value for g using G_{max} and G_{min}.

g = _____ m s^{-2}

(2)

(d) Determine the percentage uncertainty in your value for g.

percentage uncertainty = _____ %

(2)

A fault develops in the apparatus.
When the switch is opened there is now a $30\ \text{m s}$ delay before the ball is released.

(e) State the type of error produced by this fault.

_____

(1)

(f) A graph of $2s$ against t^2 is produced using results from the faulty apparatus.

Describe how this graph is different from the graph in **Figure 2**.

_____

_____

_____

(1)
(Total 10 marks)

Downloaded from www.merit-minds.com