

Name of the Student: _____

Max. Marks : 23 Marks

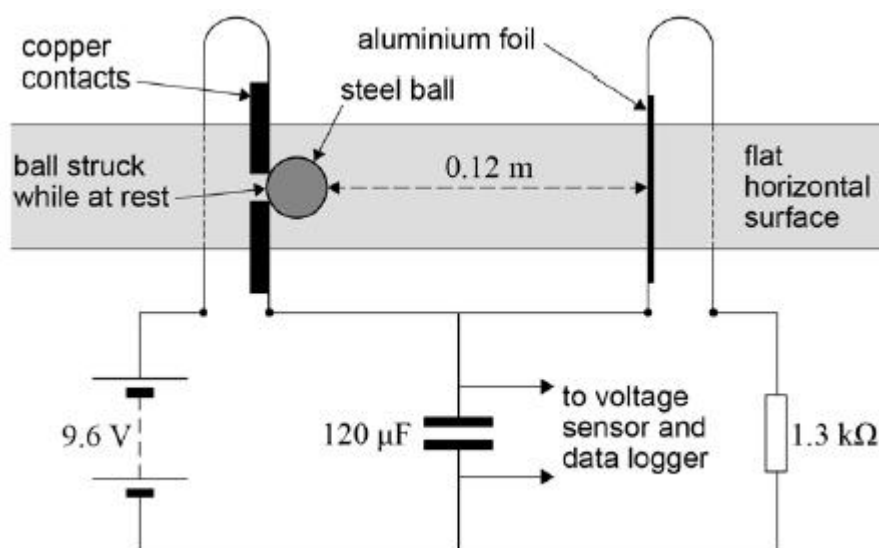
Time : 23 Minutes

Q1.

- (a) Explain what is meant by a capacitance of
- $120 \mu\text{F}$
- .

(1)

- (b)
- Figure 1**
- shows a plan view of the apparatus used by a student to measure the speed of a steel ball immediately after it has been struck from rest.

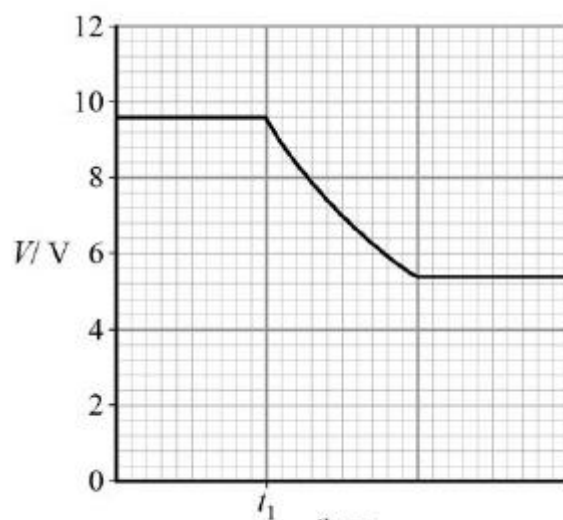
Figure 1

When the ball is touching the copper contacts, the $120 \mu\text{F}$ capacitor charges to a potential difference of 9.6 V . Once the ball has left the contacts, the capacitor discharges through the $1.3 \text{ k}\Omega$ resistor. When the ball has travelled a distance of 0.12 m , it breaks the aluminium foil so that the capacitor stops discharging.

Figure 2 shows the variation of potential difference V recorded by the data logger.

The ball is struck at time t_1 .

Figure 2



Calculate the charge that passes through the resistor as the capacitor discharges.

charge = _____ C

(1)

- (c) Calculate the maximum current in the resistor during the experiment shown in **Figure 2**

maximum current = _____ A

(1)

- (d) Calculate the energy that is transferred as the capacitor discharges through the $1.3 \text{ k}\Omega$ resistor.

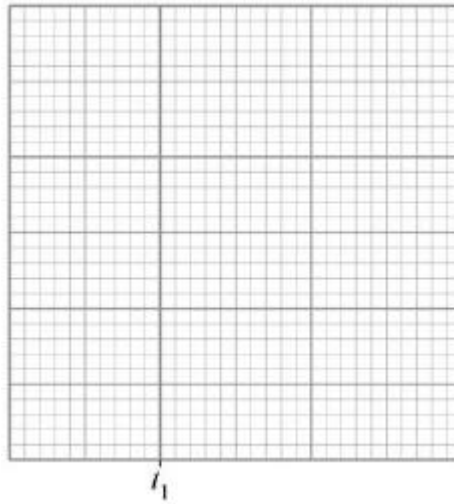
energy = _____ J

(3)

- (e) Sketch a graph on the axes of **Figure 3** that shows the variation of the magnitude of the current in the resistor during the time interval shown in **Figure 2**.

A scale is required on the current axis but not on the time axis.

Figure 3



(3)

- (f) Calculate the time for which the capacitor is discharging and hence determine the mean speed of the ball.

speed = _____ m s⁻¹

(4)

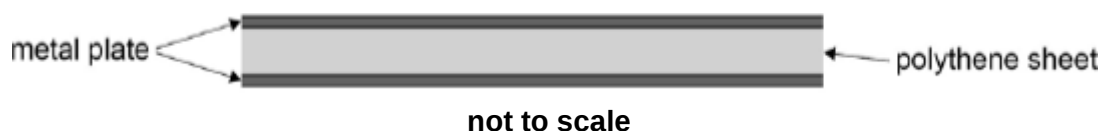
- (g) Discuss **two** reasons why your answer to part (f) is likely to be lower than the speed of the ball immediately after it is struck.

(2)

(Total 15 marks)

Q2.

The figure below shows a capacitor of capacitance 370 pF. It consists of two parallel metal plates of area 250 cm². A sheet of polythene that has a relative permittivity 2.3 completely fills the gap between the plates.



- (a) Calculate the thickness of the polythene sheet.

thickness = _____m

(2)

- (b) The capacitor is charged so that there is a potential difference of 35 V between the plates. The charge on the capacitor is then 13 nC and the energy stored is 0.23 μ J.

The supply is now disconnected and the polythene sheet is pulled out from between the plates without discharging or altering the separation of the plates.

Show that the potential difference between the plates increases to about 80 V.

(2)

- (c) Calculate the energy that is now stored by the capacitor.

energy stored = _____ μ J

(2)

- (d) Explain why there is an increase in the energy stored by the capacitor when the polythene sheet is pulled out from between the plates.

(2)

(Total 8 marks)