

A level Physics A
H556/03 Unified physics

Question Set 15

1 Fig. 3.1 shows the design of a 'mechanical' torch.

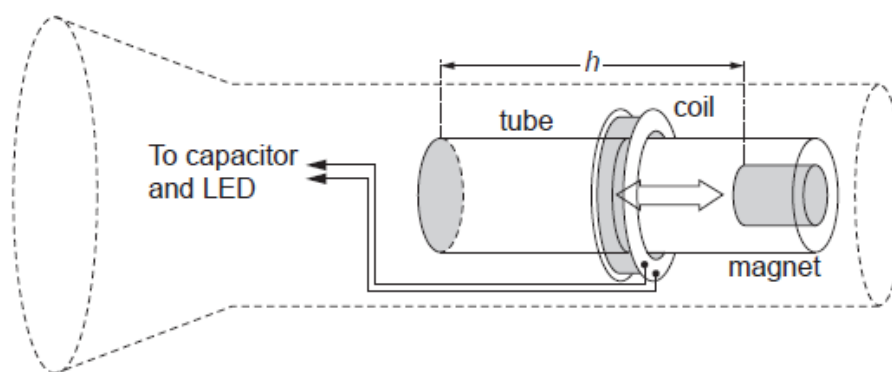


Fig. 3.1

There is no battery in the torch. Instead, when the torch is inverted, the magnet falls a short vertical distance h through the coil of wire, as shown in Fig. 3.2. This induces an electromotive force (e.m.f.) across the ends of the coil. The e.m.f. is used to store charge in a capacitor, which lights a light-emitting diode (LED) when it discharges.

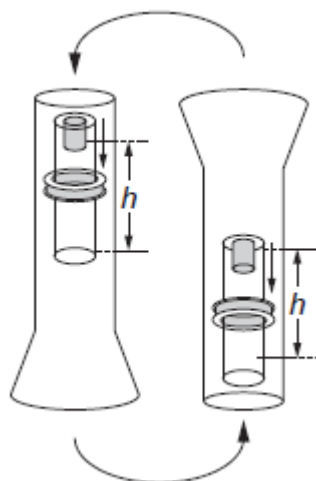


Fig. 3.2

Fig. 3.3 shows the variation with time of the e.m.f. generated as the magnet falls the distance h .

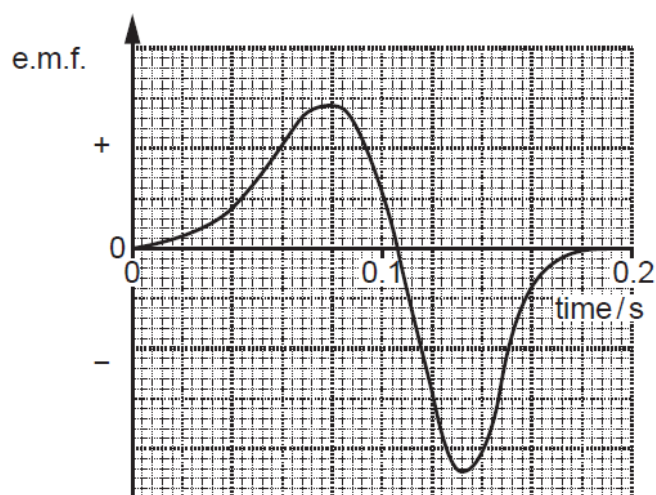


Fig. 3.3

(a) Explain the shape of the curve in Fig. 3.3.

[3]

(b) When the torch is inverted, the pulses of e.m.f. shown in Fig. 3.3 cause a capacitor of capacitance 0.12 F to become charged.
Each positive **and** each negative pulse adds 9.0×10^{-3} C to the charge stored in the capacitor.

(i) The torch is inverted 80 times.

Calculate the total energy stored in the capacitor.

total energy = J [3]

(ii) When the torch is switched on, the energy stored in the capacitor lights a 50 mW LED.

Estimate the time for which the LED lights.

time = s [1]

*(c) In the torch, the gravitational potential energy of the magnet is converted into electrical energy supplied to the 50 mW LED.

You are asked to investigate whether the efficiency of this energy conversion depends on the number of inversions of the torch.

- Describe how you will make accurate measurements to collect your data. Assume that both the torch and the tube can be opened.
- Explain how you will use the data to reach a conclusion.

[6]

Total Marks for Question Set 15: 13

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