Mark scheme for Extension Worksheet – Topic 5, Worksheet 7

1 At a maximum of the flux the rate of change of flux is zero and hence is the current; so M can be placed anywhere where the current is zero. [2]

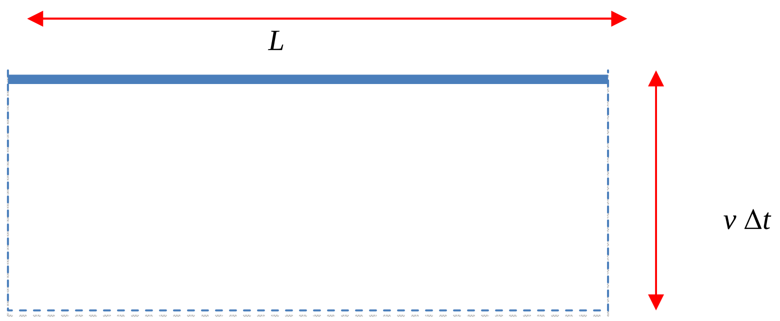
2 a As the loop moves away the magnetic field and hence the flux through the loop decreases; and so a current is established since we have a rate of change of flux. [2]

b The flux is decreasing so for the current to oppose this decrease a field into the page must be produced; and so the current must be clockwise in the loop as we look from above. [2]

c There is an attractive magnetic force between the wire and the loop; so a force must be exerted on the loop to make it move at constant speed. [2]

d The work gets dissipated as thermal energy in the loop. [1]

3 a An electron in the rod experiences a magnetic force qvB which pushes it to the side of the rod; this creates a potential difference V across the ends of the rod and hence an electric field $E = \frac{V}{L}$ is established within the rod; the motion of electrons stops when $qvB = qE \Rightarrow qvB = q\frac{V}{L} \Rightarrow V = BvL$



[3]

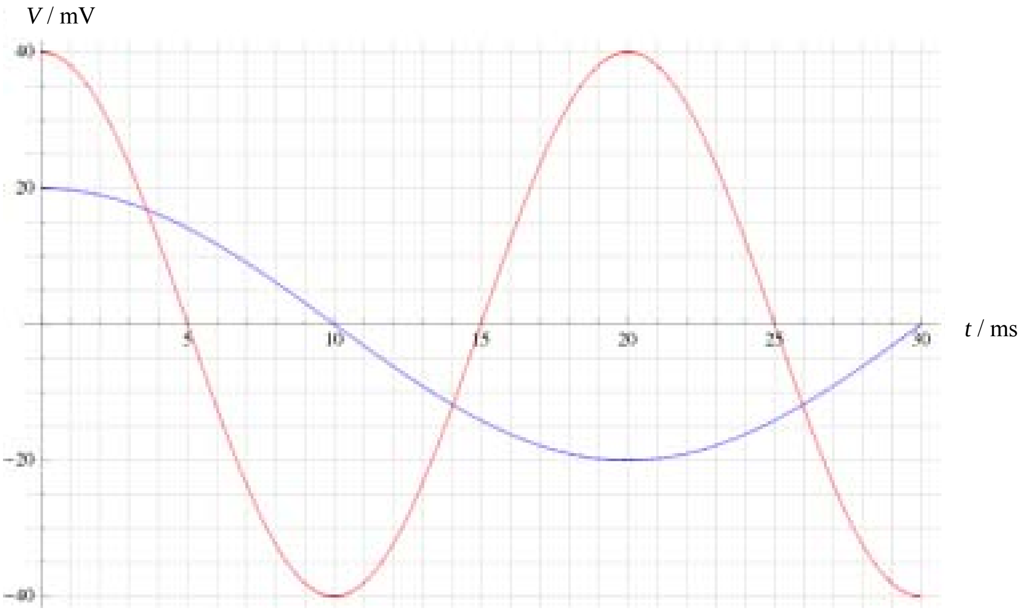
b In time Δt the rod would move a distance $v\Delta t$ and so we have an imaginary loop with area $Lv\Delta t$; and hence the flux through it as changed by $\Delta\Phi = BLv\Delta t$; hence $emf = \frac{\Delta\Phi}{\Delta t} = \frac{BLv\Delta t}{\Delta t} = BLv$ [3]

4 a $I_{\text{rms}} = \frac{I_{\text{peak}}}{\sqrt{2}} = \frac{0.40}{\sqrt{2}} = 0.2828 \approx 0.28 \text{ A}$ [1]

b The rms voltage is therefore $V_{\text{rms}} = RI_{\text{rms}} = 0.40 \times 0.2828 = 0.113 \approx 0.11 \text{ V}$ [1]

c $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} = 0.113 \times 0.2828 \approx 32 \text{ mW}$ [1]

5 See graph in blue. Amplitude correct; period correct.



[2]