Mark scheme for Topic 12

1 The flux is increasing so the current induced in the loop must oppose this increase by creating a magnetic field into the page. This means that the current in the loop will be clockwise. The net magnetic force on the loop will therefore be directed towards the right (by the right hand rule for force), hence **A**.

Exam tip: it is essential throughout this topic that you know how to find the direction of the induced current.

2 The flux is increasing so the current induced in the loop must oppose this increase by creating a magnetic field directed to the right.

This means that the current in the loop will be counterclockwise as we look along the direction of motion of the magnet. **[2]**

3 **a** Magnetic flux is defined to be the product of the magnetic field strength times the area of a loop times the cosine of the angle between the magnetic field direction and the normal to the loop. **[1]**

b Faraday's law states that:

the induced emf is equal to the (negative) rate of change

of the magnetic flux linkage with time. **[2]**

c The magnitude of the average induced emf is $\frac{\Delta\phi}{\Delta t}$

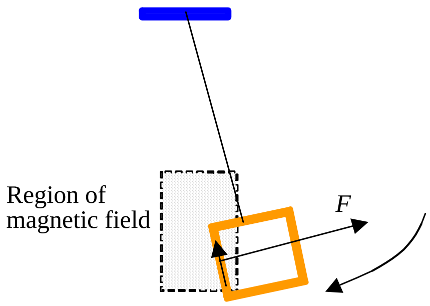
$$= \frac{3.0\times10^{-3}\times6.0\times10^{-2}}{0.50}$$

$$= 3.6\times10^{-4}\text{ V}.$$ **[3]**

4 **a** As the loop first enters the magnetic field, the magnetic flux through the area of the loop is increasing.

Therefore there will be an induced emf and current will flow in the wire. The direction of the current will be clockwise.

The force on the side of the wire that is in the magnetic field will therefore be directed against the velocity of the wire and so the oscillations will be damped. (As the wire exits the region of magnetic field the induced current will be counterclockwise and the force again opposite to the velocity. Thus the oscillations are damped).



[3]

Exam tip: note the detail required in the answer to such a question.

b The energy of the system has been dissipated as thermal energy in the wire. **[1]**

Exam tip: you must say **where** the energy is dissipated.

c The average power is $P = \frac{0.26}{4.0} = 0.065\ \text{W}$.

$0.12 \times I^2 = 0.065$.

$I = 0.74\ \text{A}$. **[3]**

5 **a** **i** Peak power is 110 kW.

$$\frac{V_{\text{peak}}^2}{250} = 110\times10^3 \Rightarrow V_{\text{peak}} = 5244 \approx 5.2\text{ kV}$$ **[2]**

ii $250\times I_{\text{peak}}^2 = 110\times10^3 \Rightarrow I_{\text{peak}} = 20.98 \approx 21\text{ A}$

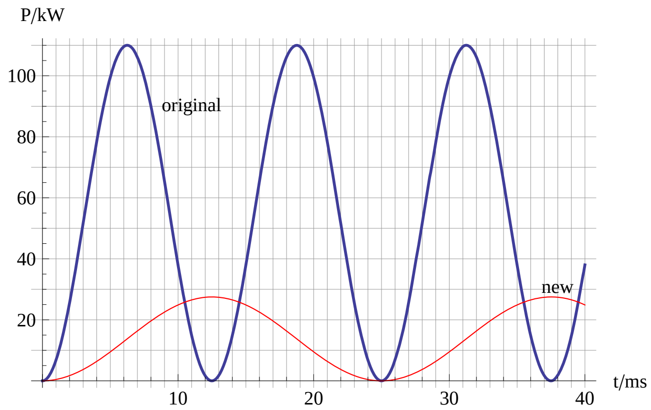
$$I_{\text{rms}} = \frac{I_{\text{peak}}}{\sqrt{2}} = \frac{20.98}{\sqrt{2}} = I_{\text{peak}}^2 = 14.8 \approx 15\text{ A.}$$ **[2]**

iii Realization that two loops must be looked at,

and so 25 ms. **[2]**

b Correct amplitude.

Correct period.



[2]