A.C. ①   A Physics

1. An a.c. supply, 6 V rms., 100 Hz, is connected to a 50 Ω resistor

(a) Calculate the peak voltage V_{peak}, (2)

(b) Explain what "r.m.s. voltage" means. (2)

(c) Calculate I_{rms}, and I_{peak} (3)

(d) Calculate average power, P_{rms}, and peak power (3)

(e) On the same axes, sketch graphs of ....

(i) Voltage vs. time   (ii) power vs. time

[18]

2 A student tests a wire coil...

(a) with 12 V d.c., steady current = 1.3 A. Coil resistance? (2)

(b) with 8 V rms, 500 Hz, I_{rms} = 0.51 A

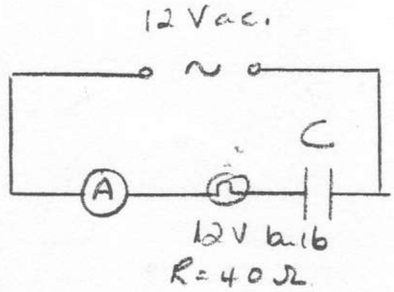
Inductive reactance? (2)

(c) Coil self inductance? (2)

(d) Calculate peak values of p.d. across coil + current through it (2)

(e) When an iron core is put in the coil, the current drops to 25 mA. Calculate the new self inductance and explain why the current is smaller (4) [12]

3. A 12 V rms a.c. supply is connected to the circuit shown. At $f = 50$ Hz the rms current is 30 mA



(a) Calculate the capacitive reactance (2)

(b) Calculate the capacitance (2)

(c) As the frequency is increased, the bulb glows brighter. Why? (3)

(d) Sketch a graph of current against frequency. (4) [11]

4 An LCR radio tuning circuit has an inductor of 800×10^{-9} H, and capacitor of 3.3×10^{-12} F. What is its resonant frequency? If you want to tune down to 87.5 MHz, what value of C do you need? (L is kept constant). (4)

TW 2.99

A. C. (i) Answers   A - Physics

1 a) $V_{rms} = V_{peak}/\sqrt{2}$ (1) so... $V_{peak} = 6 \times \sqrt{2} = 8.5\,V$ (1) (2

b) V_{rms} is the steady d.c. voltage (1) that produces the same power. (1) (2

c) $I_{rms} = V_{rms}/R$ (1) $= 6/50 = \underline{0.12\ A}$ (1)

$I_{peak} = V_{peak}/R = 8.5/50 = 0.17\ A$ or $I_{peak} = \sqrt{2} \times I_{rms} = 0.17\,A$ (1) (3

d) $P_{rms} = I_{rms} V_{rms} = 0.12 \times 6 = 0.72\ W. = I_{rms}^2 R$ (1) $= 0.72\ W.$ (2

$P_{peak} = I_p V_p = I_p^2 R = \underline{1.44\ W}$ (1) (note $P_{peak} = 2 \times P_{rms}$)

(e) for $f = 100\ Hz$

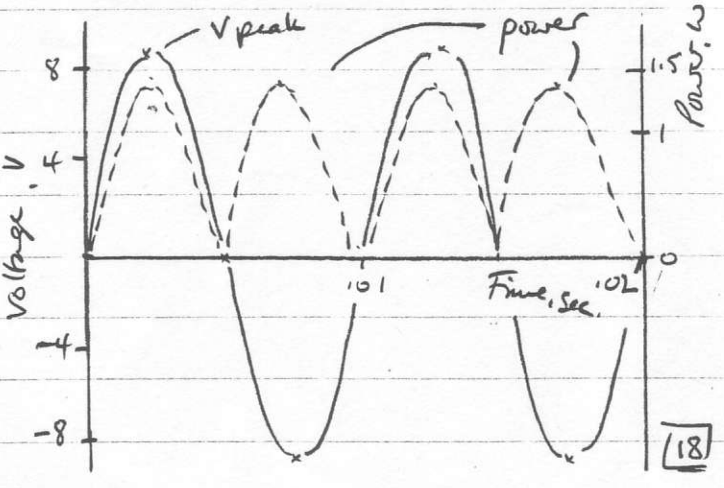
time period $T = 1/100 = 0.01\ sec$

3 axes labelled (1)

3 scales, V, t, watts (3)

Vgraph - shape (1)
- peak height (1)

Power - shape (1)
- peak height (1)



[18]

2 (a) D.C.... $R = V/I$ (1) $= \frac{12}{1.3} = \underline{9.23\ \Omega}$ (1)

(b) $X_L = V_{rms}/I_{rms}$ (1) $= 8/0.51 = \underline{15.7\ \Omega}$ (1)

(c) $X_L = 2\pi f L$ (1) $\rightarrow L = X_L / 2\pi f = 15.7/2\pi 500 = \underline{0.0049}$ (1) Henries

(d) $V_{peak} = V_{rms} \times \sqrt{2} = \underline{11.3\ V}$ (1) $I_{peak} = \sqrt{2} \times I_{rms} = \underline{0.72\ A}$ (1)

(e) Iron core .... new $X_L = 8/25 \times 10^{-3} = \underline{320\ \Omega}$ (1)

so L new $= X_L/2\pi f = 320/2\pi 500 = \underline{0.1\ Henries}$ (1)

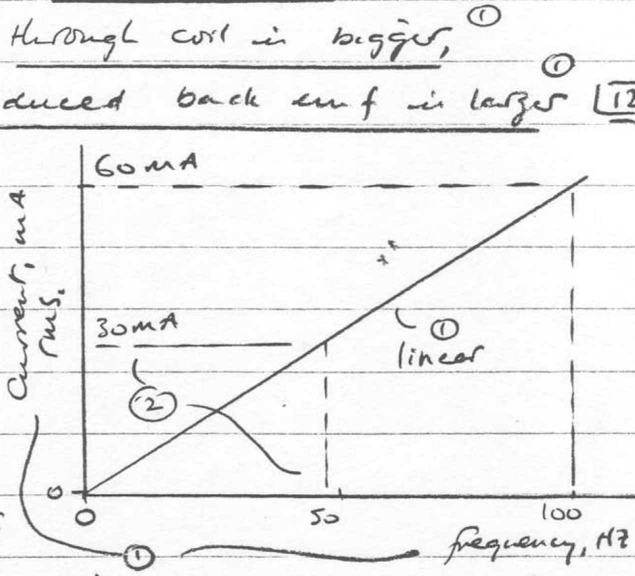
Smaller current because... flux through coil is bigger, (1)

so faster change in flux, so induced back emf is larger (1) [12]

3. (a) $X_C = V_{rms}/I_{rms}$ (1) $= 12/30 \times 10^{-3} = 400\ \Omega$ (1)

(b) $X_C = 1/2\pi f C$ (1) $\rightarrow C = 1/2\pi f X_C = \underline{7.96 \times 10^{-6}\,F}$ (1)

(c) bulb brighter because ... C is charged more times per second, (1) so more charge passes through bulb (1) per second, so current larger (1) (11)



(d) $I_{rms} = V_{rms}/X_C = V_{rms} \times 2\pi f C ... I_{rms} \propto f$

4. $f_0 = \frac{1}{2\pi\sqrt{LC}}$ (1) $= \frac{1}{2\pi\,(800 \times 10^{-9} \times 3.3 \times 10^{-12})^{1/2}} = \underline{97.9 \times 10^6\ Hz}$ (1) Radio 1!

to find C for $f_0 = 87.5\ MHz$...

rearrange $f_0^2 = \frac{1}{4\pi^2 LC}$ (1) $\rightarrow C = \frac{1}{4\pi^2 L f_0^2} = \underline{4.1 \times 10^{-12}\ F.}$ (1) (4)

new! RN 2.99

(to reduce freq you need a bigger C.)

Q.... 1/18 2/12 3/11 4/4