Physics

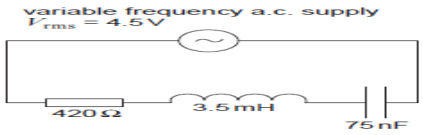
Question	Maximum Mark	Mark Awarded
#1	20	
#2	20	
#3	20	
#4	20	
Total	80	

#1

(a) With the aid of a phasor diagram, explain why the impedance of an RCL circuit is given by: [3]

$$Z = \sqrt{(X_L - X_C)^2 + R^2}$$

(b) Consider the following RCL circuit.

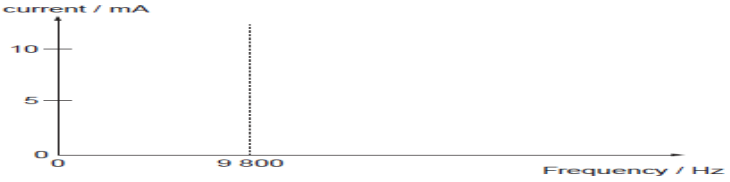


(i) Show that the combined magnitude of the reactance of the inductor and capacitor is the same (to 3 s.f.) as the resistance of the resistor when the frequency is 4 150 Hz. [3]

(ii) Hence, calculate the rms current in the circuit when the frequency is 4 150 Hz. [3]

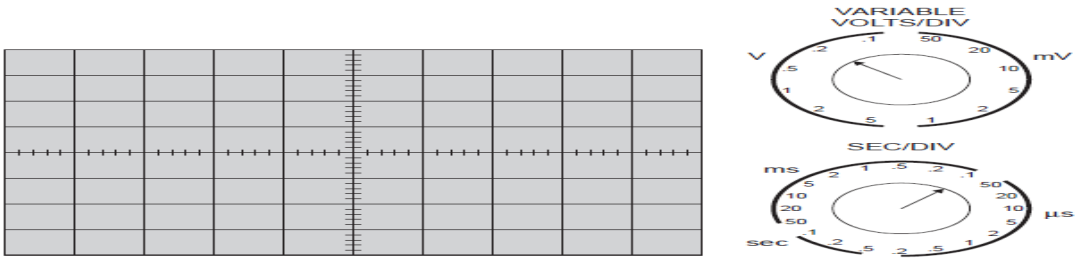
(iii) Calculate (or state) the phase angle between the applied pd and the current when the frequency is 4 150 Hz. [1]

(iv) The resonance frequency of the RCL circuit is approximately 9 800 Hz. **By sketching** a graph of rms current against frequency, explain why there is a second higher frequency that provides the same rms current as your answer to *(b)*(ii). [3]



(v) This second frequency occurs when the magnitude of the reactances of the inductor and capacitor are reversed from those in part *(b)*(i). Use this information to calculate this second frequency. [2]

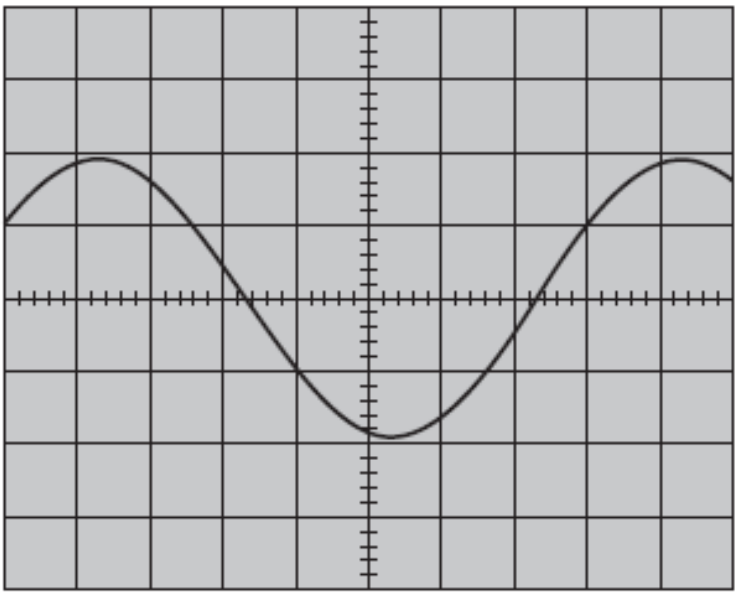
(c) Robyn is required to produce a wave trace on an oscilloscope for an a.c. power supply of frequency 3.0 kHz and rms pd 0.60 V. Deduce whether or not the settings of the oscilloscope shown below are appropriate. [5]

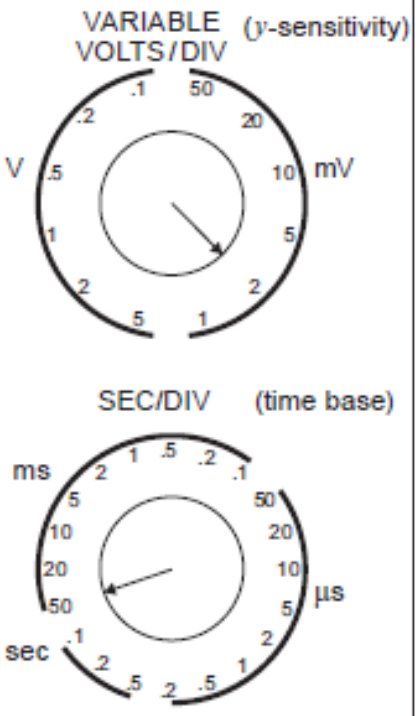


Question taken from Eduqas examination paper 842103, November 2020

#2

11. An oscilloscope trace is shown along with the settings of the y-sensitivity and the time base.





(a) (i) Calculate the **rms** pd of the oscilloscope trace shown. [2]

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(ii) Calculate the frequency of the oscilloscope trace shown. [2]

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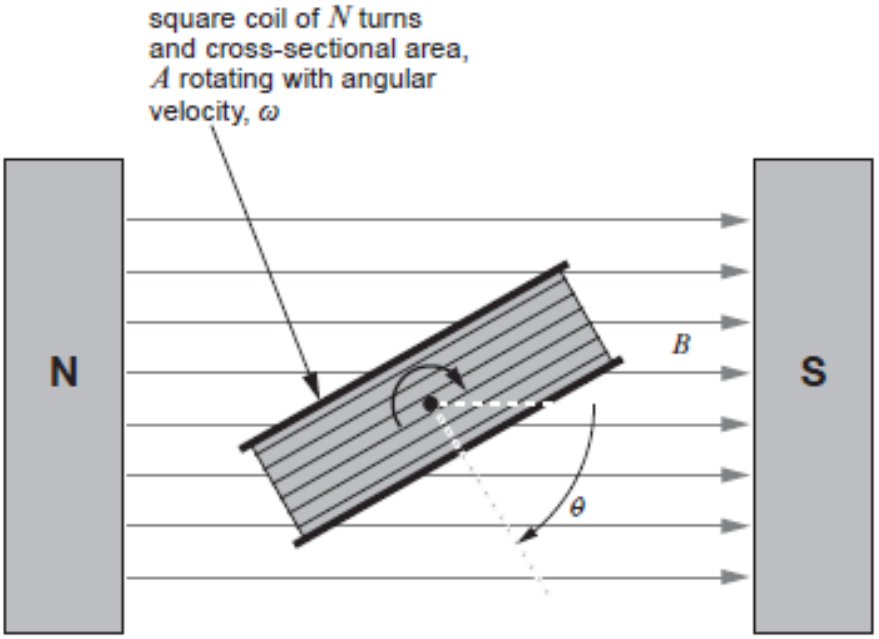
(b) A coil rotates in a magnetic field as shown.



(i) Use Faraday's Law to explain why the peak emf induced in the coil is proportional to the angular velocity of rotation of the coil. [2]

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(ii) Use Faraday's Law to explain why the emf induced in the coil depends on the angle, θ. [2]

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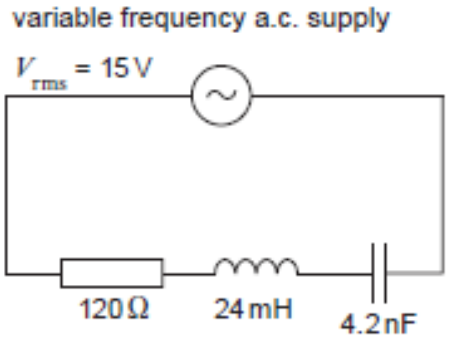
(c) (i) In the following LCR circuit, explain why the rms resonance current is 125 mA. [2]



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(ii) Calculate the resonance frequency of the circuit. [2]

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(iii) Show that the rms current is 42 mA when the frequency of the supply is 17 kHz. [3]

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(iv) Alistair claims that the mean power dissipation in the circuit at 17 kHz is:

$$P = I_{rms} V_{rms} = 0.042 \times 15 = 0.63\,W$$

Another student Michonne states that the correct value of power is 0.21 W.
Deduce which, if either, of the students is correct. [5]

Question taken from Eduqas examination paper 842103, June 2018

#3

11. *(a)* Derive the expression for the resonance frequency, f_0, of a series RCL circuit. [3]

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

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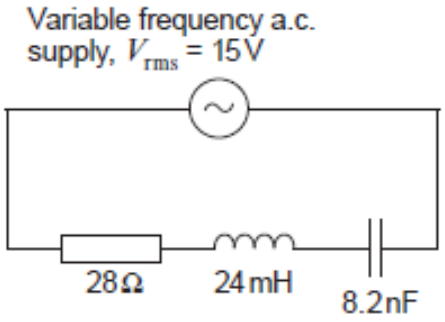
(b) Consider the following RCL circuit.



(i) Calculate the rms current at the resonance frequency (f_0). [1]

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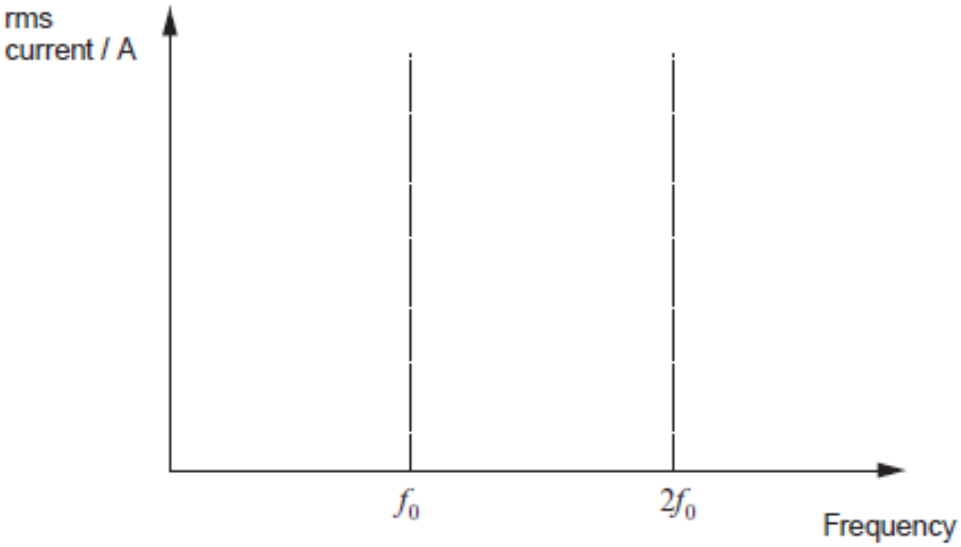
(ii) Calculate the rms current at twice the resonance frequency ($2f_0$). [4]

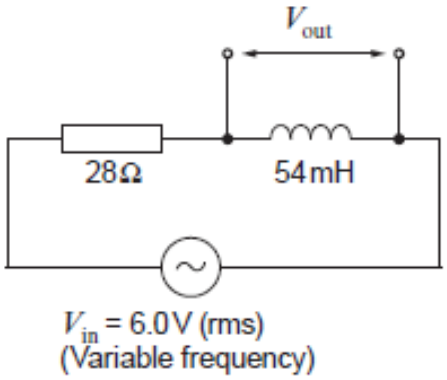
(iii) Calculate the Q factor of the RCL circuit. [2]

(iv) Sketch a graph of the rms current in the RCL circuit versus applied frequency of the a.c. supply on the axes provided. Label this graph 28 Ω. [3]



(v) The 28 Ω resistor is replaced by a 56 Ω resistor. On the same axes, sketch and label a second graph showing the rms current versus frequency for the new circuit. [2]

(c) Morgan claims that the rms output pd (V_{out}) in the following circuit is greater than 4.25 V when the frequency is greater than 82.5 Hz but less than 4.25 V below 82.5 Hz. Investigate whether or not Morgan is correct. [5]



Question taken from Eduqas examination paper 842103, June 2019

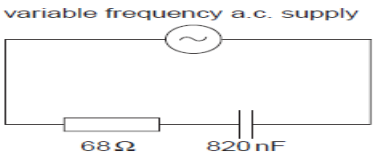
#4

(a) A 900 W toaster is supplied with a sinusoidally varying pd of **peak** pd 325 V. Calculate:

(i) the **rms** current; [2]

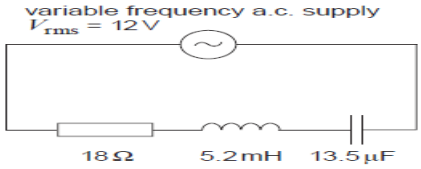
(ii) the resistance of the toaster. [2]

(b) Helen claims that the following circuit will have a minimum impedance of 68 Ω when the frequency is very low but that the impedance will be extremely large at high frequencies.



Deduce whether or not Helen is correct. [5]

(c) (i) Explain why the rms current at resonance of the following circuit is approximately 700 mA. [2]



(ii) Show that the resonance frequency (f_0) is approximately 600 Hz. [2]

(iii) Calculate the rms current when the frequency of the supply is increased to $1.5f_0$. [4]

(iv) Explain why the rms current is the same when the frequency is decreased to $\frac{f_0}{1.5}$. [3]

Question taken from Eduqas examination paper 842103, June 2017