



Complete, fold and seal
(see note 2 below)

FORENAME(S): KYRAN TYLER

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

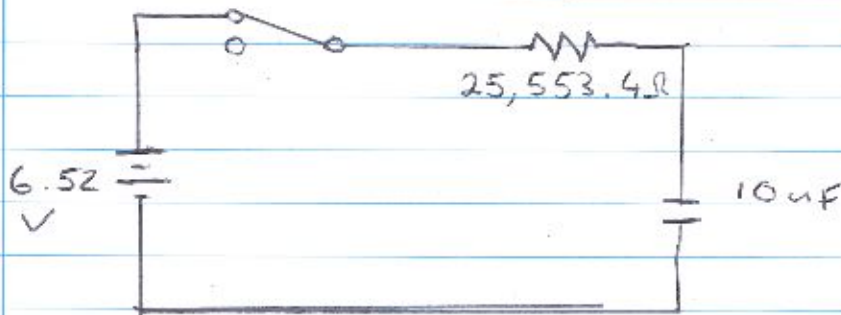
1	Student Number	
2	Title of Examination Paper	ELECTRICAL + ELECTRONIC PRINCIPLES
3	Module Code	\$9EE4000
4	Date and Time of Examination	23/05/22 09:30
5	Examination Venue	COLLEGE SIR GAR GRAIG GYM
6	Seat Number	15
7	Number of Answer Books handed in	

[illegible]
$$\begin{array}{r} 25 \\ 25 \\ \hline 9 \end{array}$$

59%
AGREED.

Q1) a) $\frac{R_1 \times R_2}{R_1 + R_2} = \frac{47,000 \times 56,000}{47,000 + 56,000} = 25,553.4 \Omega$

$$\frac{R_2}{R_1 + R_2} \times V_s = \frac{56000}{47000 + 56000} \times 12 = 6.52 \text{ V}$$



b) (i) $\tau = RC = 25,553.4 \times 10\mu = 0.25 \text{ s}$
 (ii) $5\tau = 5 \times 0.25 = 1.25 \text{ s}$

c) (i) $V_c = V_s (1 - e^{-t/\tau})$
 $\frac{V_c}{V_s} = 1 - e^{-t/\tau}$
 $e^{-t/\tau} = 1 - \frac{V_c}{V_s}$

$$\frac{-t}{\tau} = \ln\left(1 - \frac{V_c}{V_s}\right)$$

$$t = -\tau \ln\left(1 - \frac{V_c}{V_s}\right)$$

$$t = -0.25 \ln\left(1 - \frac{3}{6.52}\right) = 0.15 \text{ s}$$

(ii) $V_c = V_s (e^{-t/\tau})$
 $\frac{V_c}{V_s} = e^{-t/\tau}$

$$\ln \frac{V_c}{V_s} = -\frac{t}{\tau}$$

$$-\tau \ln\left(\frac{V_c}{V_s}\right) = t \quad = -0.25 \ln\left(\frac{3}{6.52}\right) = 0.19 \text{ s}$$

9

$$d) (i) \tau = \frac{L}{R} = \frac{200 \text{ m}}{1 \text{ k}} = 0.2 \text{ ms} \quad \checkmark$$

2

$$(ii) I = \frac{V}{R} = \frac{24}{1,000} = 0.024 \text{ A} \quad \checkmark$$

2

$$(iii) i = I (e^{-t/\tau})$$

$$\frac{i}{I} = e^{-t/\tau}$$

$$\ln\left(\frac{i}{I}\right) = -\frac{t}{\tau}$$

$$t = -\tau \ln\left(\frac{i}{I}\right) = -0.2 \times 10^{-3} \ln\left(\frac{20 \times 10^{-3}}{0.024}\right)$$

6

$$= 0.036 \text{ ms} \quad \checkmark$$

$$= -0.2 \times 10^{-3} \ln\left(\frac{5 \times 10^{-3}}{0.024}\right)$$

6

$$= 0.31 \text{ ms} \quad \checkmark$$

16

16

Polar form

Q2) a) $Z_1 = 5 \angle -53.13^\circ$ $Z_2 = 9.22 \angle 49.40^\circ$
 $Z_3 = 6.96 \angle -68.96^\circ$

$$Z_1 \times Z_2 = 5 \angle -53.13^\circ \times 9.22 \angle 49.40^\circ$$

$$= 46.1 \angle -3.73^\circ$$

$$Z_1 + Z_2 = (3 - j4) + (6 + j7) = 9 + j3 \text{ or } 9.49 \angle 18.43^\circ$$

$$\frac{Z_1 Z_2}{Z_1 + Z_2} = \frac{46.1 \angle -3.73^\circ}{9.49 \angle 18.43^\circ} = 4.86 \angle -22.16^\circ$$

$$\text{or } 4.5 - j1.83$$

$$Z_T = \left[\frac{Z_1 Z_2}{Z_1 + Z_2} \right] + Z_3 = (4.5 - j1.83) + (2.5 - j6.5)$$

$$= 7 - j8.33 \checkmark$$

$$\text{or } 10.88 \angle -49.96^\circ$$

10

b) (i) $X_L = 2\pi fL = 2\pi \times 60 \times 0.4 = 150.80$
 $Z = 40 + j150.80 \text{ or } 156.01 \angle 75.14^\circ \checkmark$

~~(ii) $V = \frac{200 \angle 0^\circ}{156.01 \angle 75.14^\circ} = 1.28 \angle -75.14^\circ$~~

~~(iii) $V_R = I R = 1.28 \angle -75.14^\circ \times 40 \angle 0^\circ = 51.2 \angle -75.14^\circ$~~

(ii) $I = \frac{V}{Z} = \frac{200 \angle 0^\circ}{156.01 \angle 75.14^\circ} = 1.28 \angle -75.14^\circ \checkmark$

2

(iii) $V_R = I R = 1.28 \angle -75.14^\circ \times 40 \angle 0^\circ = 51.2 \angle -75.14^\circ \checkmark$

3

(iv) $V_L = I X_L = 1.28 \angle -75.14^\circ \times 150.80 \angle 90^\circ$
 $= 193.02 \angle 14.86^\circ \checkmark$

3

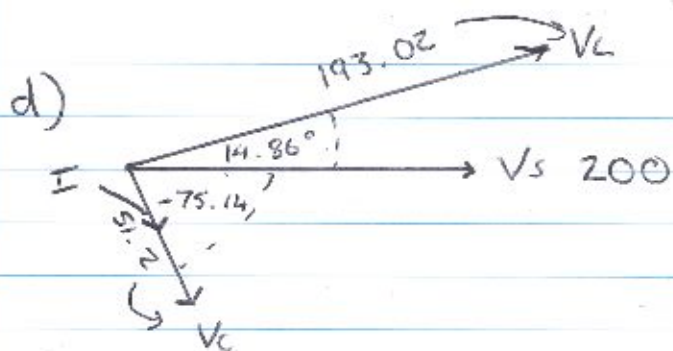
c) $V_C = 51.2 \angle -75.14^\circ \text{ or } 13.13 - j49.49$

$V_L = 193.02 \angle 14.86^\circ \text{ or } 186.56 + j49.50$

$= 199.69 + j0.01 \checkmark$

3

22



3

3

3

Q4) a) $f_r = \frac{1}{2\pi} \sqrt{\left(\frac{1}{LC} - \frac{R^2}{L^2}\right)}$

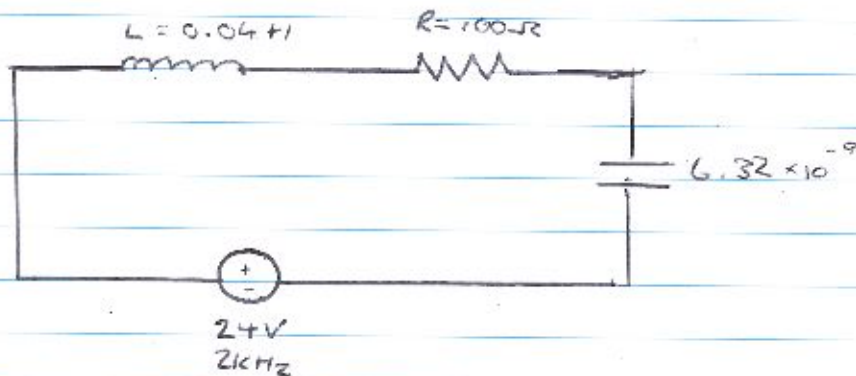
$$2\pi f_r = \sqrt{\left(\frac{1}{LC} - \frac{R^2}{L^2}\right)}$$

$$(2\pi f_r)^2 = \frac{1}{LC} - \frac{R^2}{L^2}$$

$$(2\pi f_r)^2 + \frac{R^2}{L^2} = \frac{1}{LC}$$

$$C = \frac{1}{\left((2\pi f_r)^2 + \frac{R^2}{L^2}\right) L} = \frac{1}{(2\pi \times 2k)^2 + \frac{100^2}{0.04^2} \times 0.04}$$

$$= 6.32 \times 10^{-9}$$



b) $R_D = Z_r = \frac{L}{CR} = \frac{0.04}{6.32 \times 10^{-9} \times 100} = 63,291.14 \Omega$

c) $I_r = \frac{V}{R_D} = \frac{24}{63,291.14} = 0.38 \text{ nA}$

d) $Q = \frac{2\pi f_r L}{R} = \frac{2\pi \times 2k \times 0.04}{100} = 5.03$

e) $BW = \frac{f_r}{Q} = \frac{2,000}{5.03} = 397.6$

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