

Complete, fold and seal
(see note 2 below)

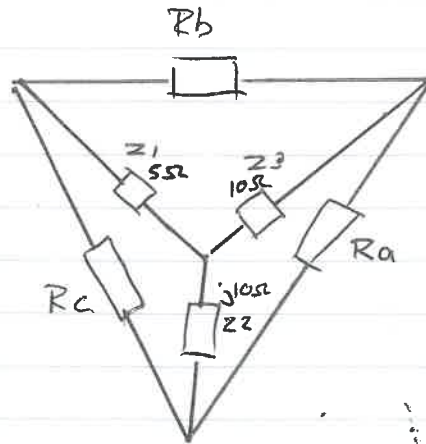
FORENAME(S): IAN RICHARD

12 Pages

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	1503509/3
2	Title of Examination Paper	ELECTRICAL PRINCIPLES THEORY
3	Module Code	GOAC 5001
4	Date and Time of Examination	20-05-19
5	Examination Venue	HALL
6	Seat Number	
7	Number of Answer Books handed in	

[illegible]



$$R_a = \frac{R_1 \times R_2 + R_2 \times R_3 + R_3 \times R_1}{R_1}$$

-1 for missing units

$$\frac{(5 \times 10j) + (10j \times 10) + (10 \times 5)}{5}$$

$$= \frac{(50j) + (100j) + (50)}{5}$$

$$= \frac{50 + 150j}{5}$$

$$= \frac{50 + 150j}{5} \times \frac{5}{5}$$

$$= \frac{250 + 750j}{25}$$

$$R_a = 10 + 30j \quad \text{units?}$$

$$R_b = \frac{R_1 \times R_3 + R_2 \times R_3 + R_3 \times R_1}{j10}$$

$$= \frac{50 + 150j}{j10}$$

$$= \frac{50 + 150j}{10j} \times \frac{-10j}{-10j}$$

$$= \frac{1500 - 500j}{100}$$

$$R_b = 15 - 5j \quad \text{units?}$$

Q1
a

4

1,
9,

$$R_c = \frac{R_1 \times R_2 + R_2 \times R_3 + R_3 \times R_1}{R_3}$$

$$R_c = \frac{50 + 150j}{10}$$

$$R_c = \frac{50 + 150j}{10} \times \frac{10}{10} \checkmark$$

$$R_c = \frac{500 + 1500j}{100} \checkmark$$

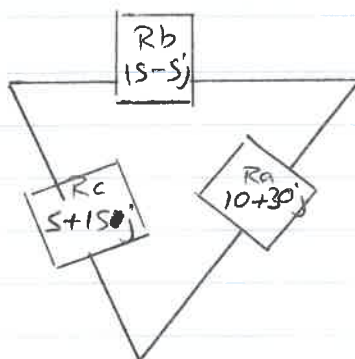
$$R_c = 5 + 15j \text{ units?} \checkmark$$

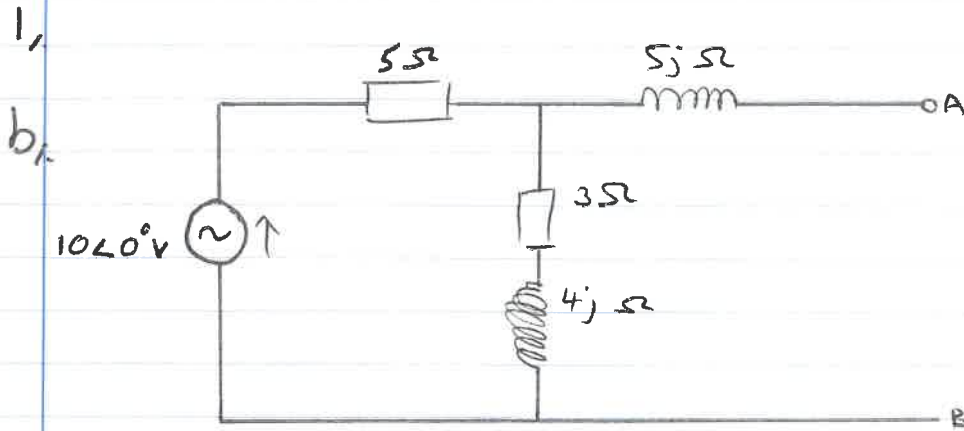
$$R_a = 10 + 30j$$

$$R_b = 15 - 5j$$

~~$$R_c = 5 + 15j$$~~

$$R_c = 5 + 15j$$





Find $I = \frac{V}{Z}$

$$Z = 5 + (3 + 4j)$$

$$Z = 8 + 4j$$

$$I = \frac{10}{8 + 4j} \times \frac{8 - 4j}{8 - 4j} = \frac{80 - 40j}{80} = 1 - 0.5j$$

$$I = 1 - 0.5j \text{ Amps}$$

$$V_{TH} = I \times Z = 1 - 0.5j \times 3 + 4j$$

$$= 5 + 2.5j \text{ units}$$

$$= 5.59 \angle 26.5^\circ$$

6

$$R_{TH} = \frac{(5)(3 + 4j)}{(5) + (3 + 4j) + (5j)}$$

$$= \frac{15 + 20j}{8 + 4j} + (5j)$$

$$= \frac{15 + 20j}{8 + 4j} \times \frac{8 - 4j}{8 - 4j}$$

$$= \frac{200 + 100j}{80} + 5j$$

$$= 2.5 + 1.25j + (5j)$$

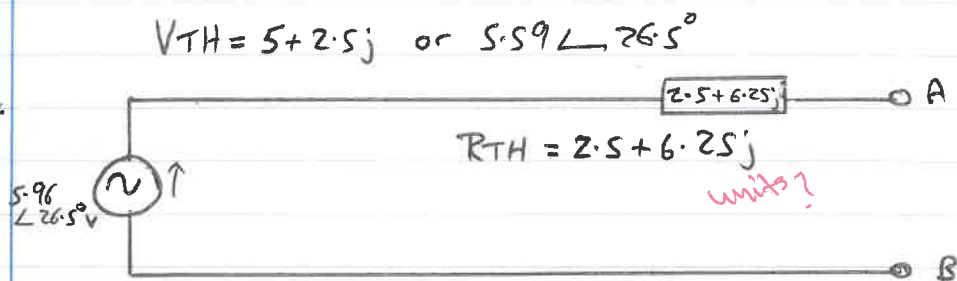
$$R_{TH} = 2.5 + 6.25j \text{ units}$$

Q1
b1
9

-1 for missing units

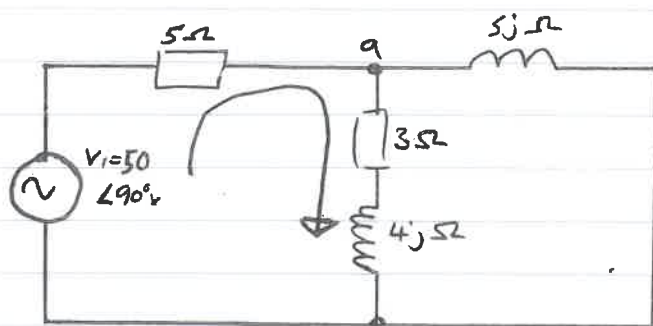
1,

b.



11
C1

circuit 1



$$Z_{Total} = \frac{(3+4j)(5j)}{(3+4j) + (5j)} + (5j)$$

~~$$= \frac{15+20j}{3+9j} + (5j)$$~~

~~$$= \frac{15+20j}{3+9j} \times \frac{3-9j}{3-9j} + (5j)$$~~

$$= \frac{-20+15j}{3+9j} + (5j)$$

$$\frac{-20+15j}{3+9j} \times \frac{3-9j}{3-9j} + (5j)$$

$$= \frac{75+225j}{90} + (5j)$$

$$= 0.83 + 2.5j + 5$$

$$R_{Total} = 5.833 + 2.5j \text{ units?}$$

$$I_{Total} = \frac{V}{R} = \frac{50j}{5.833+2.5j} \times \frac{5.833-2.5j}{5.833-2.5j} = \frac{125+291.65j}{40.27} = 3.1+7.24j \text{ units?}$$

Q1
C110

5j

✓

✓

✓

✓

$$I = \frac{a b}{Z_{ab} Z_{Tot}} \times I_{Tot}$$

$$= \frac{(5.833 + 2.5j)}{(3 + 4j) + (5.833 + 2.5j)} \times (3.1 + 7.24j)$$

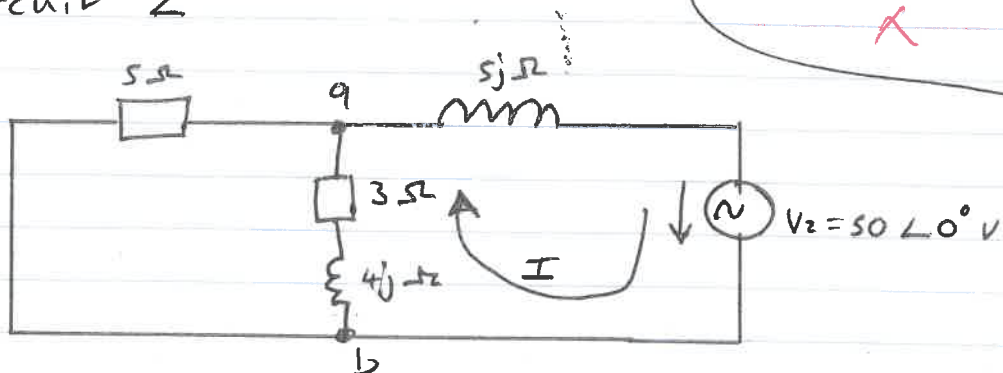
$$\frac{5.833 + 2.5j}{8.833 + 6.5j} \times \frac{3.1 + 7.24j}{1.833 - 6.5j}$$

$$\frac{67.77 - 15.832j}{115.8 + 3.26j}$$

$$= 0.56 - 0.1316j \times 3.1 + 7.24j$$

$$I_{ab} = 2.688 + 3.64j$$

Circuit 2



$$R_{Total} = \frac{(5)(3 + 4j)}{(5) + (3 + 4j)} + 5j$$

$$\frac{15 + 20j}{8 + 4j} + 5j$$

$$\frac{15 + 20j}{8 + 4j} \times \frac{8 - 4j}{8 - 4j} + 5j$$

$$\frac{200 + 100j}{80} + 5j$$

$$2.5 + 1.25j + 5j$$

$$R_{Total} = 2.5 + 6.25j$$

$$I_{Total} = \frac{V}{R} = \frac{50}{2.5 + 6.25j} \times \frac{2.5 - 6.25j}{2.5 - 6.25j} = \frac{125 - 312.5j}{45.3125}$$

$$= 2.75 - 6.89j$$

$$= 2.75 - 6.89j$$

$$I_{ab} = \frac{Z_{TOL}}{Z_{ab} + Z_{Td}} \times I_{TOL}$$

$$= \frac{(2.5 + 6.25j)}{(3 + 4j)(2.5 + 6.25j)} \times (2.75 - 6.89j)$$

$$\frac{2.5 + 6.25j}{5.5 + 10.25j} \times 2.75 - 6.89j$$

$$\frac{2.5 + 6.25j}{5.5 + 10.25j} \times \frac{5.5 - 10.25j}{5.5 - 10.25j} \times 2.75 - 6.89j$$

$$\frac{77.81 + 8.75j}{135.3125} \times 2.75 - 6.89j$$

$$0.57 + 0.0646j \times 2.75 - 6.89j$$

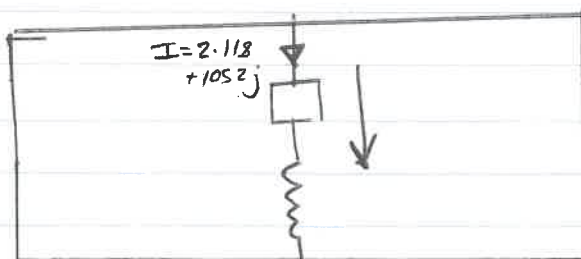
$$\text{Circuit } I_{ab} = 0.57 - 688.8j$$

$$\text{Circuit 1 } I_{ab} = 2.688 + 364j$$

$$\text{Circuit 2 } I_{ab} = 0.57 - 688.8j$$

$$I_{ab} = 2.688 + 364j - 0.57 - 688.8j$$

$$= 2.118 + 1052j$$



Q2

$$f(x) = a_0 + \sum_{n=1}^{\infty} [a_n \cos nx + b_n \sin nx] \quad \checkmark$$

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^{\pi} f(x) dx \quad \checkmark$$

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^0 f(x) dx + \frac{1}{2\pi} \int_0^{\pi} f(x) dx \quad \checkmark$$

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^0 -3 dx + \frac{1}{2\pi} \int_0^{\pi} 3 dx \quad \checkmark$$

$$a_0 = \frac{1}{2\pi} \left[-3x \right]_{-\pi}^0 + \frac{1}{2\pi} \left[3x \right]_0^{\pi} \quad \checkmark$$

$$a_0 = \frac{1}{2\pi} [-3(0) - (-3\pi)] + \frac{1}{2\pi} [3(\pi) - (0)] \quad \checkmark$$

$$a_0 = 0 \quad \checkmark$$

8/11

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos nx \, dx \quad \checkmark$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^0 f(x) \cos nx \, dx + \frac{1}{\pi} \int_0^{\pi} f(x) \cos nx \, dx \quad \checkmark$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^0 -3 \cos nx \, dx + \frac{1}{\pi} \int_0^{\pi} 3 \cos nx \, dx \quad \checkmark$$

$$a_n = \frac{1}{\pi} -3 \left[\frac{\sin nx}{n} \right]_{-\pi}^0 + \frac{1}{\pi} 3 \left[\frac{\sin nx}{n} \right]_0^{\pi} \quad \checkmark$$

u//

?

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin nx \, dx \quad \checkmark$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^0 -3 \sin nx \, dx + \frac{1}{\pi} \int_0^{\pi} 3 \sin nx \, dx \quad \checkmark$$

$$b_n = \frac{1}{\pi} -3 \left[\frac{-\cos nx}{n} \right]_{-\pi}^0 + \frac{1}{\pi} 3 \left[\frac{-\cos nx}{n} \right]_0^{\pi} \quad \checkmark$$

u//

?

3.

$$i. 1 + 2t - \frac{1}{3}t^4 \Rightarrow \frac{1}{s} + \frac{1}{s^2} - \frac{1}{3} \frac{4!}{s^{4+1}}$$

$$\Rightarrow \frac{1}{s} + \frac{1}{s^2} - \frac{8}{s^5}$$

$$ii. 5e^{2t} - 3e^{-t} \Rightarrow \frac{5}{s-2} - \frac{3}{s+1}$$

$$iii. 6 \sin(3t) - 4 \cos(5t) \Rightarrow 6 \cdot \frac{3}{s^2+3^2} - 4 \cdot \frac{5}{s^2+5^2}$$

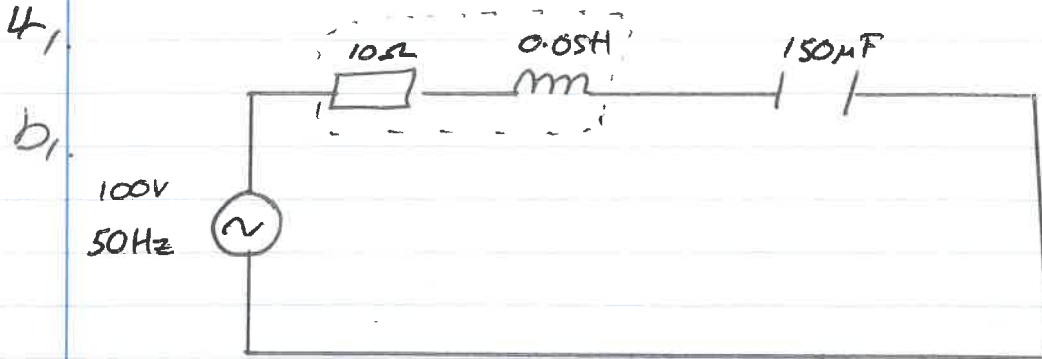
$$= \frac{18}{s^2+9} - \frac{20}{s^2+25}$$

$$iv. e^{-2t} \sin(4t) \Rightarrow \frac{4}{(s+2)^2+4^2} = \frac{4}{(s+2)^2+16}$$

$$v. \cos(2t) + 3e^{-4t} \Rightarrow \frac{s+4}{(s+4)^2+2^2} = \frac{s+4}{(s+4)^2+4}$$

Q3
a

7.



Q4

b

14

$$X_L = 2\pi fL$$

$$= 2 \cdot \pi \cdot 50 \cdot 0.05H$$

$$= 15.7j\Omega \quad \checkmark$$

$$X_C = \frac{1}{2\pi fC}$$

$$= \frac{1}{2 \cdot \pi \cdot 50 \cdot 150 \cdot 10^{-6}}$$

$$= -21.22j\Omega \quad \checkmark$$

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

$$\sqrt{10^2 + (15.7 - 21.22)^2}$$

$$R = 11.422\Omega$$

$$Z = R + (X_L - X_C)$$

$$10 + (15.7j - 21.22j)$$

$$= 10 - 5.52j\Omega \quad \checkmark$$

$$Z = \frac{10 - 5.52j\Omega}{\sqrt{10^2 + (-5.52)^2}}$$

$$= 11.42\Omega \quad \checkmark$$

$$\theta = \tan^{-1} \frac{b}{a} = \tan^{-1} \frac{5.52}{10}$$

$$\theta = 28.89^\circ \quad \checkmark$$

+ Total impedance

$$= 11.42 \angle 28.89^\circ \quad \checkmark$$

+ Supply Current

$$I = \frac{V}{R} = \frac{100}{11.422} = 8.75A \quad \checkmark$$

ii.

$$P = I^2 R$$

$$= 8.75^2 \times 11.422$$

$$= 874.49W \quad \checkmark$$

Power factor ①

$$\cos 28.89 = 0.87 \quad \checkmark$$