

12 Pages

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3. The answers must be legibly written. The Examiners can either ignore the script or have it typed and the expense of typing charged to the candidate.
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6. No part of this book is to be torn out; it must be handed in complete.
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1	Student Number	2506135
2	Title of Examination Paper	Electrical and electronic principles
3	Module Code	ACD4006
4	Date and Time of Examination	18/09/2026 9:30
5	Examination Venue	301F
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	22 ✓
2	14 ✓
3	12 ✓
4	14 ✓
Total	62 ✓

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Examiner Only

627.

$\frac{P2 P}{8/6/26}$

$\frac{62}{100}$

~~He~~

1.

a) $R = 2$ area $\approx 25 \text{ m}^2$ length $= 15 \text{ cm}$

$$\rho = \frac{RA}{L}$$

$$\rho = \frac{2 \times 25}{15}$$

$$\rho = 3.33$$

b) 80w in

75w out.

$$\text{Efficiency} = \frac{P_{\text{out}}}{P_{\text{in}}}$$

$$= \frac{75}{80}$$

$$= 0.9375 \times 100$$

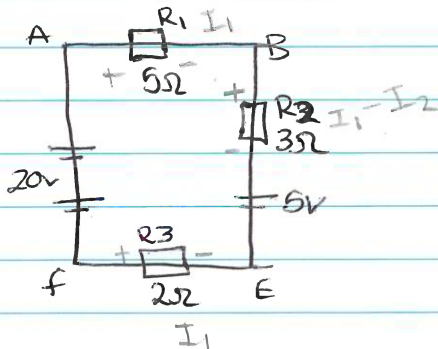
$$= 93.75\%$$

$$\text{total power loss} = P_{\text{in}} - P_{\text{out}}$$

$$= 80 - 75$$

$$= 5 \text{ w}$$

c) KVL across ABEFA

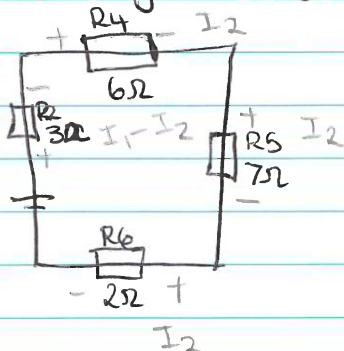


$$-5I_1 - 3(I_1 - I_2) - 2I_1 - 15 = 0$$

$$-5I_1 - 3I_1 + 3I_2 - 2I_1 - 15 = 0$$

$$-10I_1 + 3I_2 = 15 \rightarrow (1)$$

KVL through BCDEB.



$$-6I_2 - 7I_2 - 2I_2 - 5 + 3(I_1 - I_2) = 0$$

$$-6I_2 - 7I_2 - 2I_2 + 3I_1 - 3I_2 - 5 = 0$$

$$-18I_2 + 3I_1 = 5 \rightarrow (2)$$

$$-10I_1 + 3I_2 = 15 \rightarrow (1)$$

$$-18I_2 + 3I_1 = 5 \rightarrow (2)$$

multiply (1) by 6.

$$-60I_1 + 18I_2 = 90$$

$$3I_1 - 18I_2 = 5$$

$$-60I_1 - 18I_2 = -90$$

$$3I_1 - 18I_2 = -5$$

$$\begin{array}{r} -57I_1 = -95 \\ -57 \end{array}$$

$$I_1 = 1.667$$

Sub into ② ①

~~$$18I_2 + 3(1.667) = -5$$~~

~~$$18I_2 + 5.001 = -5$$~~

$$① \rightarrow -10I_1 - 3I_2 = -15$$

$$-10(1.667) - 3I_2 = -15$$

$$-16.67 - 3I_2 = -15$$

$$-3I_2 = -15 + 16.67$$

$$-3I_2 = \frac{1.67}{+3}$$

$$I_2 = 0.57$$

$$R_1 = I_1$$

$$= 1.667A$$

$$R_4 = I_2$$

$$= 0.57A$$

$$R_2 = I_1 - I_2$$

$$= 1.097A$$

$$R_5 = I_2$$

$$= 0.57A$$

$$R_3 = I_1$$

$$= 1.667$$

$$R_6 = I_2$$

$$= 0.57A$$

$$Q_1 = 2 + 5 + 15 = 22$$

2+1
/

2+1
/

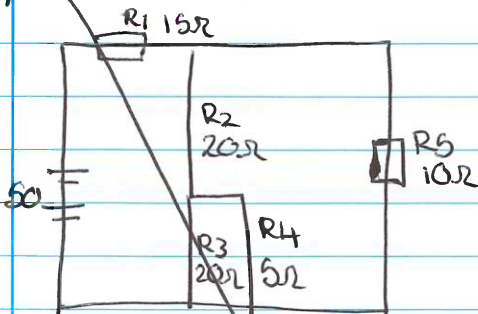
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22
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2.

a)

i) total resistance in the circuit



$$\frac{1}{R_{eq1}} = \left(\frac{1}{R3} \right) + \left(\frac{1}{R4} \right)$$

$$\frac{1}{R_{eq1}} = \left(\frac{1}{20} \right) + \left(\frac{1}{5} \right)$$

$$\frac{1}{R_{eq1}} = 4$$

$$R_{eq1} = 0.25$$

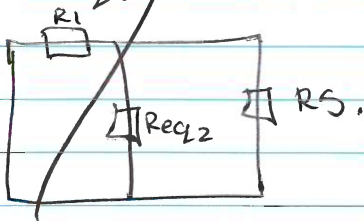
$R2$ and R_{eq1} are in series

$$R2 + R_{eq1} = R_{eq2}$$

$$20 + 0.25$$

$$= 20.25$$

$$R_{eq2} = 20.25$$



$R5$ and R_{eq2} are in parallel

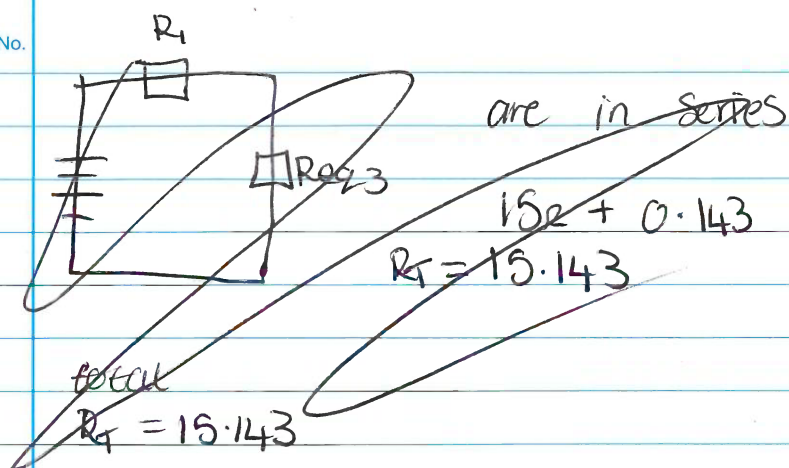
$$\frac{1}{R_{eq3}} = \frac{1}{\left(\frac{1}{R_{eq2}} \right) + \left(\frac{1}{R5} \right)}$$

$$\frac{1}{R_{eq3}} = \left(\frac{1}{20.25} \right) + \left(\frac{1}{10} \right)$$

$$= 6.694$$

$$\frac{1}{R_{eq3}} = \frac{1}{6.694}$$

$$R_{eq3} = 0.143$$



2a total resistance.

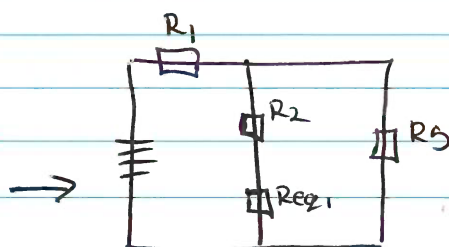
i) parallel =
 R_3 and R_4 .

$$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5}$$

$$\frac{1}{R_T} = 0.25$$

$$\frac{1}{0.25} = 4.$$

$$R_4 = R_{eq1}$$



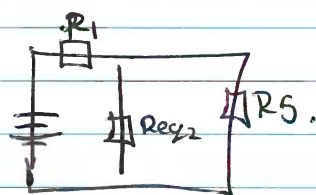
R_2 and R_{eq1} are in series.

$$R_T = R_2 + R_{eq1}$$

$$R_T = 20 + 4$$

$$= 24$$

$$R_{eq2} = 24$$



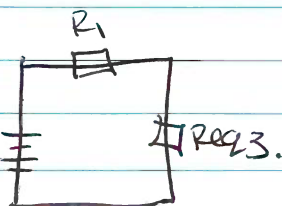
R_5 and R_{eq2} are in parallel.

$$R_T = \frac{1}{R_5} + \frac{1}{R_{eq2}}$$

$$= \frac{1}{10} + \frac{1}{24}$$

$$= 0.1416$$

$$\frac{1}{R_{eq3}} = 7.059$$



R_1 and R_{eq3} are in series.

$$R_T = R_1 + R_{eq3}$$

$$= 15 + 7.059$$

$$R_1 = 22.059$$

$$ii) I = \frac{V}{R}$$

$$T = \frac{50}{22.059}$$

$$I = 2.267 \text{ A}$$

iii) Current across each resistor.

$$I_1 = I \left(\frac{R_2}{R_1 + R_2} \right)$$

$$I_1 = 2.267 \left(\frac{20}{15+20} \right)$$

$$R_1 = 1.295 \text{ A.}$$

$$I_2 = I \left(\frac{R_1}{R_2 + R_1} \right)$$
$$= 2.267 \left(\frac{15}{20 + 15} \right)$$

$$R_2 = 0.971 \text{ A}$$

$$I_4 = I \left(\frac{R_4}{R_3 + R_4} \right)$$

$$T_3 = T \left(\frac{R_3}{R_4 + R_3} \right)$$

$$= 2267 \left(\frac{5}{2045} \right)$$

$$= 2.267 \left(\frac{1820}{5+20} \right)$$

$$R_3 \rightarrow = 0.4534$$

$$R_4 = 1.81$$

$$I_5 = I \left(\frac{(I_4 + I_3 + I_2) R_4}{R_5 + I_4} \right)$$

$$= 0.24439 \text{ A}$$

$$= 0.24439 \dots$$

iv) voltage across each resistor

$$V_1 = V \frac{R_1}{R_1 + R_2}$$

$$= 50 \left(\frac{15}{15+20} \right)$$

$$= 21.428\text{V}$$

$$V_2 = V \frac{R_2}{R_2 + R_1}$$

$$= 50 \frac{20}{20+15}$$

$$= 7.4674\text{V}$$

$$V_3 = V \frac{R_3 - R_4}{R_3 + R_2 - R_4}$$

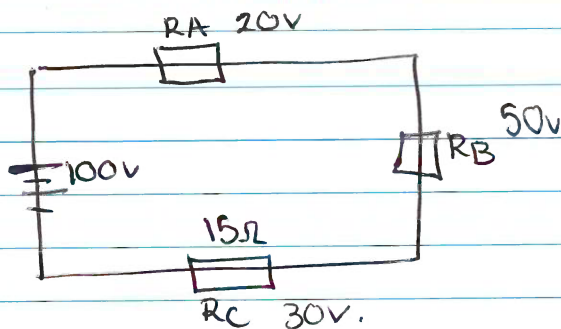
$$= 50 \frac{20-5}{20+20-5}$$

$$= 21.428\text{V}$$

$$Q_2 = 14$$

3)

a)



total current = 2.

i) $V = I \times R$
 $= 2 \times 15$
 $R_C = 30\text{V}$

ii) $R_A = 100 - 50 - 30$
 $R_A = 20\text{V}$

iii) resistance of R_A and R_B

$$R_A = \frac{V}{I}$$

$$= \frac{20}{2}$$

$$= 10\Omega$$

$$R_B = \frac{V}{I}$$

$$= \frac{50}{2}$$

$$= 25\Omega$$

b) maximum power transfer theorem is the maximum amount of load (v) that can be travelled and taken through a circuit without causing harm to other components

c) Reactance is the amount of resistance a ^{diode} resistor can withstand before breaking.

impedance is the combined load of the reactance and capacitance in a given circuit.

an intrinsic semiconductor is a control measure put in place in order to ensure that there is no jumping of voltage between systems.

d. $v(t) = 75 \cos(200\pi t)$

i) Amplitude: $75 \cos(200\pi)$
 $= 2.201$

ii) $75 \cos(200\pi)$ Peak to Peak $P_k = 75$
 $\neq 2.201$ $= 2 \times 75$ I_{max}
 $= 150$

iii) RMS

$$V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$V_m = 75 \quad \frac{75}{\sqrt{2}}$$

$$= 53.033$$

iv) $f = \frac{1}{T}$

$$f = \frac{1}{75 \cos(200\pi)}$$

$$= 0.45 \text{ Hz}$$

$v = \text{time period}$

$$t = \frac{1}{f}$$

$$t = \frac{1}{0.45 \text{ Hz}}$$

$$= 2.22$$

$$Q_3 = 8 + 0 + 0 + 4 = 12$$

4) impedance



$$\text{Voltage} = 240$$

$$\text{frequency} = 50\text{Hz}$$

$$\text{resistance} = 200\Omega$$

$$L = 47\text{mH}$$

$$\times 10^{-3}$$

$$C = 55\mu\text{F}$$

$$= \times 10^{-6}$$

$$X_L = 2\pi f L$$

$$= 2 \times \pi \times 50 \times 47 \times 10^{-3}$$

$$= 14.765$$

$$X_C = \frac{1}{2\pi f C}$$

$$= \frac{1}{2 \times \pi \times 50 \times 55 \times 10^{-6}}$$

$$= 57.875$$

$$= 57.875$$

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

$$|Z| = \sqrt{200^2 + (14.765 - 57.875)^2}$$

$$|Z| = 204.593$$

$$\text{ii) phase angle} = \tan^{-1} \left(\frac{X_L - X_C}{R} \right)$$

$$= \tan^{-1} \left(\frac{14.765 - 57.875}{200} \right)$$

$$\theta = -12.164^\circ$$

$$\text{iii) } I = \frac{V}{R}$$

$$= \frac{240}{200}$$

$$I = 1.2\text{A}$$

3) iv)

voltage drop across capacitor

$$V_C = I X_C$$

$$= 2.1 \times 57.875$$

$$= 121.5375$$

voltage drop across inductor

$$V_L = I X_L$$

$$= 2.1 \times 14.765$$

$$= 31.0065$$

voltage drop across resistor.

$$\frac{P}{I}$$

$$= \frac{240}{2.1}$$

$$= 114.286$$

b)

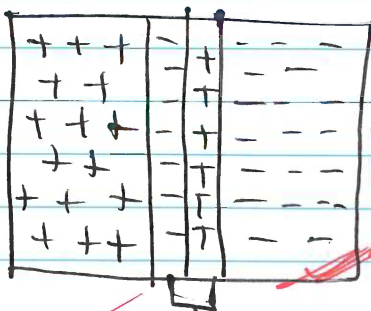
voltage drop of 0.7
 voltage of 5V
 resistor = 1000Ω

$$5 - 0.7 = 4.3$$

$$I = \frac{V}{R} \quad I = \frac{4.3}{1000}$$

$$I = 4.3 \times 10^{-3} \text{ A}$$

c)



when a PN junction is forward biased it can cause for the depletion region to get bigger due to the circuit level increasing, this causes an influx of current. this can then lead to inaccurate readings and can effect the functioning of the circuit.

$$Q_4 = 10 + 3 + 1 = 14$$



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Question No.

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