

Examination Answer Books

Instructions to Candidates

1. Please give the information requested in the book.
2. Enter your name in the space provided to the right, fasten the book with the provided tags and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either deduct marks or the question is 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.**

List the numbers of the questions you have attempted	Office Use
1	24 ✓
2	14 ✓
3	17 ✓
4	24 ✓
Total	79

(Gweler yr ochr arall am y fersiwn Cymraeg)

$$\begin{array}{r} \times 40.25 \\ \hline 0.15 \end{array}$$

1 ✓
1 ✓
2 ✓

797.

12/1
8/6/20

$$\frac{79}{100}$$

~~de~~

Question 1

a.) $R = \frac{P L}{A}$ $\rho = \frac{R A}{L}$ $\rho = \frac{2 \times 0.25}{0.15}$

$\rho = 3.33 \Omega \text{m (2dp)}$

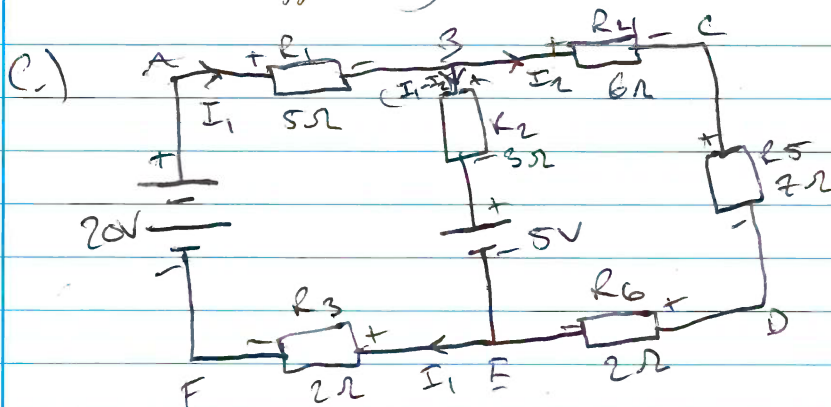
b.) $P_{\text{Loss}} = P_{\text{in}} - P_{\text{out}}$

$P_{\text{Loss}} = 80 - 75 = 5 \text{ W}$

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

$\text{Efficiency} = \frac{75}{80} = 0.9375 = 0.94 \text{ (2dp)}$

$\text{Efficiency} = 94\%$



Applying KVL in ABEFA

$$-5I_1 - 3(I_1 - I_2) - 5 - 2I_1 + 20 = 0$$

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

Applying KVL in BCDEB

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

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

$$(1) \times 6: -60I_1 + 18I_2 = -90 \quad (3)$$

Cont Q1C)

(3) + (2)

$$\begin{array}{r}
 -60I_1 + 18I_2 = -90 \\
 + \quad 3I_1 - 18I_2 = -5 \\
 \hline
 \end{array}$$

$$-57I_1 = -95$$

$$I_1 = 1.67 \text{ A (2dp)}$$

Sub I_1 into (2)

$$3(1.67) - 18I_2 = -5$$

$$5.01 - 18I_2 = -5$$

$$-18I_2 = -10.01$$

$$I_2 = 0.56 \text{ A (2dp)}$$

current across $R1, R3 = 1.67 \text{ A}$ current across $R4, R5, R6 = 0.56 \text{ A}$ current across $R2 = 1.67 - 0.56 = 1.11 \text{ A}$

$$Q_1 = 2 + 5 + 17 = 24$$

Question 3a) $R_3 + R_4$ in parallel

$$R_{eq1} = \frac{1}{\frac{1}{20} + \frac{1}{5}} = 4 \Omega$$

 $R_2 + R_{eq1}$ in series

$$R_{eq2} = 20 + 4 = 24 \Omega$$

 $R_{eq2} + R_5$ in parallel

$$R_{eq3} = \frac{1}{\frac{1}{24} + \frac{1}{10}} = 7.06 \Omega \quad (2 \text{ dp})$$

 $R_1 + R_{eq3}$ in series

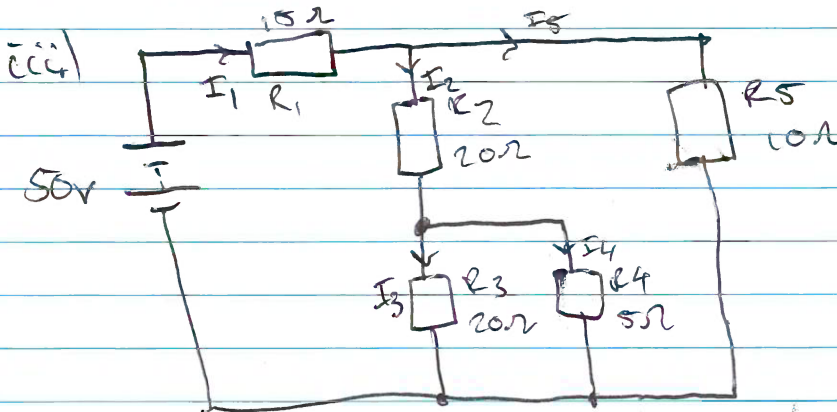
$$R_{eq4} = 15 + 7.06 = 22.06 \Omega$$

$$\text{Total resistance} = 22.06 \Omega$$

$$\text{a ii.) } I = \frac{V}{R}$$

$$I = \frac{50}{22.06}$$

$$I = 2.27 \text{ A (2 dp)}$$



$$I_1 = 2.27 \times \frac{15}{15 + 24} = 0.87 \text{ A (2 dp)}$$

$$I_2 = 2.27 \times \frac{(20 \times 10)}{20 + 10 + 4} = 2 \text{ A (2 dp)}$$

$$I_3 = 2 \times \frac{20}{20 + 5} = 1.6 \text{ A}$$

$$I_4 = 2 \times \frac{5}{20 + 5} = 0.4 \text{ A}$$

$$I_5 = 2.27 \times \frac{10}{10 + 24} = 0.67 \text{ A (2 dp)}$$

2iv.)

$$V_1 = I_1 \times R_1 \quad V_1 = 0.87 \times 15 \quad V_1 = 13.05 \text{ V}$$

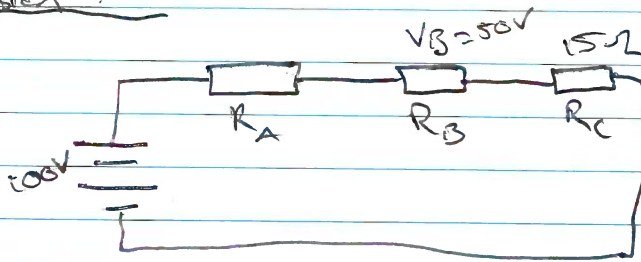
$$V_2 = I_2 \times R_2 \quad V_2 = 2 \times 20 \quad V_2 = 40 \text{ V}$$

$$V_3 = I_3 \times R_3 \quad V_3 = 1.6 \times 20 \quad V_3 = 32 \text{ V}$$

 $Q_2 \text{ 2/4}$

Question 3

a.)



$I = 2 \text{ A}$

i.) $V_C = I \times R_C$

$V_C = 2 \times 15 = 30 \text{ V}$

ii.) $V_A = 100 \text{ V}$

iii.) $R_A = \frac{V_A}{I} \quad R_A = \frac{100}{2} \quad R_A = 50 \Omega$

$R_B = \frac{V_B}{I} = \frac{50}{2} = 25 \Omega$

b.) • Maximum power transfer theorem states that as the current increases so does the voltage until they both reach their maximum and then decrease



c.)

• Reactance is the opposition to change of current flow (AC property)

cii.) • Impedance is the total circuit's opposition to change of current flow (AC property)

ciii.) • An intrinsic semiconductor is a property that has the potential to both conduct and insulate electricity.

322.)

$$V_{\max} = 75 \text{ V} = \text{Amplitude}$$

$$\text{ii.) } V_{pp} = 75 \times 2 = 150 \text{ V}$$

$$\text{iii.) } V_{RMS} = \frac{75}{\sqrt{2}} \quad V_{RMS} = 53.03 \text{ V (2dp)}$$

$$\text{iv.) } \omega = 200\pi$$

$$\begin{aligned} \omega &= 2\pi f \\ \frac{200\pi}{2\pi} &= f \\ f &= 100 \text{ Hz} \end{aligned}$$

$$\text{v.) } t = \frac{1}{f} \quad t = \frac{1}{100} = 0.01 \text{ seconds}$$

$$Q_3 = 4 + 0 + 5 + 8$$

2 (17)

Question 4

ai.) $|Z| = \sqrt{R^2 + (X_L - X_C)^2}$ ✓
 $X_L = 2\pi fL$ ✓
 $X_C = \frac{1}{2\pi fC}$ ✓

$$X_L = 2\pi \times 50 \times (47 \times 10^{-3}) = 14.77 \Omega \text{ (2dp)} \quad 2$$

$$X_C = \frac{1}{2\pi \times 50 \times (55 \times 10^{-6})} = 57.87 \Omega \text{ (2dp)} \quad 2$$

$$|Z| = \sqrt{200^2 + (14.77 - 57.87)^2}$$

$$|Z| = 204.59 \Omega \text{ (2dp)} \quad 2$$

ii.) $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

$$\phi = \tan^{-1}\left(\frac{14.77 - 57.87}{200}\right)$$

$$\phi = -12.16^\circ \quad 2$$

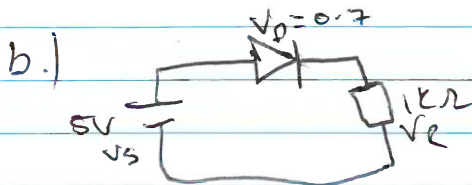
Current lags the voltage by about 12.16°

iii.) $I = \frac{V}{Z} \quad I = \frac{240}{204.59} \quad I = 1.17 \text{ A (2dp)} \quad 2$

iv.) $V_R = 1.17 \times 200 = 234 \text{ V} \quad 2$

$$V_L = 1.17 \times 14.77 = 17.28 \text{ V (2dp)} \quad 2$$

$$V_C = 1.17 \times 57.87 = 67.71 \text{ V (2dp)} \quad 2$$



$$-V_D - V_R + V_S = 0$$

$$V_R = V_S - V_D$$

$$V_R = 4.3 \text{ V} \quad 2$$

$$I_D = I_R = \frac{4.3}{1000} = 4.3 \text{ mA} \quad 2$$

$$I_D = 4.3 \text{ mA as well}$$

Because in series

- 4c.)
- When a PN junction is forward biased an external supply is needed to be applied to remove the depletion region
 - Once the supply is applied the positive charge particles in the p-region will fill the holes in the n-region
 - And the negatively charged particles will fill the holes in the p-region
 - Once an external supply is applied current will start to flow through the diode

$$Q_4 = 16 + 4 + 4$$

$$Q_4 = 24$$



Question No.

Examiner Only

Arholwr yn unig

Rhif y Cwestiwn

