

Examiner Only

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 read 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	2420842
2	Title of Examination Paper	Electrical and Electronic Principles
3	Module Code	ACDA4006
4	Date and Time of Examination	13/09/25 09:00 AM
5	Examination Venue	UWTSD 316
6	Seat Number	7
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
2	16
	22
3	18
4	1
Total	57%

(Gweler yr ochr arall am y fersiwn Cymraeg)

1-

$$a) 25W - 20W = 5W = \text{Power Lost}$$

$$5/25 = 0.2 \times 100 = 20\%$$

$$100\% - 20\% = 80\% \text{ Total efficiency}$$

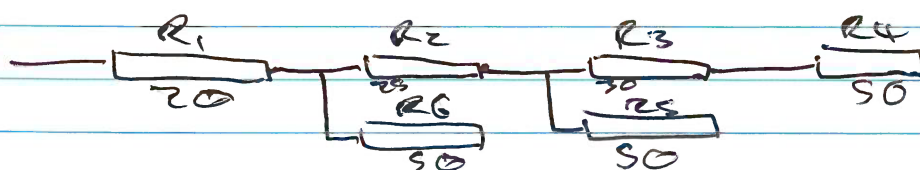
$$\text{Total efficiency} = 80\%$$

$$\text{Power lost} = 5W$$

$$b) \frac{P}{IV}$$

$$I = P \times V \quad 1W \times 30 = 3A$$

c)



$$R_{3/4} = R_3 + R_4 = 30 + 50 = 80\Omega$$

$$R_{3/4/5} = \frac{R_{3/4} \times R_5}{R_{3/4} + R_5} = \frac{80 \times 50}{80 + 50} = 30.769\Omega$$

$$R_{3/4/5/2} = R_2 + R_{3/4/5} = 25 + 30.769\Omega = 55.769\Omega$$

$$R_{3/4/5/2/6} = \frac{R_{3/4/5/2} \times R_6}{R_{3/4/5/2} + R_6} = \frac{55.769 \times 50}{55.769 + 50} = 26.364\Omega$$

c)

i - Continued.

$$R_{\text{total}} = R_{3/4/5/2/6} + R_1 = 26.364 + 20 = 46.364 \Omega$$

ii - $I_{R1} = I_{\text{total}}$

$$I_{R1} = \text{total } V / R_{\text{total}} = 15 / 46.364 = 0.323527 \text{ A}$$

$$I_{R1} = 323.527 \text{ mA}$$

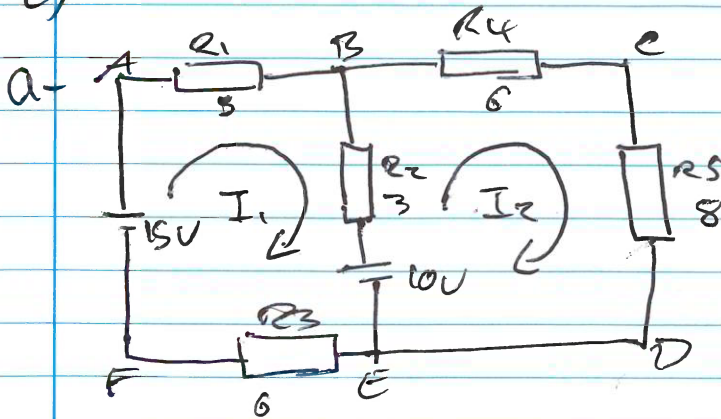
d)

e) Kirchhoff's Current Law states that the overall current into a circuit must equal the overall current out

Q1 total

16
25

2)



$$ABEF = -I_{R1} - I_{R2} - 10V - I_{R3} + 15V$$

$$\Rightarrow -5I_1 - 3(I_1 - I_2) - 10 - 6I_1 + 15 = 0$$

$$= -14I_1 + 3I_2 + 5V = 0$$

$$BCDE = -3(I_1 + I_2) - 6I_2 - 8I_2 - 10 = 0$$

$$= -3I_1 - 3I_2 - 6I_2 - 8I_2 - 10 = 0$$

$$= -3I_1 - 17I_2 - 10 = 0$$

$$ABEF \quad -14I_1 + 3I_2 + 5V = 0 \quad (\times 3)$$

$$BCDE \quad -3I_1 - 17I_2 - 10 = 0 \quad (\times 14)$$

$$-42I_1 + 9I_2 + 15V = 0$$

$$-42I_1 - 238I_2 - 140 = 0$$

$$-224I_2 - 135V = 0$$

$$-224I_2 = 135V$$

$$I_2 = \frac{135}{-224} = -0.589519A$$

2)

a) Cont.

Substitute back

$$I_1 = -14I_1 + 3(589.519 \times 10^{-3}) + 50 = 0$$

$$-14I_1 + 1.768557 = -50$$

$$-14I_1 = -50 - 1.768557$$

$$I_1 = \frac{3.231443}{14} = 0.230817 \text{ A}$$

$$Q_1 = I_1 = 0.230817 \text{ A} = 230.817 \text{ mA}$$

$$Q_2 = I_1 + I_2 = 0.230817 + (-0.589519) = -0.358702 \text{ A} \\ = 358.702 \text{ mA}$$

$$Q_3 = I_1 = 0.230817 \text{ A} = 230.817 \text{ mA}$$

$$Q_4 = I_2 = -0.589519 \text{ A} = 589.519 \text{ mA}$$

$$Q_5 = I_2$$

$$b) \text{ (Z)} = \sqrt{R^2 + X_T^2}$$

$$X_T = X_L - X_C$$

$$X_L = 2\pi fL = 2\pi \times 50 \times (1 \times 10^{-3}) = 0.314159 \Omega$$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times (1 \times 10^{-6})} = 6.772551 \Omega$$

$$X_T = 0.314159 - 6.772551 = -6.458392$$

$$|Z| = \sqrt{100^2 + (-6.458392)^2} = 100.208 \Omega$$

$$ii) I = \frac{V}{Z} = 120 / 100.208 = 1.197509 A$$

$$iii) \phi = \tan^{-1} \left(\frac{X_L - X_C}{R} \right) = \tan^{-1} \left(\frac{1 \times 10^{-3}}{R} \right)$$

$$\phi = \tan^{-1} \left(\frac{X_L - X_C}{R} \right) = \tan^{-1} \left(\frac{1 \times 10^{-3} - 470 \times 10^{-6}}{100} \right) = \tan^{-1} \left(\frac{530 \times 10^{-6}}{100} \right) = 3.037 \times 10^{-4}$$

Q 2 total

22
25

3

a) i) Resistance - Resistance to the flow of current

ii) Impedance - Resistance to the change of flow of current

iii) Reactance - How the change in current response to a change in frequency

w) Voltage Rating - The maximum voltage a component can withstand without damaging the component

b)

$$i = 40 \sin 36314 = -28.774 A$$

$$ii) i_{rms} = \frac{i}{\sqrt{2}} = \frac{-28.774}{\sqrt{2}} = -20.346$$

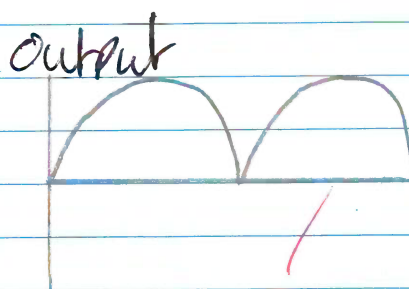
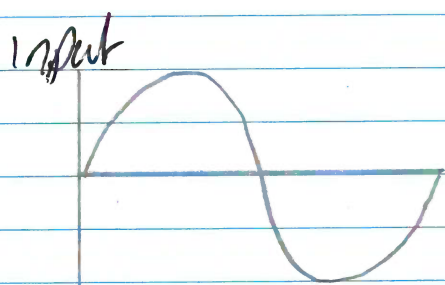
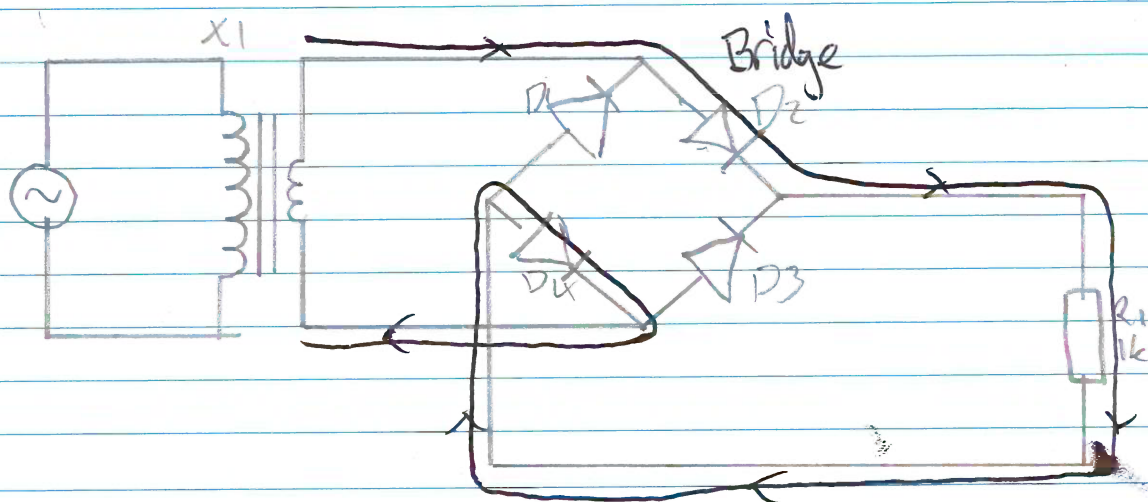
iii)

x.

c) The circuit is a transformer circuit that converts the input signal from AC to DC. The input steps down in voltage through the transformer, $\times 1$. Where the input AC signal is then rectified by the bridge diodes which direct the flow of current, maintaining a positive flow in relation to ground. The resistor serves

To limit the flow of current preventing the ~~low~~ current from tending to ~~the~~ infinity.

Below is a circuit diagram showing the flow of current through the circuit and how the input differs from the output.



Q3 total

18
25

Q4)

a)

Load Resistance (Ω)

Load Power (W)

4	9W
8	7.2W
12	6W
16	5.143W
20	4.5W

$$P = V \times I$$

$$I = V/R$$

$$I_4 = 12 / (4 + 12)$$

$$P_4 = V \times I_4 = 12 \times (12 / (4 + 12)) = 9W$$

$$P_8 = V \times I_8 = 12 \times (12 / (8 + 12)) = 7.2W$$

$$P_{12} = V \times I_{12} = 12 \times (12 / (12 + 12)) = 6W$$

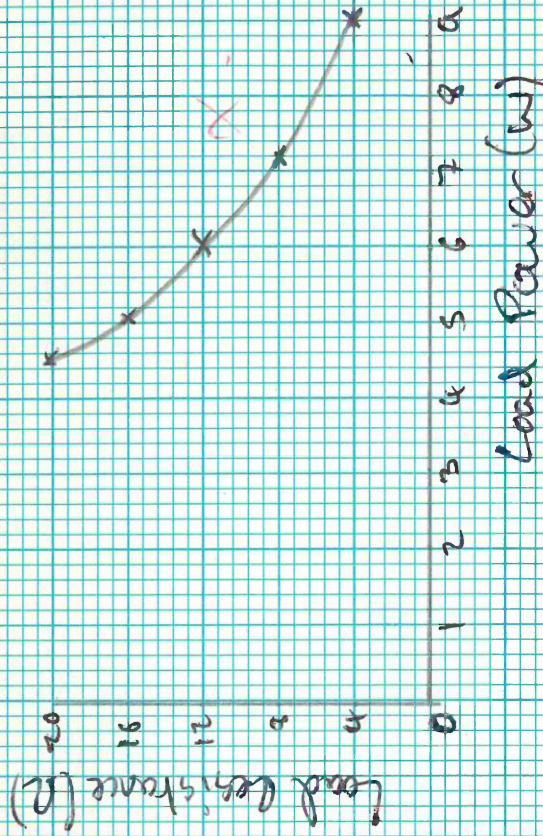
$$P_{16} = V \times I_{16} = 12 \times (12 / (16 + 12)) = 5.143W$$

$$P_{20} = V \times I_{20} = 12 \times (12 / (20 + 12)) = 4.5W$$

b- See graph paper.

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Load Power vs Load Resistance



Load Resistance (Ω)	Load Power (W)
4	9
8	7.2
12	6
16	5.143
20	4.5