



Examiner Only

## Examination Answer Books

12 Pages

## Instructions to Candidates

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 may require you to write in legible 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                   | 2316744                              |
| 2 | Title of Examination Paper       | Electrical and electronic principles |
| 3 | Module Code                      | ACDA4006                             |
| 4 | Date and Time of Examination     | 09/01/2024<br>12:00                  |
| 5 | Examination Venue                | 10310                                |
| 6 | Seat Number                      | 032                                  |
| 7 | Number of Answer Books handed in |                                      |

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

95

$$\frac{95}{100}$$

Q 1.

A)  $V = IR$   $I = \frac{V}{R}$

$$\frac{3V}{330\Omega} = \cancel{0.009A} \quad 0.009A \quad \checkmark$$

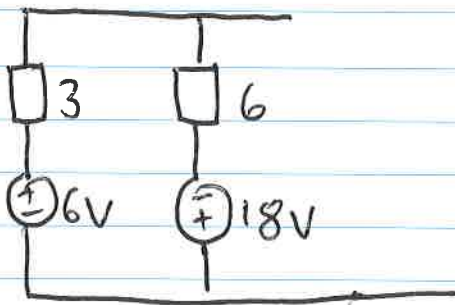
$$\frac{3}{270} = 0.01A \quad \checkmark$$

if the Resistor value is lowered the current in the indicator increases

B)

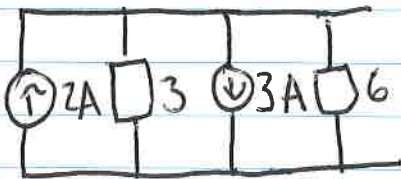
$$P = VI \quad I = \frac{P}{V} \quad \frac{1}{3} = 0.33A \quad \checkmark$$

C)

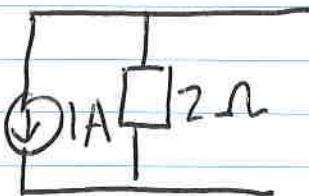


$$\frac{6}{3} = 2A \quad \checkmark$$

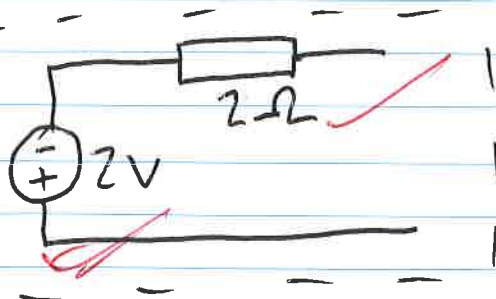
$$\frac{18}{6} = 3A \quad \checkmark$$



$$\frac{1}{\frac{1}{3} + \frac{1}{6}} = 2\Omega \quad \checkmark$$

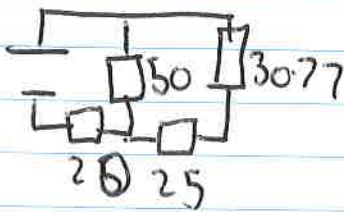
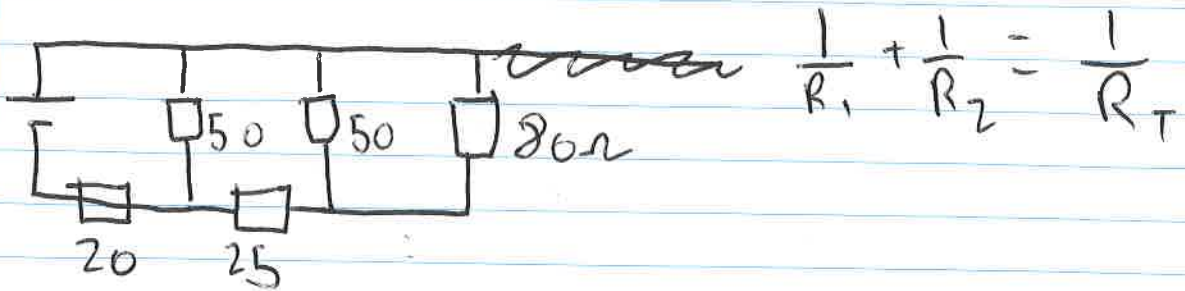


$$3 - 2 = 1A \quad \checkmark$$

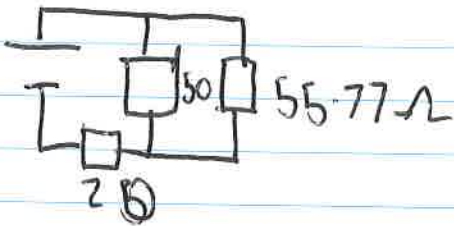


D)

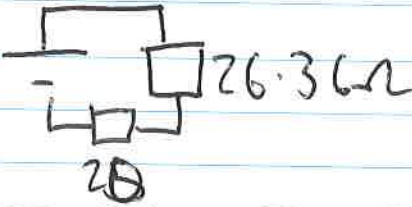
i)



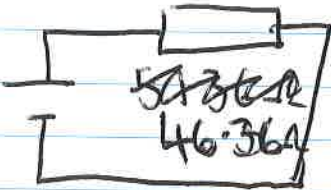
$$\frac{1}{\frac{1}{50} + \frac{1}{80}} = 30.77 \Omega$$



$$30.77 + 25 = 55.77 \Omega$$



$$\frac{1}{\frac{1}{55.77} + \frac{1}{20}} = 26.36 \Omega$$



$$26.36 + 20 = 46.36 \Omega$$

ii)

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

$$\frac{15}{46.36} = 0.324 \text{ A}$$

e)

$$P_{in} - P_{out} = P_{loss}$$

$$25 - 20 = 5 \text{ W power loss}$$

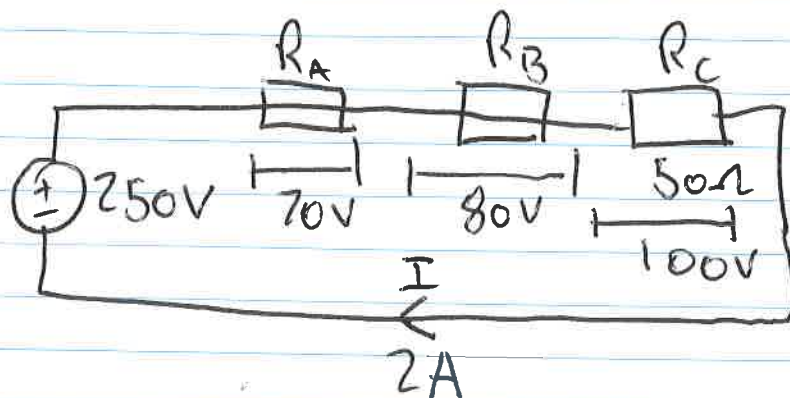
$$\frac{P_{out}}{P_{in}} \times 100 = \% \text{ efficiency}$$

$$\frac{20}{25} \times 100 = 80\% \text{ efficiency}$$

Q2

- A) Voltage across each resistor is 10V because they are all in parallel  
10V

B)



$$V = IR$$

$$V_{RC} = IR \quad V_{RC} = 50 \times 2 = 100V$$

- i)  $V_{RA} = 250 - 80 - 100 = 70V$   
Voltage across  $R_A = 70V$

- ii)  $V_{RC} = 100V$   $V = IR$   
 $2 \times 50 = 100V$

- iii)  $R_A = \frac{70}{2} = 35\Omega$   
 $R_B = \frac{80}{2} = 40\Omega$

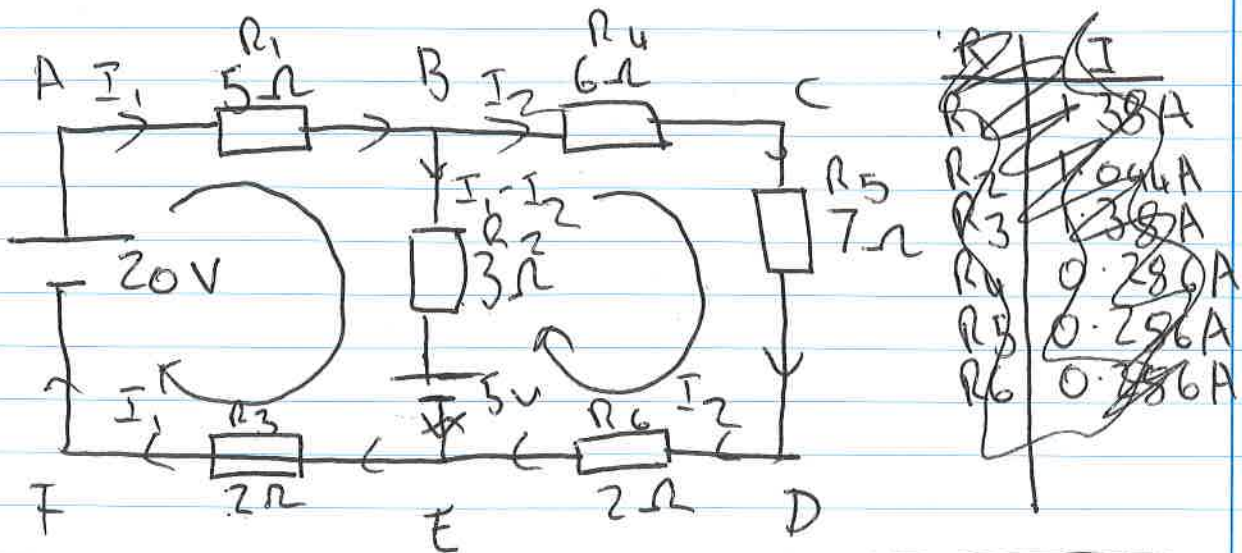
- c)
- i) Resistance is the opposition to the flow of current, physical property of resistors DC
  - ii) Impedance is a combined opposition of the flow of current in both AC and DC circuits,  $R$  and  $X$
  - iii) Reactance is the opposition to the change of current flow, AC property of both capacitors -  $X_c$  and inductors -  $X_L$
  - iv) Doping is the process of adding impurities to a semiconductor to give desired properties. Doped ~~these~~ semiconductors can be trivalent or pentavalent turning them into n-type or p-type semiconductors
  - v) Voltage Rating is the maximum input voltage a circuit was designed/intended to be operated at

d) a step-up transformer has more secondary windings than primary where as a step-down transformer has more primary windings than secondary

a step down transformer has a ~~lower~~ lower secondary side resistance than a step-up transformer

a step down has lower voltage on secondary than primary where as a step-up has higher voltage on secondary

Q3) (c)



| R  | I      |
|----|--------|
| R1 | 1.38A  |
| R2 | 1.094A |
| R3 | 1.38A  |
| R4 | 0.28A  |
| R5 | 0.296A |
| R6 | 0.286A |

Current loops:

A B E F A:

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

$$-8I_1 - 3I_1 + 3I_2 + 15 = 0$$

$$-11I_1 + 3I_2 = -15$$

$$-3 \times 1.38 + 3I_2 = -5$$

$$-4.14 + 3I_2$$

$$3I_2 = 4.14 - 5 = -0.86$$

$$I_2 = -0.286A$$

B C D E B:

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

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

$$-12I_2 - 3I_1 = -5$$

$$-3I_1 - 12I_2 = -5$$

$$-11I_1 + 3I_2 = -15$$

$$-3I_1 - 12I_2 = -5$$

$$-40I_1 + 12I_2 = -60$$

$$-43I_1 = -65$$

$$I_1 = \frac{65}{43} = 1.51A$$

$$I_1 = 1.51A$$

$$I_2 = 0.157A$$

$$I_1 - I_2 = 1.353A$$

$$R_1 = 1.51A$$

$$R_2 = 1.353A$$

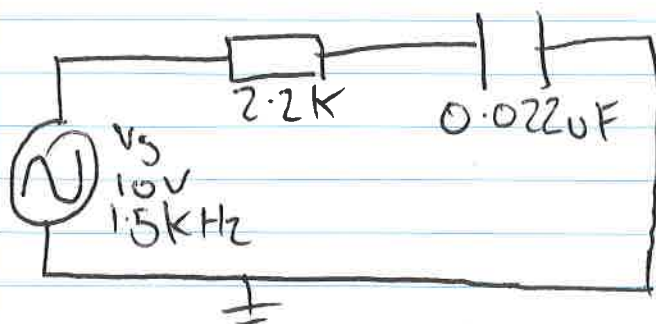
$$R_3 = 1.51A$$

$$R_4 = 0.157A$$

$$R_5 = 0.157A$$

$$R_6 = 0.157A$$

B)



$$i) \quad X_c = \frac{1}{2\pi f_c} = \frac{1}{2\pi \cdot 1.5 \times 10^3 \times 0.022 \times 10^{-6}}$$

$$X_c = 4822.9 \, \Omega$$

$$ii) \quad Z = \sqrt{R^2 + X_c^2}$$

$$\sqrt{2200^2 + 4822.9^2} = 5301.0 \, \Omega$$

$$iii) \quad \frac{V}{Z} = I \quad \frac{10}{5301.0} = 0.0019 \, A$$

$$Q4) \quad I = 40 \sin(314t) \quad I = I_m \sin(\omega t)$$

$$i) \quad 40 \, A$$

$$ii) \quad I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{40}{\sqrt{2}} = 28.3 \, A$$

$$\omega = 2\pi f$$

$$iii) \quad \frac{\omega}{2\pi} = f \quad \frac{314}{2\pi} = 49.97 \, Hz$$

B)

N type Semiconductors are doped  
becoming penta-valent meaning there  
is majority negative charge carriers

2

P type Semiconductors are doped  
with tri-valent material meaning  
they have majority positive charge  
carriers

2

C)

NPN transistor ✓

PNP transistor ✓

P channel mosfet ✓

N channel mosfet ✓

IGBT

Triac

4

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$$10^3 \times 0.022 \times 10^{-6}$$

$$22.9 \Omega$$

$$301.0 \Omega$$

$$0.19 A$$

$$= I_m \sin(\omega t)$$

Q3-21  
(21)

Scale

Big Square

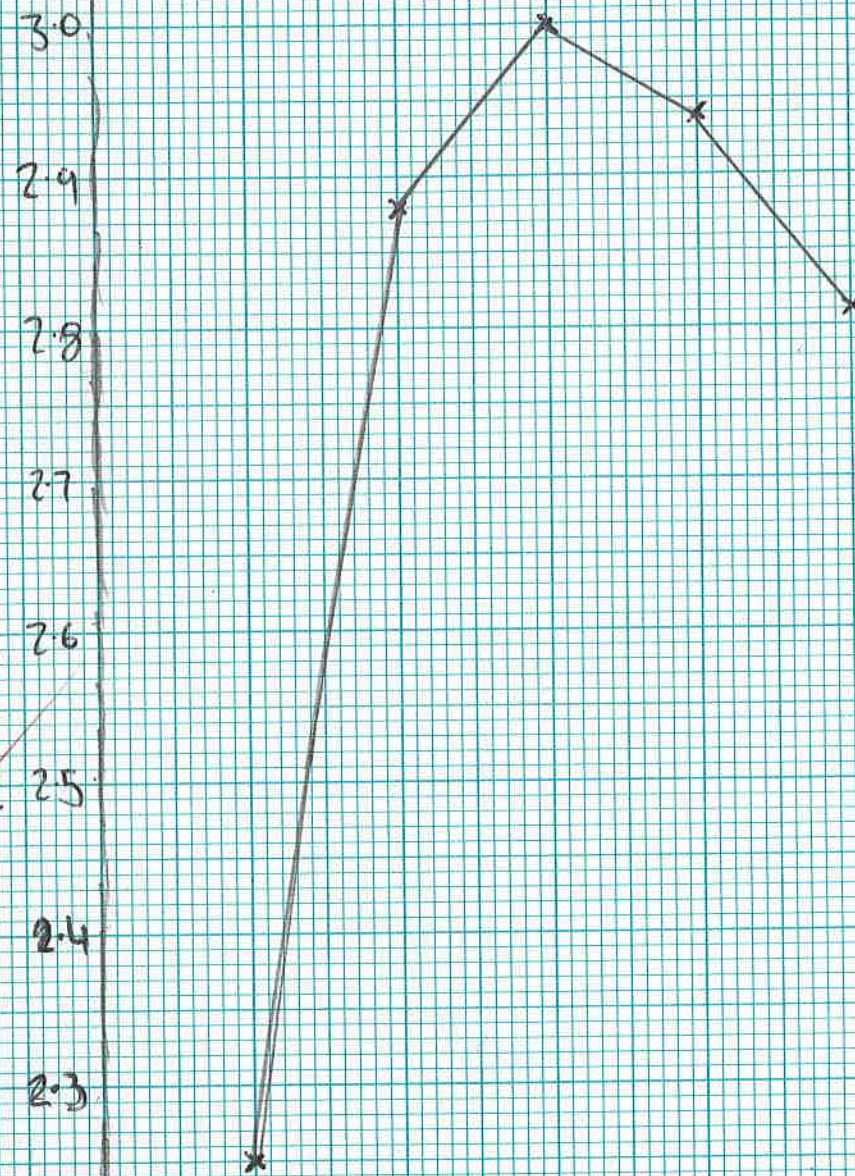
$$x = 4 \Omega$$

$$y = 0.1 W$$

Load Resistance

against Power in Load

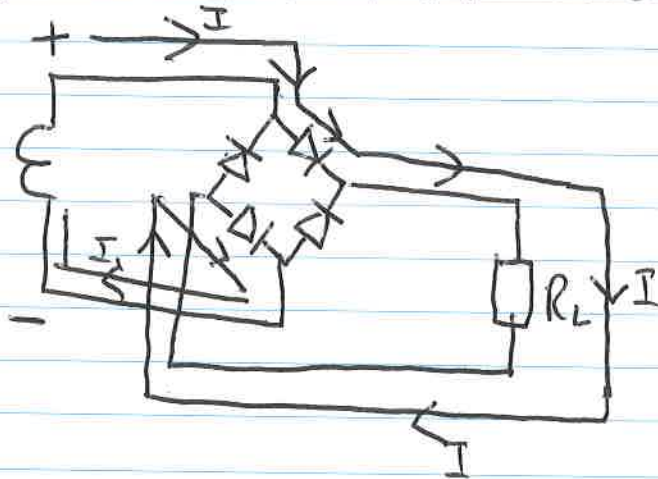
Power dissipated in load resistor (W)



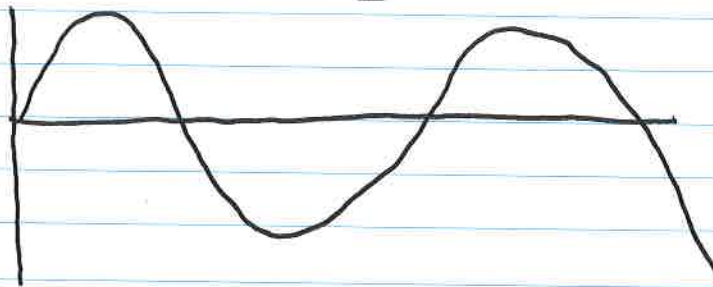
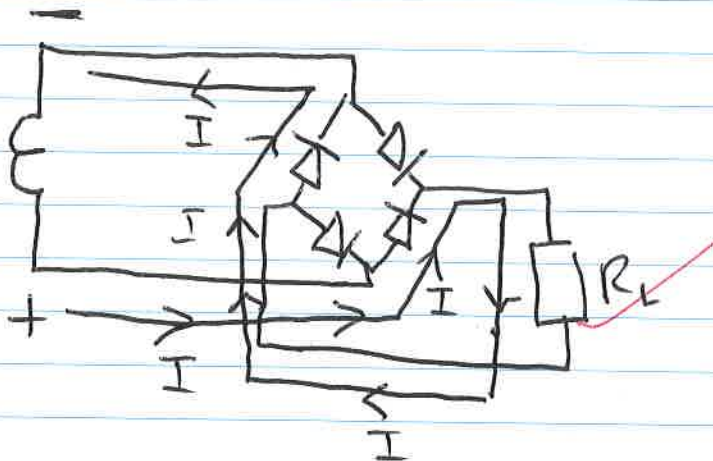
7

D) The purpose of this circuit is to Step-Down and Rectify ~~an~~ incoming A.C Voltage

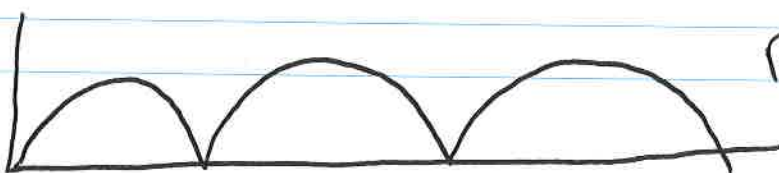
on the positive half wave diodes D2 and D4 are conducting



on the negative half cycle diodes D1 and D3 are conducting



In coming waveform



Rectified waveform

6 ✓

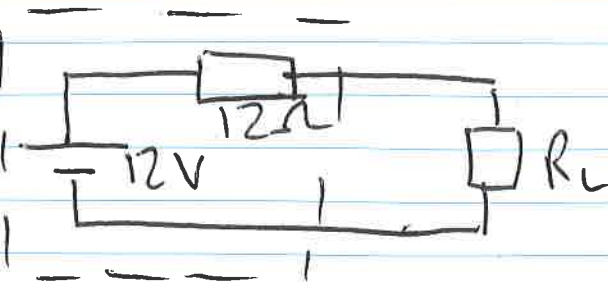
19

18+1

Q4

5)

6)



$$P = \frac{V^2}{R}$$

$$P = I^2 R$$

$$I = \frac{V}{12 + R_L}$$

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

| Load (Ω) | Load Power (W) |
|----------|----------------|
| 4        | 2.25 ✓         |
| 8        | 2.88 ✓         |
| 12       | 3 ✓            |
| 16       | 2.94 ✓         |
| 20       | 2.8125 ✓       |

$$\left( \frac{V}{12 + R_L} \right)^2 \times R_L$$

15 ✓

Graph = 7

$$\left( \frac{12}{12 + 4} \right)^2 \times 4 = 2.25 \text{ W}$$

B) on graph paper

c) two applications of transformers would be to switch on and off a load and as an amplifier ✓

2

$$Q_5 = 24$$

(24)