



2 ✓
2 ✓

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 a poor 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.**

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

53

53 | 100

~~4~~

i
V
I R

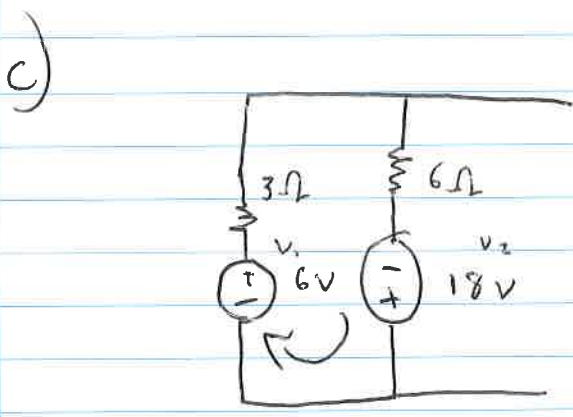
a) $I = \frac{V}{R} \quad \frac{3}{330} = 0.009A = 9.09 \text{ mA}$

$\frac{3}{270} = 0.0111A = 11.1 \text{ mA}$

current change $11.1 - 9.09 = 2.01 \text{ mA}$
Increase of 2.01 mA

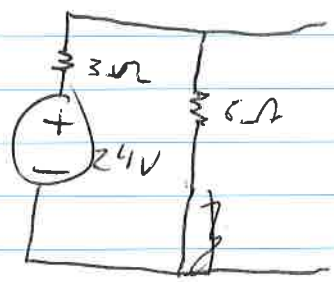
b) $P = VI \quad P: 1 \quad V = 3$

$I = \frac{1}{3} \text{ or } 0.3 \text{ A}$



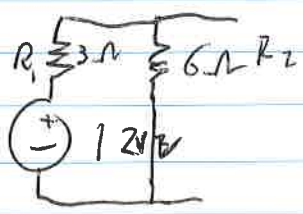
as voltage sources follow in a loop you can add together

$\frac{6}{3} = 2 \text{ A}$



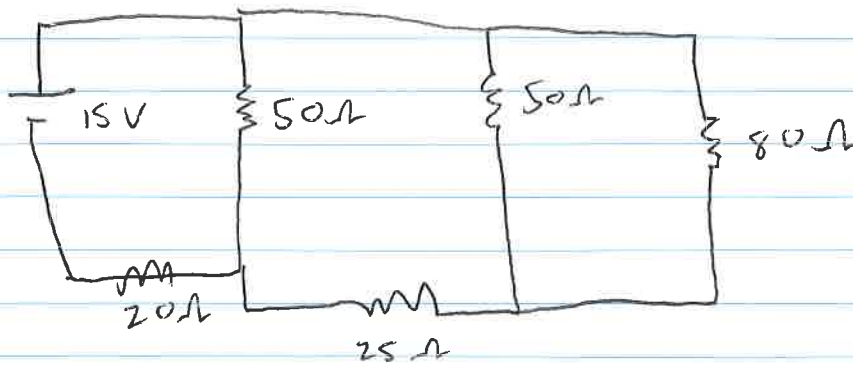
parallel therefore

$\frac{24}{2} = 12 \text{ V}$

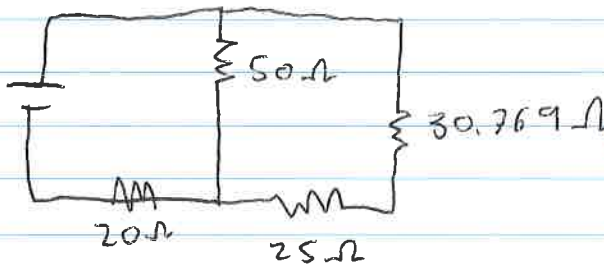


current through $R_1 = \frac{12}{3} = 4 \text{ A} \quad R_2 = \frac{12}{6} = 2 \text{ A}$

d) i)



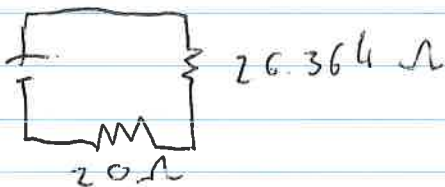
$$\left(\frac{1}{50} + \frac{1}{80} \right)^{-1} = 30.769 \Omega$$



$$\left(\frac{1}{30.769} + \frac{1}{25} \right)^{-1} = 13.793 \Omega$$

$$30.769 + 25 = 55.769$$

$$\left(\frac{1}{50} + \frac{1}{55.769} \right)^{-1} = 26.364 \Omega$$



$$20 + 26.364 = \underline{46.364 \Omega}$$

$$\text{ii) } V = IR$$

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

$$15/20 = 0.75 \text{ A}$$

e) 3 25 W_{in}

20 W_{out}

$$\frac{W_{out}}{W_{in}} \times 100 = \text{eff}$$

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

$$\text{power loss} = 5 \text{ W}$$

2 ✓

2 ✓

Q₁ = 18 ✓
(18)

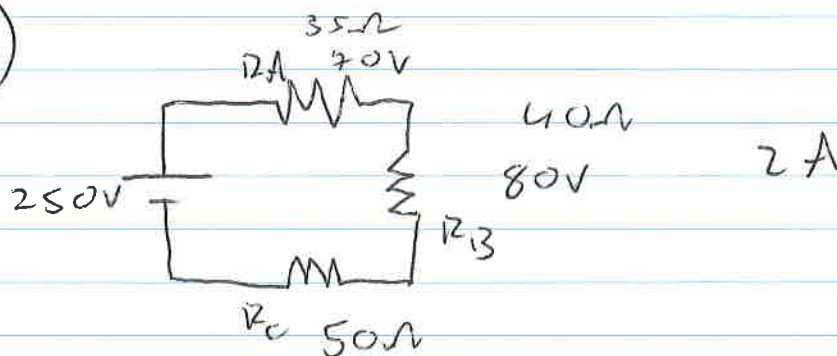
2

a) each resistor is in parallel, therefore

$$V_1 = V_2 = V_3 = V_4 = V_5$$

$$V = 10V$$

b)

i) 70V

$$100V$$

 R_B

$$\frac{80}{2} = 40\Omega$$

ii) 50Ω $2A$ $50 \times 2 = 100V$

$$R_B \quad 2 \times 40\Omega = 80$$

$$100V + 80V + V_A = 250$$

iii) $70V$ $2A$ $\frac{70}{2} = 35\Omega$

$$250 - 180 = V_A$$

$$V_A = 70$$

$$R_B \quad \frac{80}{2} = 40\Omega$$

c)

i) Regulates the flow of electrons through a circuit measured in ohms

ii) impedes the flow of electrons. measured in ohms

iii) can act as a switch to regulate a circuit safely.

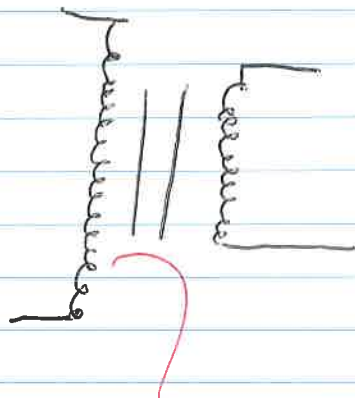
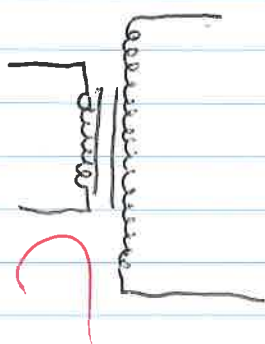
iv) adding impurities to semiconductors to change its properties

v) the maximum voltage that is safe to use for the product

d)

Step up
converts a lower
Voltage into a higher
Voltage

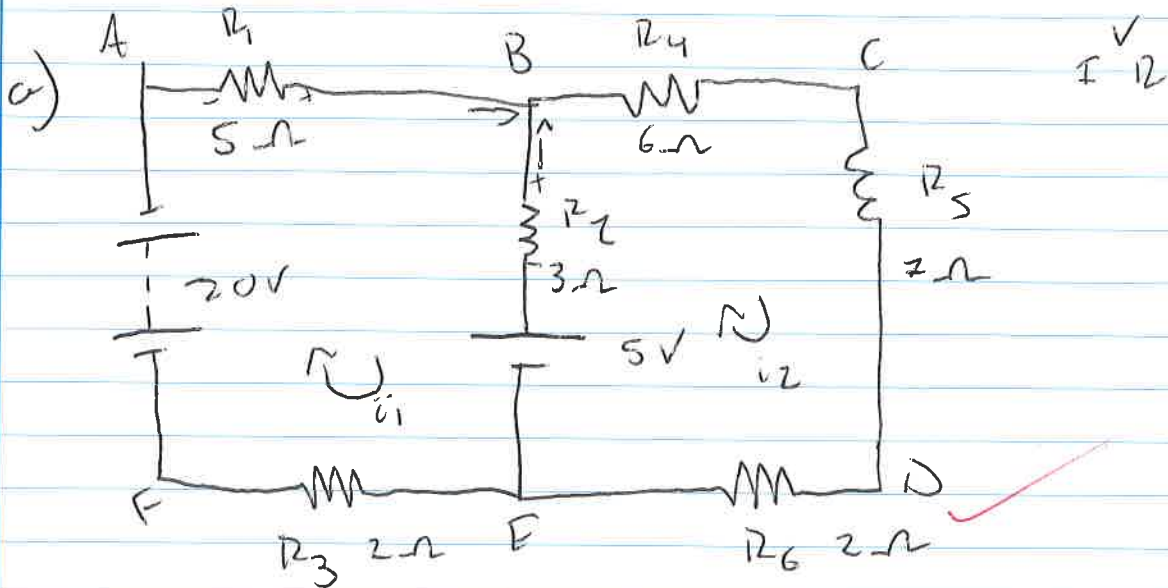
Step down
converts a higher Voltage
into a lower voltage



$$Q_2 = 20$$

(20)

3



The voltage entering a node must equal the voltage leaving the node

$$20 + 5I_1 - 3I_2 - 5 + 2I_1 = 0 \quad 15 + 4I_1 = 0$$

$$5 + 3I_1 + 6I_2 + 2I_1 + 2I_2 = 0 \quad 5 + 18I_1 = 0$$

$$I_1 = -15$$

$$15 + 4I_1 = 0 \times 1$$

$$5 + 18I_1 = 0 \times 2$$

$$135 + 36I_2 - 36I_2 - 135 = 0$$

$$135I_2 + 10 = 0$$

$$I_1 = 4A \quad I_2 = -5A \quad \frac{5}{3} - \frac{20}{3} = -5A$$

$$I_3 = 10A \quad I_4 = \frac{20}{6} + \frac{5}{6} = 4.167A$$

$$I_5 = \frac{25}{7} = 3.57A \quad I_6 = 12.5A$$

$$A \quad 20V \text{ in} = 20V \text{ out} \quad 20A \text{ Amp}$$

$$B \quad \frac{20V}{5\Omega} + \frac{5V}{3\Omega} = 5.6A \text{ Amp}$$

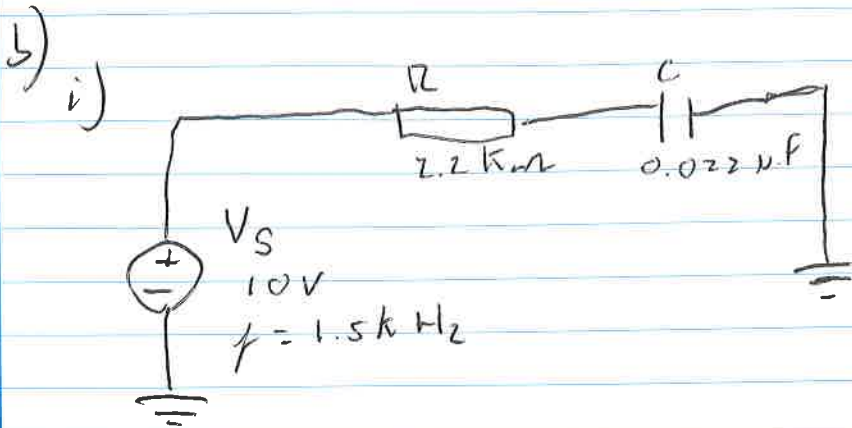
$$B \rightarrow 5.6A \text{ Amp} \quad V = IR \quad 5.6 \times 6 = 33.6V$$

$$E \quad 25V \text{ in} \quad 2\Omega \quad 12.5A \text{ Amp in}$$

$$E \rightarrow F \quad 10A \text{ Amp before resistor} \quad 10 \times 2 = 20V$$

$$E \rightarrow B \quad 2.5A \text{ Amp} + 5V \quad 2.5 \times 2 = 5V$$

voltage leaving the node is equal to the cell



i) $X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 1500 \times 0.022 \times 10^{-6}} = 4.822877013$
 $X_C = 4.82 \Omega$

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

$\sqrt{2200^2 + 4.82^2} = 2200.00528$

iii) current

$I_C = \frac{V}{X_C} = \frac{10}{4.82} = 2.075$

$\frac{10}{2200} = 0.0045$

Current $= 0.0045 + 2.075 = 2.0795 \text{ A}$

$Q_3 = 6$

4

a) i) 40 A $\frac{V_m}{\sqrt{2}}$ ✓

ii) $40/\sqrt{2} = 28.284 \text{ A}$ ✓

iii) 100 Hz ✗

$40 \sin 314 t$
 $\rightarrow 40 \sin \pi f t$

b) P type is positive ✓

$\pi f = 314$
 $f = 100$

N type is negative ✓

P type has an increase in voltage ✗
 N type has a decrease in voltage ✗

c) JFET, MOSFET, PNP BJT, NPN BJT ✓

d)

AC converter, comes from high voltage from power line. Step down transformer, likely to enter a building such as a house and therefore doesn't need a high voltage. $1 \text{ K}\Omega$ resistor in order to provide a safe current for the house. current = $\frac{240 \text{ V}}{1000 \Omega} = 0.24 \text{ Amp}$

$Q_4 = 9$

5 a) 12V battery 12 Ω $I = 1A$

Load resistance (Ω)	Load Power (W)
4	9 $\times$
8	7.2 $\times$
12	6
16	5.14 $\times$
20	4.5 $\times$

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

$$P = \frac{V^2}{\text{internal } R + R}$$

$$P = \frac{12^2}{12 + \text{Load } \Omega} \times$$

Graph (4)

b) on graph sheet

c) transfer resistor

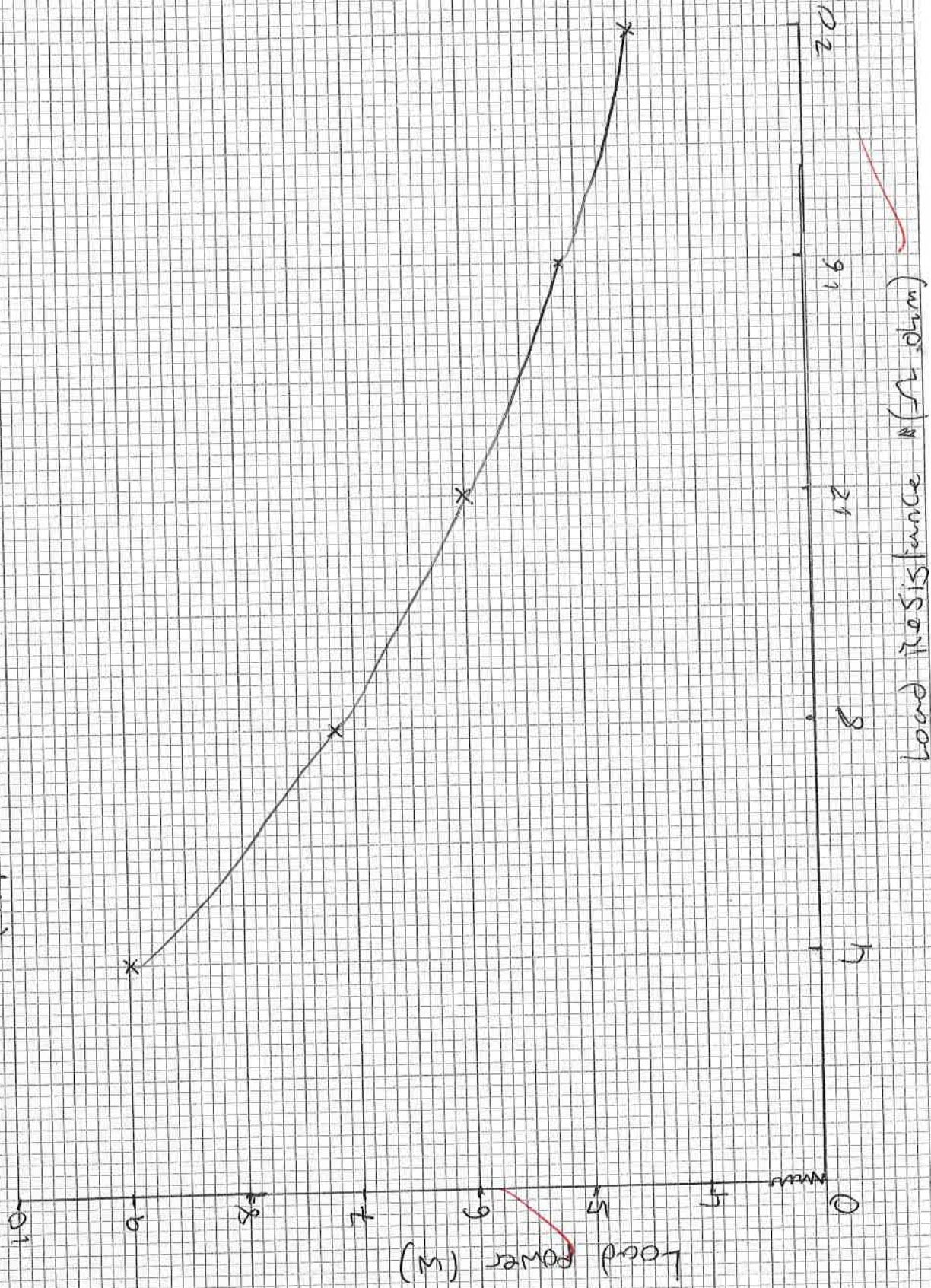
transfers current loads

can act as a switch

Q5 = (5)
(5)

b)

Graph to show load power from a 12V battery is given different resistor loads
(with a 12 ohm internal resistor)



Ratio
X axis each block (10)
represents 0.2 ohms
Y axis each block (10)
represents 0.1 W

