

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 reject 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).
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[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

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3
2

127.
 $\frac{11}{816/26}$

$$\frac{72}{100}$$

Q1) $P = \frac{RA}{L}$ ✓

a) $= \frac{2 \times 15}{25^2}$

$= 0.048 \Omega$ ✗

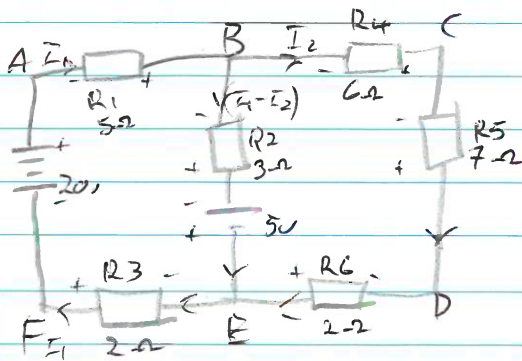
b)

$E = \frac{V_{out}}{V_{in}} = \frac{60}{75} + \frac{75}{80} = 0.9375 = 93.75\% \approx 94\%$

$= 93.8\% \text{ (d.p.)}$

Total power loss $= 60 - 75 = 5W$ ✓

c)



Current through ABEFA

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

$-25 - 10I_1 + 3I_2 = 0$

$-10I_1 + 3I_2 = 25$

Current through BCDEB

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

$-18I_2 + 3I_1 + 5 = 0$

$3I_1 - 18I_2 = -5$

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$$(c) \begin{aligned} -10I_1 + 3I_2 &= 25 \quad (1) \times 6 \\ 3I_1 - 18I_2 &= -5 \quad (2) \end{aligned}$$

$$-60I_1 + 18I_2 = 150$$

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

add together

$$-57I_1 = 145$$

$$I_1 = \frac{145}{-57} = -2.54A$$

$$R_1 = 2.54A$$

Sub into equation

$$-10(2.54) + 3I_2 = 25$$

$$-25.4 + 3I_2 = 25$$

$$3I_2 = 25 + 25.4 = 50.4$$

$$I_2 = \frac{50.4}{3} = 16.8A$$

Current across ~~R4~~ R4, R5 & R6 = 16.8A

$$\text{Current across } R_2 = I_1 - I_2 = 2.54 - 16.8 = -14.26$$

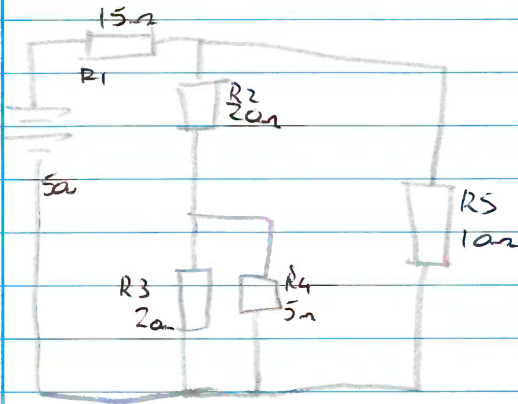
$$Q_1 = 1 + 5 + 11$$

$$Q_1 = 17$$

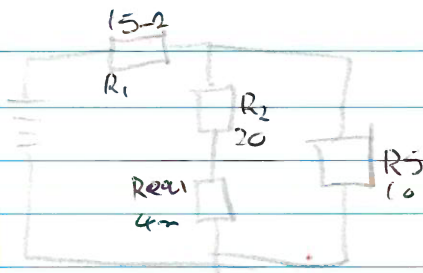
Q2)

a)

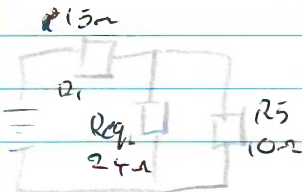
i) Total Resistance



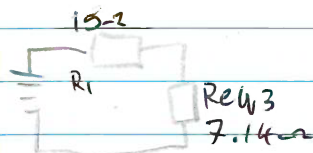
$$R_{eq1} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{20} + \frac{1}{5} = \frac{1}{0.25} = 4\Omega$$



$$R_{eq2} = R_2 + R_{eq1} = 20 + 4 = 24\Omega$$



$$R_{eq3} = \frac{1}{R_{eq2}} + \frac{1}{R_5} = \frac{1}{24} + \frac{1}{10} = \frac{1}{0.14} = 7.14 \text{ (2 d.p.)}$$



$$R_T = R_1 + R_{eq3} = 15 + 7.14 = 22.14\Omega$$

$$\text{Total Resistance} = 22.14\Omega$$

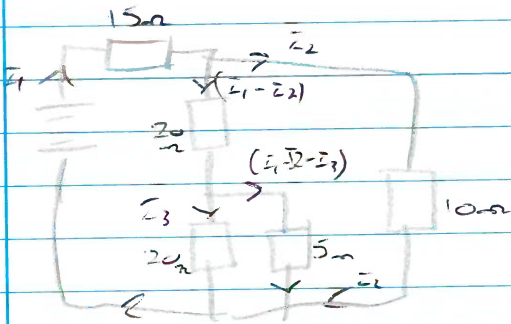
ii) Total current

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

$$I = \frac{50}{22.14}$$

$$I = 2.26 \text{ A (2d.p.)}$$

iii) Current across each resistor



$$\text{Current over } R_1 = 2.26 \text{ A}$$

$$\text{Current over } R_5 = I \frac{R_{eq2}}{R_{eq2} + R_5} = 2.26 \frac{24}{24 + 10} = 1.6 \text{ A (1d.p.)}$$

$$\text{Current over } R_2 = 2.26 - 1.6 = 0.66 \text{ A}$$

↑
 $I_1 - I_2$

$$\text{Current across } R_3 = 0.66 \frac{5}{20 + 5} = 0.132 \text{ A}$$

$$\text{Current across } R_4 = I_3 = (I_1 - I_2) - I_3 = 0.66 - 0.132 = 0.528 \text{ A}$$

$$R_1 = 2.26 \text{ A}$$

$$R_2 = 0.66 \text{ A}$$

$$R_3 = 0.132 \text{ A}$$

$$R_4 = 0.528 \text{ A}$$

$$R_5 = 1.6 \text{ A}$$

i) Voltage across R_1, R_2 & R_3

~~$V = IR$~~

$$V = I \times R = 2.26 \times 15 = 33.9 \text{ V } R_1$$

$$V = I \times R = 2.26 \times 1.6 \times 10 = 16 \text{ V } R_5$$

$$\text{Voltage going down } R_2 = 33.9 - 16 = 17.9 \text{ V } R_2$$

$$V = I \times R = 0.132 \times 20 = 2.64 \text{ V } R_3$$

$$Q_2 = 219$$

(Q3)

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

Voltage across $R_c = 30 \text{ V}$

ii) Voltage across R_a

$$R_c = 30 \text{ V}$$

$$R_d = 50 \text{ V}$$

$$V_T = 100 \text{ V}$$

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

Voltage across $R_A = 30 \text{ V}$

iii) Resistance of R_A and R_B

$$R = \frac{V}{I} = \frac{100}{2} = 50 \Omega \text{ For total resistance}$$

If $R_c = 15 \Omega$ and in series, R_A and $R_b = 50 - 15 = 35 \Omega$ between them.

If $V_B = 50 \text{ V}$

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

which means $R_A = 35 - 25 = 10 \Omega$

$$R_A = 10 \Omega$$

$$R_B = 25 \Omega$$

B) Maximum power transfer theorem is

C) i

i) Reactance is the change of current flow in an AC circuit measured in ohms

ii) Impedance is the change of current

ii) Reactance is the opposition of change in current flow measured in ohms. Displayed in an AC circuit

ii) impedance is the opposition of change in current flow in a AC circuit measured in ohms.

iii) An intrinsic Semiconductor is a material that can conduct electricity but not amazingly. The gap forbidden gap is present but able to have electrons cross. It has another material fused with it to help its conduction

D)

i) 75

ii) $75 \times 2 = 150$

iii) $V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{212.13}{\sqrt{2}} = 150.06 \text{ V}$

ii)

$$0.88 \times 200 = 176$$

$240 - 176 = 64 \text{ V}$ dropped across the resistor

$$0.88 \times 176 = 154.88$$

$176 - 154.88 = 21.12 \text{ V}$ dropped across inductor

$$0.88 \times 154.88 = 136.2944$$

$154.88 - 136.2944 = 18.5856 \text{ V}$ dropped across cap

$$Q_3 = 8 + 0 + 6 + 3$$

$$Q_3 = 17$$

Q4) Total impedance =

i) $R = 200 \Omega$

$X_L = 2\pi fL$

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

$= 14.77 \Omega$ (2d.p.)

$X_C = \frac{1}{2\pi fC}$

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

$= 57.87 \Omega$ (2d.p.)

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

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

$= 204.6 \Omega$ (4d.p.)

$= 204.59$ (2d.p.)

ii)

ii) Current Flow through

$200 + 14.77 + 57.87 = 272.64 \Omega$

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

$= \frac{240}{272.64}$

$= 0.88 A$

$= 0.88 A$

ii) $0.88 \times 200 = 176$

$240 - 176 = 64 V$ dropped on R

$0.88 \times 176 = 154.88$

$176 - 154.88 = 21.12 V$ dropped on L

$0.88 \times 154.88 = 136.2944$

$154.88 - 136.2944 = 18.5856 V$ dropped on C

Q4)

b) $5 - 0.7 = 4.3$ ✓

$$\frac{4.3}{1000} = 0.0043 \text{ A}$$

$$= 4.3 \text{ mA}$$
 ✓

2 ✓

2 ✓

c) If a diode is a PN junction, it means that the positive charged particles are closer to the anode (+) and the negative charged particles are closer to the cathode (-). In the centre, there is a wall where the positive side has negative charged particles and the negative side has positive charged.

2 ✓

$$Q4 = 8 + 4 + 2$$

$$2 \text{ (12)} \quad \checkmark$$



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