

1 1 3

12 Pages

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3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
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[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1)

a)

$$P = \frac{RA}{L} \quad R = 2\Omega$$

$$L = 1.5\text{cm}$$

$$A = \frac{2 \times 25}{15} = 3.3$$

b)

$$\frac{P_{out}}{P_{in}} = \frac{75}{80} = 0.9375 \times 100 = 93.75\% \text{ efficiency}$$

$$\text{loss} = 100 - 93.75 = 6.25\% \text{ power loss}$$

c)

ABEFA

$$-5I_1 - 3(I_1 - I_2) - 5 - 2I_1 = 0 \quad \text{--- (1)}$$

BCDEB

$$-6I_2 - 7I_2 - 2I_2 + 5 + 3(I_1 - I_2) = 0 \quad \text{--- (2)}$$

$$-5I_1 - 3I_1 - 3I_2 - 2I_1 - 15 = 0$$

$$-10I_1 - 3I_2 = 15 \quad \text{--- (3)}$$

$$-6I_2 - 7I_2 - 2I_2 + 3I_1 - 3I_2 = 0$$

$$-18I_2 + 3I_1 = -5 \quad \text{--- (4)}$$

$$-10I_1 - 3I_2 = 15 \quad \times 3$$

$$3I_1 - 18I_2 = -5 \quad \times 10$$

$$-30I_1 - 12I_2 = 45$$

$$+30I_1 - 180I_2 = -50$$

$$-192I_2 = -5$$

$$I_2 = \frac{-5}{-192} = 0.02A$$

Sub 0.02A into (3)

$$-10I_1 - 3(0.02) = 15$$

$$-10I_1 - 0.06 = 15$$

$$-10I_1 = 15 + 0.06$$

$$-10I_1 = 15.06$$

$$I_1 = \frac{15.06}{-10}$$

$$I_1 = -1.506A$$

$$Q_1 = 2 + 3 + 12 = 17$$

(2)

a)

i) R_3 and R_4 are in parallel

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

 R_2 and R_{eq1} are in series

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

 R_5 and R_{eq2} are in parallel

$$R_{eq3} = \frac{R_5 \times R_{eq2}}{R_5 + R_{eq2}} = \frac{10 \times 24}{10 + 24} = 7.05\Omega$$

 R_1 and R_{eq3} are in series $R_{eq3} + R_1 = 7.05 + 15 = 22.05\Omega$

$$ii) I = \frac{V}{R} = 2.26A$$

$$iii) R_3 = \frac{R_4 \times I}{R_4 + R_3} = \frac{5 \times 2.26}{5 + 20} = 0.452A \quad I_1$$

$$R_4 = \frac{R_3 \times I}{R_3 + R_4} = \frac{20 \times 2.26}{20 + 5} = 1.808A \quad I_2$$

$$R_2 = \frac{R_{eq3} \times I}{R_{eq3} + R_2} = \frac{7.05 \times 1.808}{7.05 + 20 + 10} = 0.47A \quad I_3$$

$$R_5 = \frac{R_{eq3} \times I}{R_{eq3} + R_5} = \frac{7.05 \times 1.808}{7.05 + 10} = 0.74A \quad I_4$$

$$R_1 = \frac{R_{eq4} \times I}{R_1 + R_{eq4}} = \frac{22.05 \times 2.26}{15 + 22.05} = 1.34A \quad I_5$$

$$iv) R_1 = \frac{V}{I} = \frac{50V}{1.34A} = 37.3\Omega$$

$$V = I \times R$$

$$= 1.34A \times 15\Omega = 20.1V$$

$$R_2 = 0.47A \times 20\Omega = 9.4V$$

$$R_3 = 0.452A \times 20\Omega = 9.04V$$

Q2 = 13

(3)

a)

i)

$$V = I \times R$$

$$= 2 \times 15 = 30V$$

ii)

$$V_{\text{at } R_B} = 100V$$

$$V_{\text{at } R_B} = 50V$$

$$V_{\text{at } R_C} = 30V$$

$$100 - 80 = 20V$$

$$= 80V$$

$$\text{voltage at } R_A = 20V$$

iii)

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

$$R_A \quad I = 2$$

$$V = 20$$

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

$$R = \frac{V \times I}{I} = 10\Omega$$

b) The maximum amount of power allowed to travel safely without causing any damage to passing components.

a)

i) Reactance is opposition of flow of current measured in ohms used in DC circuits.

ii) Impedance is the opposition of change of flow of current measured in ohms used in AC circuit.

iii) A material/component, that can conduct electricity partially.

d) i) ii) Amplitude = 75V

ii) ~~75~~ $2 \times 75 = 150V$

iii)

$$V_{rms} = \frac{V}{\sqrt{2}} \quad V = 75$$

$$\frac{75}{\sqrt{2}} = 53.03V$$

iv)

$$\omega = 200$$

$$\omega \text{ also } = 2\pi f$$

$$200 = 2\pi f$$

$$\frac{2\pi f}{200}$$

$$200 = 6.28f$$

$$\frac{200}{6.28} = f$$

$$f = 31.83 \text{ Hz}$$

v)

$$f = \frac{1}{t}$$

$$t = \frac{1}{f} = \frac{1}{31.83} = 3.1 \text{ m/s}$$

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

$$= 17$$

(4)

a)

$$X_L = 2\pi fL$$

$$55\mu\text{f} = 0.00055\text{f}$$

$$47\text{mH} = 0.0047\text{H}$$

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

$$X_L = 2\pi \times 50 \times 0.0047 = 1.47\Omega$$

$$X_C = \frac{1}{2\pi \times 50 \times 0.00055} = 5.78\Omega$$

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

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

$$\sqrt{100^2 + (5.78 - 1.47)^2} = 100.09\Omega$$

ii)

$$V = IR$$

$$I = \frac{V}{R} = \frac{240}{100.09} = 2.39\text{A}$$

$$i) \quad V_L = V = R_L \times I = 1.47 \times 2.39\text{A} = 3.51\text{V}$$

$$X_C = V = R_C \times I = 5.78 \times 2.39\text{A} = 13.8\text{V}$$

$$R = V = R \times 2.39\text{A} = 239\text{V}$$

$$b) \quad 5 - 0.7 = 4.3 \quad R = 1000\Omega$$

$$\frac{4.3}{1000} = 4.3 \times 10^{-3}\text{A}$$

- c) When a PN junction diode is forward biased it has been introduced to voltage. In the depletion region the holes diffuse into electrons from the positive ions and the electrons diffuse into positive holes from the negative ions.

$$Q_4 = 5 + 4 + 2$$

$$Q_4 = 11$$

2

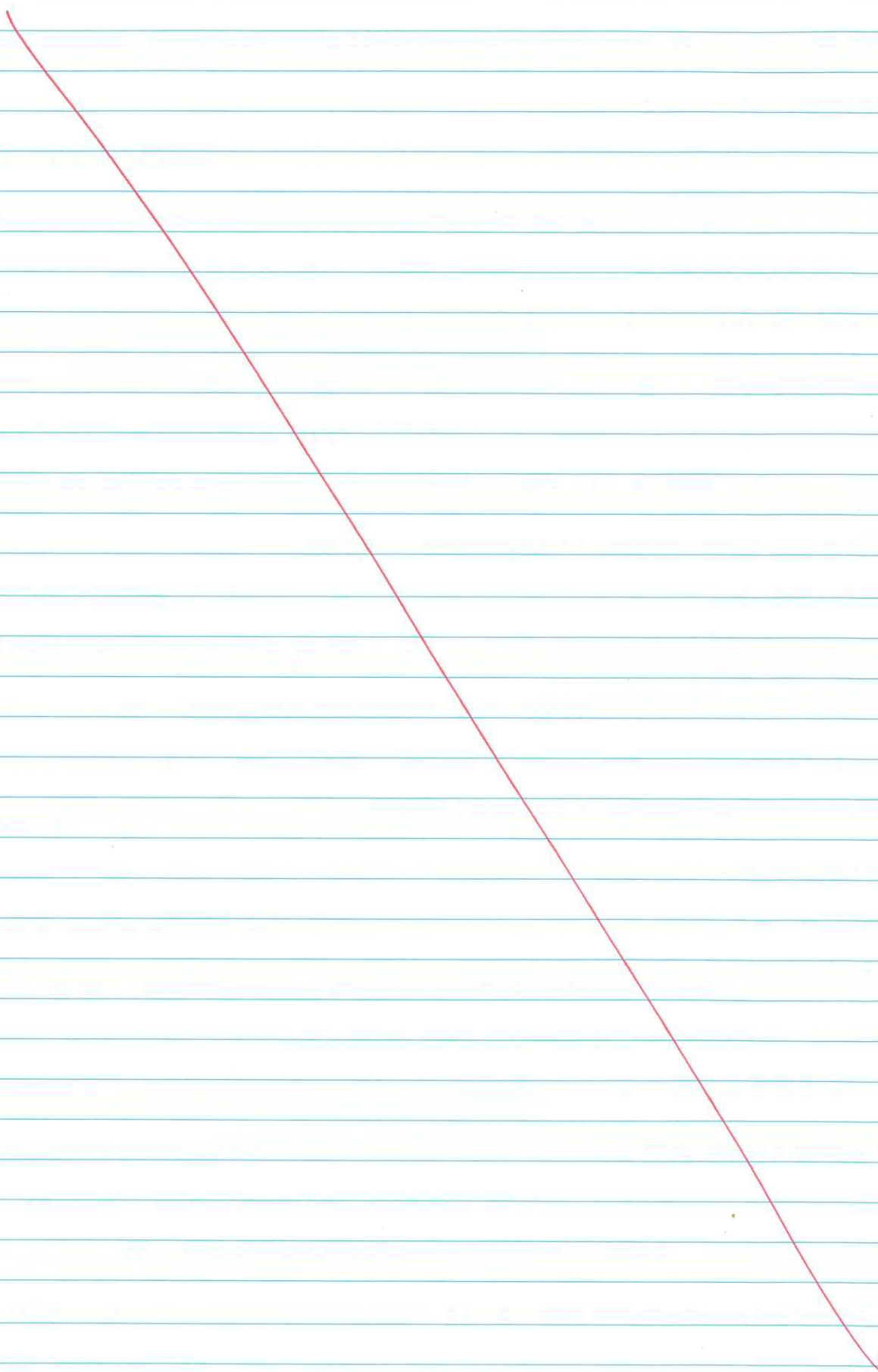
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Examiner Only

Question No.



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