
$$\eta = \text{Efficiency, \%}$$

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 the flap and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible answers 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)

12-1

1a) $\frac{20}{25} \times 100$
 Efficiency = 80%

$$\frac{V_{out}}{V_{in}} \times 100 = \text{Efficiency} \%$$

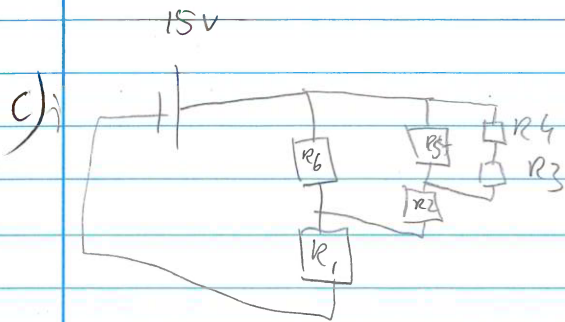
power loss = $25 - 20 = 5 \text{ Watts lost}$

b) $V = IR$

$$P = IV$$

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

$$\frac{1}{3} = \frac{1}{3} = 0.33 \text{ A}$$



$$R_4 + R_5 = 50 + 30 = 80$$

$$\frac{1}{\frac{1}{80} + \frac{1}{50}} = \frac{400}{13}$$

$$\frac{400}{13} + 30 = \frac{790}{13}$$

$$\frac{1}{\frac{790}{13} + \frac{1}{50}} = \frac{1975}{72} \times \frac{1795}{72}$$

$$\frac{1975}{72} + \frac{20}{R_1} = \frac{3415}{72}$$

$$\text{total } R = \frac{3415}{72} = 47.43 \Omega$$

ii Current Equation $I_2 = \left(I_s \times \frac{R_2}{R_1 + R_2} \right)$

$$V_2 = \left(V_{s1} \times \frac{R_1}{R_1 + R_2} \right)$$

$$V = IR$$

$$\frac{15}{47.43} = 0.316 \text{ A}$$

$$15 \times \left(\frac{3415}{72} \right)$$

$$= 10.55097$$

$$15 - 10.55097 = 4.44902$$

$$\frac{4.44902}{20} = 0.222 \text{ A}$$



$$V = IR$$

nodal analysis

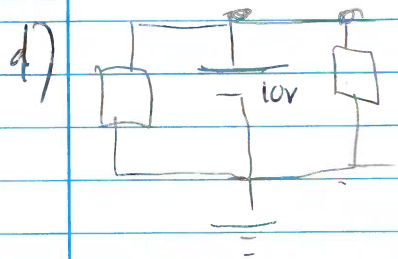
$$V = IR$$

Question No.

$$R_7 - (R_3 + R_4 + R_5) = \frac{1}{\frac{1}{3500} + \frac{1}{1000} + \frac{1}{6000}} = \frac{42000}{67}$$

$$R_2 + R_7 = \frac{1}{\frac{1}{42000} + \frac{1}{2000}} = 688.53$$

Examiner Only



$$10000 + 688.53 = 10688.53$$

$$\frac{10}{10688.53} = 9.3558 \times 10^{-4} \text{ A}$$

$$10000 \times 9.3558 \times 10^{-4} = 9.3558$$

$$\left(\frac{V_A - 0}{10000} + \frac{V_B - 10}{2000} + \frac{V_C - V_B}{688.53} \right) \times 10,000$$

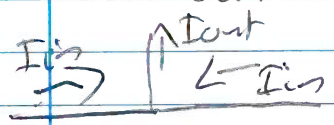
$$V_A + 5(V_B - 10) + 14.523(V_C - V_B)$$

$$V_A + 5V_B - 50 + 14.523V_C - 14.523V_B$$

$$V_A - 9.523V_B + 14.523V_C = 50$$

e) KCL

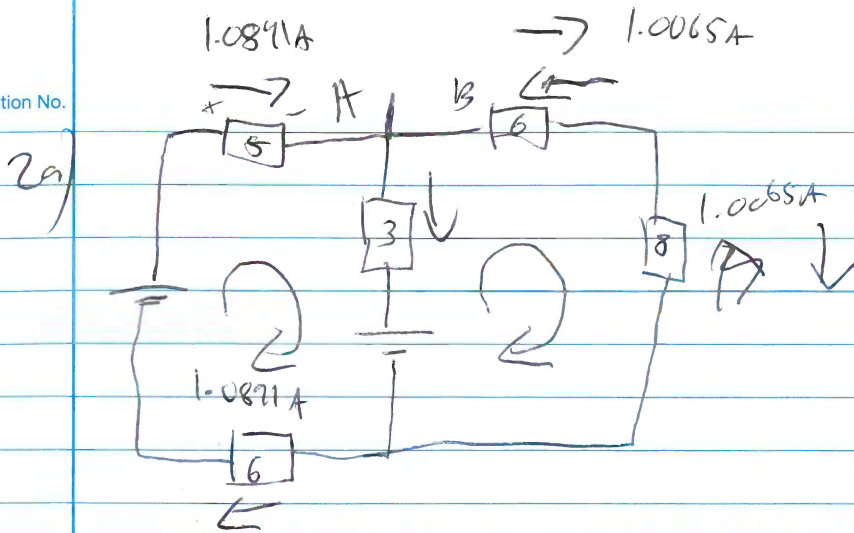
current cannot be greater
 current coming out of node cannot be greater
 than or less than current coming into node
 = all currents must sum to 0 in node



$$I_{1in} + I_{2in} = I_{out}^3$$

$$I_1 + I_2 - I_3 = 0$$

$$Q_1 \text{ total} = \frac{20}{25}$$



KVL A $V = IR$

$$15 = 5I_1 + 3I_2 + 6I_1$$

KVL B

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

Simultaneous equations

$$15 = 11I_1 + 3I_2 \quad \times 3$$

$$0 = 16I_2 - 3I_1 \quad \times 11$$

$$45 = 33I_1 + 9I_2$$

$$0 = 154I_2 - 33I_1$$

$$+ 155 = 154I_2$$

$$I_2 = \frac{155}{154}$$

Sub in I_2 into

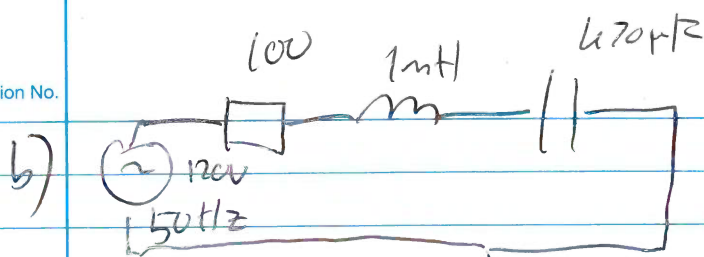
$$15 = 11I_1 + 3\left(\frac{155}{154}\right)$$

$$15 - \frac{465}{154} = 11I_1$$

$$I_1 = 1.0891$$

$$I_2 = 1.0065$$

6.



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

$$\frac{1}{2\pi f C} = \frac{1}{2\pi \times 50 \times 670 \times 10^{-6}} = 6.773 \Omega$$

$$2\pi L F = 2\pi \times 100^{-3} \times 50 = \frac{1}{10} \pi$$

$$\frac{1}{10}\pi - 6.773 = -6.4588$$

$$i) z = \sqrt{(100)^2 + (6.4588)^2} = 100.208 = z$$

$$ii) I = \frac{V}{Z} = \frac{120}{100.208} = 1.198 \text{ A}$$

(ii) $\tan^{-1}\left(\frac{-6.4588}{100}\right) = -3.695^\circ$ ✓

Q2 total

3ii) opposition to current plan though hearting of union includes

ii) Total opposition to current flow includes resistance and reactance

iii) Current and Voltage being out of phase is due to inductive or capacitive components causing a resistive effect.

iv) Maximum ^{operating} voltage the ^{appliance} ~~appliance~~ can handle is normally

$$3b) i = 40 \sin 314t$$

Max current $i = 40 \sin 314t = 1$
 Max current = 40 A

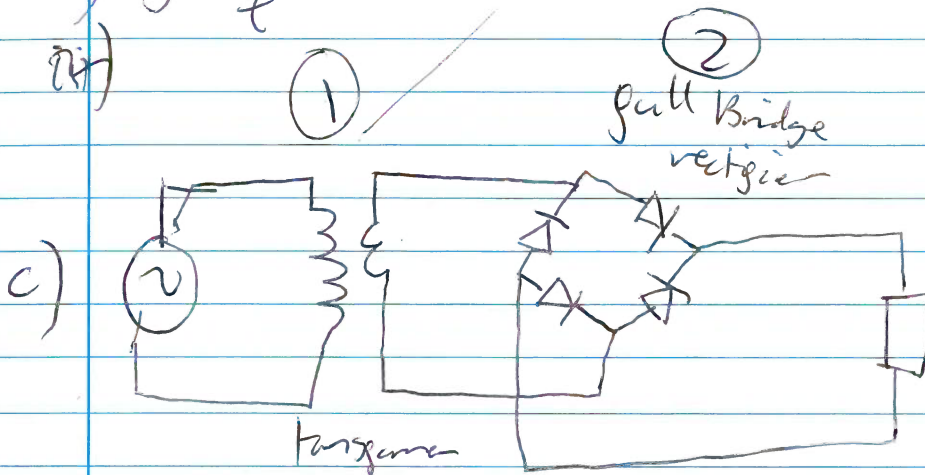
$$ii) \frac{1}{\sqrt{2}} = I_{rms} \quad \frac{40}{\sqrt{2}} = 28.284 \approx 20\sqrt{2} \text{ A}$$

$$iii) f = \frac{1}{T}$$

due to many coils

$$\text{at } T = 1$$

$$\frac{1}{40 \sin 314t} = 0.0348 \text{ s}$$

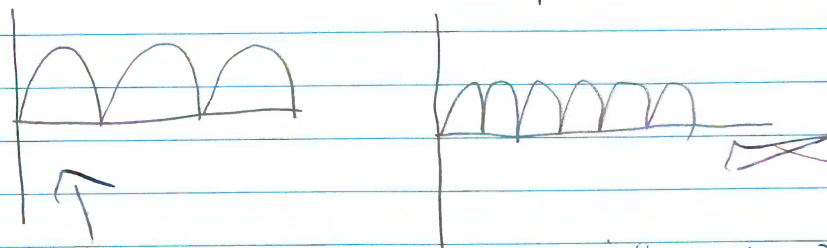


use of circuit is to turn high Voltage AC into low DC Voltage using a step down transformer and 4 diode arranged in a full bridge rectifier configuration.

① V_1 high voltage AC
 Voltage goes into the step down transformer

with a ratio of 4:2 2:1 ratio
 you can tell it's a step down due to the larger number of coils on the primary side compared to the secondary side.

② after high voltage has been stepped down the diode which blocks current going in alternating directions we used to block the reversing aspects of the current.



the halfbridge rectifier with only 2 diodes blocks the negative side. ~~with~~ D2 and D4 the D1 and D3 configurations blocks the positive diodes. The full bridge rectifier with all of them configured reflects the negative side of the ac wave into positive side.

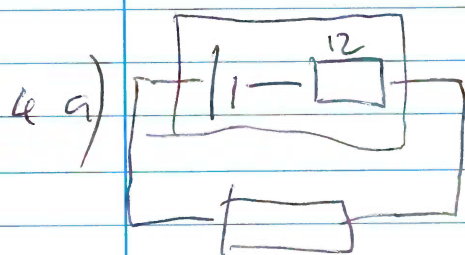
R_L is used as a load resistor to draw the voltage

$$P = VI$$

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

Q3 total

$$\frac{21}{25}$$



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

$$\frac{12^2}{(12+4)} = 9$$

$$\frac{12^2}{(12+8)} = 7.2$$

$$\frac{12^2}{(12+12)} = 6$$

$$\frac{12^2}{12+16} = 5.1429$$

$$\frac{12^2}{12+20} = 4.5$$

R_L	P_L
4	9
8	7.2
12	6
16	5.143
20	4.5

Q2

