



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examiner Only

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 and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners cannot read or have it typed and the expense of typing will be 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	200311
2	Title of Examination Paper	Electrical Engineering
3	Module Code	ACDA5001
4	Date and Time of Examination	16/05/2023 9:00
5	Examination Venue	1a 310
6	Seat Number	30
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

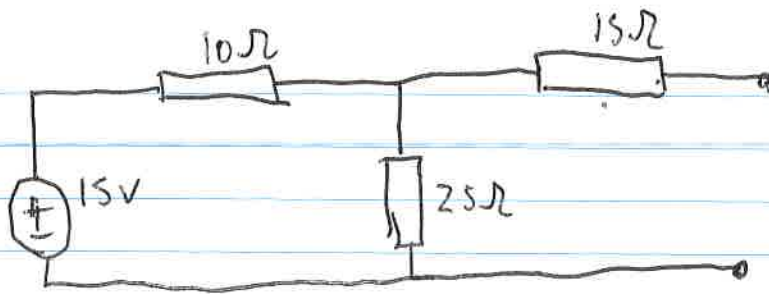
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~~car~~

SUR TMS ~~THAT~~

Q1a)
i)

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

$$I = \frac{15}{35} = 0.428571 \text{ A} \quad \checkmark$$

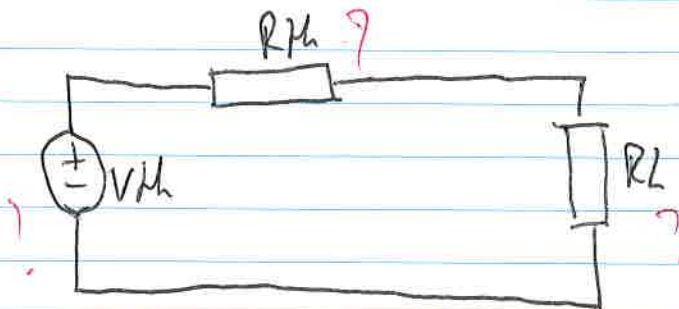
$$V_{th} = 0.429 \text{ A} \times 25\Omega = 10.71 \text{ V } 2dp \quad \checkmark$$

$$R_{th} = \left(\frac{10 \times 25}{10 + 25} \right) + 15 = 22.14 \Omega \quad 2dp \quad \checkmark$$

$$V_{th} \quad I_L = \frac{V_{th}}{R_{th} + R_L} = 0.24 \text{ A } 2dp \quad \checkmark$$

$$ii) \quad R_{th} = R_L \quad \text{Load resistor} = 22.14 \Omega \quad \checkmark$$

iii)



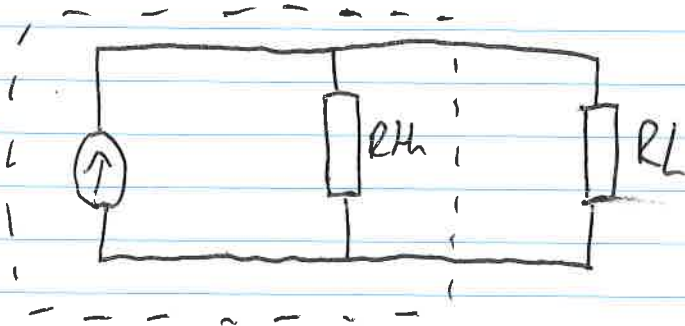
$$iv) \quad P_L = I_L^2 \times R_L$$

$$= 0.24^2 \times 22.14 = 1.275 \text{ Watts} \quad \checkmark$$

2a)

1b)

Norton's theorem states that a linear circuit can be simplified into a circuit of equivalent current source and ~~resistance~~ equivalent resistance in parallel.



c) RT

$$V_{th} = 1.314 \times 0.83 \\ = 1.095$$

$$R_{th} = 7.83 \Omega$$

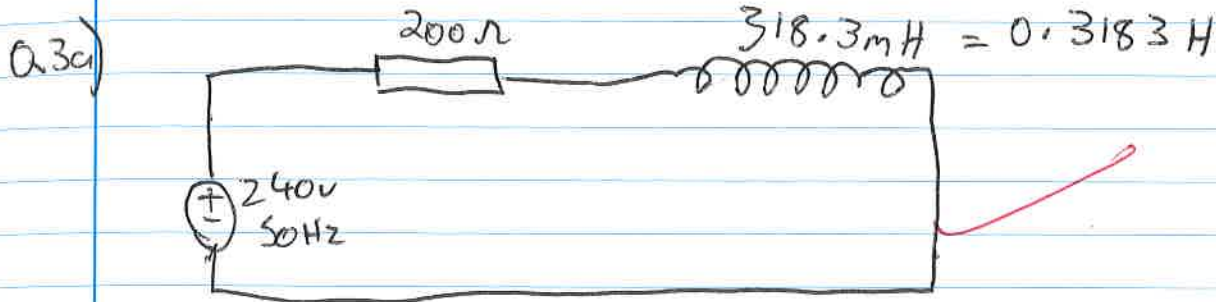
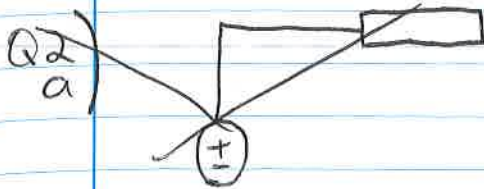
$$I = \frac{V}{R}$$

$$= \frac{9.8}{\left(\frac{5 \times 1}{5+1}\right) + 7}$$

$$I = 1.314$$

Q1

$$1+2+2+2+2+1+3+3=16$$



i) $X_L = 2\pi fL$ $2\pi \times 50 \times 0.3183 = 99.997\Omega$ 2

ii) $Z = \sqrt{R^2 + X_L^2}$
 $= \sqrt{200^2 + 99.99^2}$

$Z = 223.61\Omega$ 2dp ✓

iii) $I = \frac{V}{Z}$ $I = \frac{240}{223.61}$ $I = 0.89 A$ 2dp ✓

v) Phase angle

$\phi = \tan^{-1} \frac{X_L}{R}$ $\phi = \tan^{-1} \frac{99.99}{200} = 26.56^\circ$ 2dp ✓

3b) $I = 25 + j40 A$

$I_m = 25$ Phase angle = 40° ✓

$\frac{I_m}{\sqrt{2}}$ $\frac{25}{\sqrt{2}} = 17.68 A$ ✓

0

3c) Active power

$$P = V I \cos \phi$$

$$P = 240 \times 0.89 \cos(26.56)$$

$$P = 191.06 \text{ watts}$$

Reactive power

$$Q = V I \sin \phi$$

$$Q = 240 \times 0.89 \sin(26.56)$$

$$Q = 95.508 \text{ watts}$$

~~Apparent power~~

~~$$S = V \times I$$~~

~~$$= 240 \times 0.89 = 213.6 \text{ watts}$$~~

$$Q_3$$

$$2 + 2 + 1 + 2 + 2 = 9$$

Q4a) $V = 120 \sin(314t)$ $I = 10 \sin(314t + \frac{\pi}{6})$

$V_m = 120$ $I_m = 10$ $\phi = \frac{\pi}{6}$ $\phi = 30^\circ$
 -30°

~~$I = I_m \sin(\omega t + \phi)$
 $= 10 \sin(314t + 30)$
 $= -2.756 \text{ A}$
 $= 2.8 \text{ A}$~~

$V = V_m \sin$

$V = \frac{V_m}{\sqrt{2}}$ $I = \frac{I_m}{\sqrt{2}}$

$V = 84.9$ $I = 7.07$

$Z = \frac{V}{I} = 12.00 \Omega$

~~$X_C = \frac{1}{2\pi fC}$~~ $Z = 12 \angle -30^\circ$
 $Z = X_C \text{ and } R$

$Z = R \cos \phi + j \sin \phi$

$12 \cos(-30) + j \sin(-30)$

$12 \cos(30) - j \sin(30)$

$10.39 - j 0.5$

Resistance = 10.39Ω $X_C = 0.5$

~~$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times 0.25}$
 $0.5 = \frac{1}{2\pi \times 50 \times ?}$~~

~~$C = \frac{X_C}{2\pi f}$~~

resistance

$$X_R = 10.39$$

$$X_C = 2\pi fC$$

$$C = \frac{X_C}{2\pi f} = \frac{0.5}{2\pi f} = 1.5915 \times 10^{-3} \text{ F}$$

$$= 1.59 \mu\text{F}$$

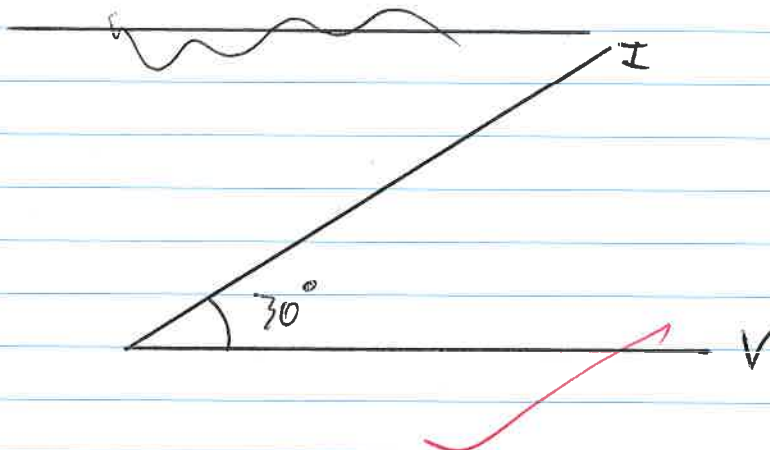
ii) Power consumed

$$P = VI \cos \phi$$

$$= 84.9 \times 7.07 \cos 30$$

$$= 519.83 \text{ WATTS}$$

iii) Phasor diagram



4b)

5a) Current

$$I_p = \frac{V_p}{Z_p} \quad \checkmark$$

$$V_p = V_L = 400 \text{ V} \quad \checkmark$$

$$Z_p = \sqrt{R^2 + X_L^2} \quad \checkmark$$

$$Z_p = \sqrt{30^2 + 40^2} = 50 \Omega \quad \checkmark$$

$$I_p = \frac{400}{50} = 8 \text{ A} \quad \checkmark$$

$$I_L = \sqrt{3} I_p \quad \checkmark$$

$$I_L = 13.86 \text{ A} \quad \checkmark = \text{Current supplied by alternator}$$

ii) output power

$$P = 3 I_p^2 R_p \quad \checkmark$$

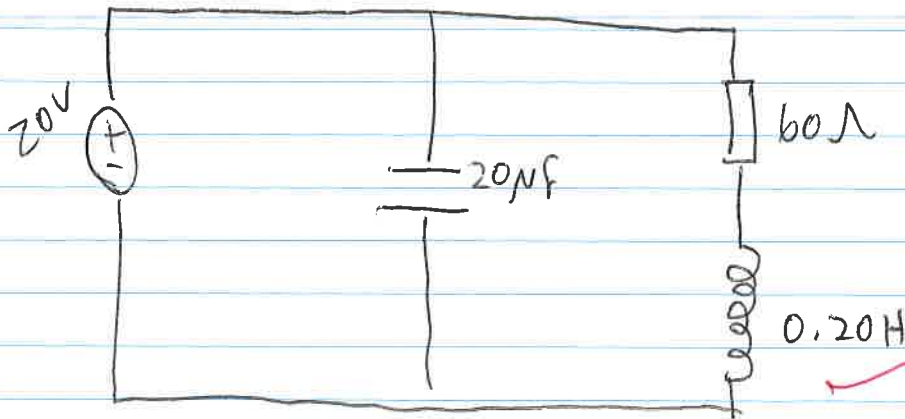
$$P = 3 \times 8^2 \times 30 = 5760 \text{ Watts} \quad \checkmark$$

$$\text{iii) } S = \sqrt{3} V_L I_L \quad \checkmark$$

$$= \sqrt{3} \times 400 \times 13.86$$

$$S = 9602.49 \text{ VA} \quad \checkmark$$

4b)



$$f_r = \frac{1}{2\pi \sqrt{LC}}$$

$$f_r = \frac{1}{2\pi \sqrt{0.20 \times 20 \times 10^{-6}}} = 79.577 \text{ Hz}$$

ii) Dynamic resistance

$$R_D = \frac{V}{I_r} = \frac{L}{RC} = \frac{0.2}{60 \times 20 \times 10^{-6}}$$

$$\text{Dynamic res} = 166.6 \Omega$$

iii) Current at resonance

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

$$\frac{20}{166.6} = 0.12$$

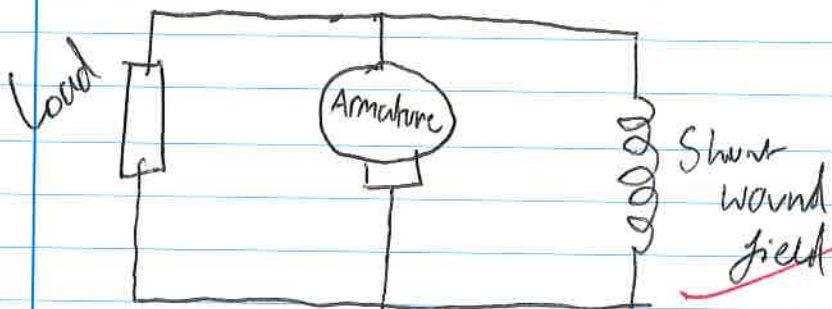
$$Q = \frac{2\pi f_r L}{R} = \frac{2\pi \times 79.577 \times 0.2}{60}$$

6a) • Self excited • separately excited ✓

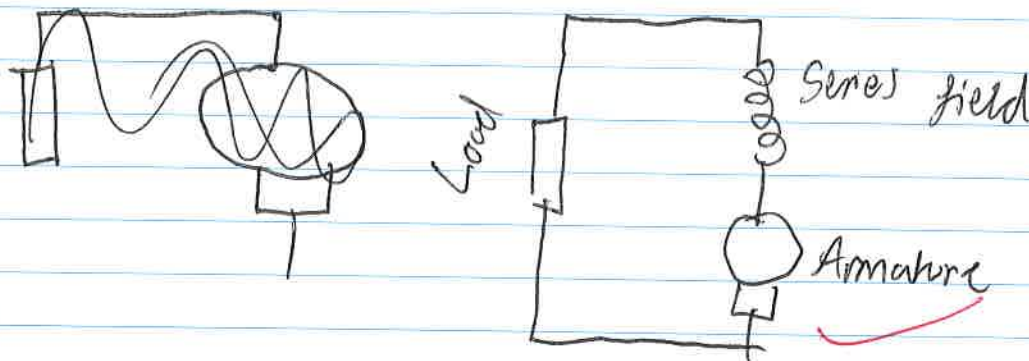
• Series wound • Shunt wound ✓
• Compound wound ✓

• Short Shunt Compound ✓
• long Shunt Compound ✓
• Cumulative Compound ✓
• Differential Compound ✓

Shunt Shunt wound



Series wound



4b

$$iv) \quad X_L = 2\pi fL = 99.99$$

$$X_C = 2\pi fC = 9.99 \times 10^{-3}$$

$$Q = \frac{2\pi f_r L}{R} = \frac{2\pi \times 79.577 \times 0.2}{60}$$

Q4
1+1+1+2+2+1+2+1+1
= 12

6b)

8 : 1
3A :
240 :

$$240 / 8 = 30V = \text{second Voltage}$$

Step down

Q6

5+1+1+1+2=10

5b)

$$\phi = \cos 0.8$$

$$PF = \cos \phi$$

$Q = \frac{PF}{\cos}$

$$\cos 0.8 = 0.999$$

$$200k \times 0.8 = 160000$$

$$200000 - 160000 = 40000$$

40000 Watts reactive power

Q5

1+2+2+2+1+4+3=15