



PRIFYSGOL CYMRU

Y Drindod Dewi Sant

UNIVERSITY OF WALES

Trinity Saint David

Examination Answer Book

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 and seal to hide your name.
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.
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	
2	Title of Examination Paper	Electrical + Electronic principles
3	Module Code	SGEE 4000
4	Date and Time of Examination	29th April 9:30 am
5	Examination Venue	G43, Coleg 'Sir Gar
6	Seat Number	

7	Number of Answer Books handed in	1
---	----------------------------------	---

[illegible]

86%

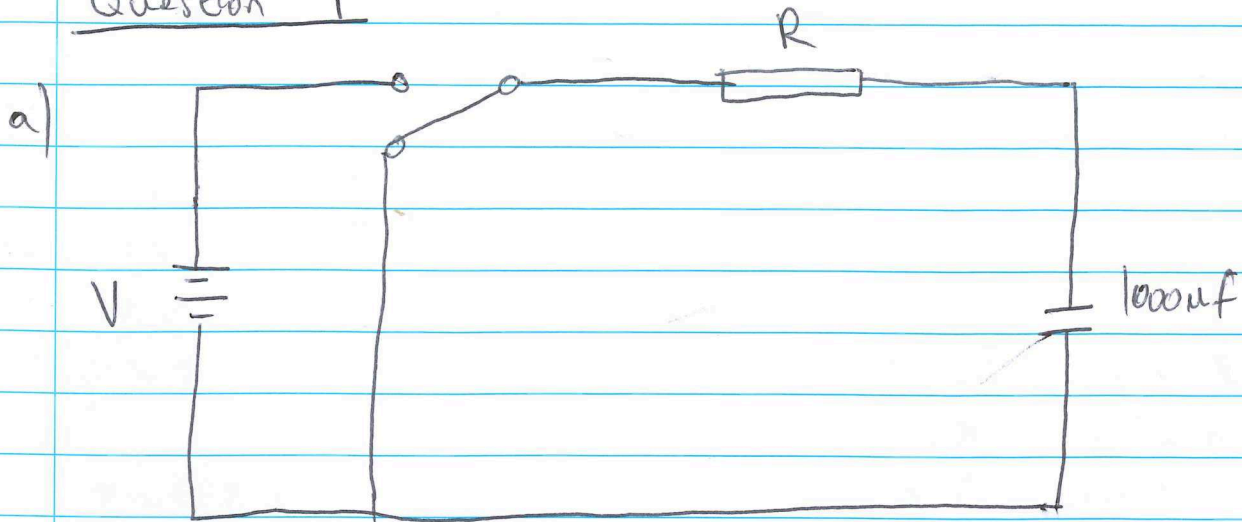
Complete
section,
remove
strip, fold as
indicated
and SEAL

Please complete this section and SEAL before the examination starts.

Surname ALGER - PALMER (Block Capitals) Forename(s) EWAN

(Gweler yr ochr arall am y fersiwn Cymraeg)

Question 1



$$R = \frac{5000 \times 8000}{5000 + 8000} = 3076.9 \Omega$$

$$V = \frac{8000}{5000 + 8000} \times 10 = 6.15 \text{ V}$$

b) i) $\tau = RC = 3076.9 \times 1000 \times 10^{-6}$
 $= 3 \text{ seconds}$

ii) Time taken to fully charge $= 5\tau = 5 \times 3 = 15 \text{ seconds}$

c) i) $V_C = V_S (1 - e^{-\frac{t}{\tau}})$
 $5 = 6.15 (1 - e^{-\frac{t}{3}})$
 $\ln \left(1 - \frac{5}{6.15} \right) \times 3 = -t$

$$t = 5.03 \text{ seconds}$$

ii) $V_C = V_S (e^{-\frac{t}{\tau}})$
 $5 = 6.15 (e^{-\frac{t}{3}})$
 $\ln \left(\frac{5}{6.15} \right) \times 3 = -t$

$$t = 0.621 \text{ seconds}$$

d)

$$i) \tau = \frac{L}{R} = 0.625 \text{ m Seconds} \quad /$$

$$ii) I = \frac{V}{R} = \frac{9}{400} = 22.5 \text{ mA} \quad /$$

$$iii) i = I (e^{-\frac{t}{\tau}})$$

$$20 \times 10^{-3} = 22.5 \times 10^{-3} (e^{-\frac{t}{0.625 \times 10^{-3}}})$$

$$\ln \left(\frac{20 \times 10^{-3}}{22.5 \times 10^{-3}} \right) \times 0.625 \times 10^{-3} = -t$$

$$t = 73.61 \text{ } \mu \text{ seconds} \quad /$$

$$i = I (e^{-\frac{t}{\tau}})$$

$$10 \times 10^{-3} = 22.5 \times 10^{-3} (e^{-\frac{t}{0.625 \times 10^{-3}}})$$

$$\ln \left(\frac{10 \times 10^{-3}}{22.5 \times 10^{-3}} \right) \times 0.625 \times 10^{-3} = -t$$

$$t = 566.83 \text{ } \mu \text{ seconds} \quad /$$

2

2

12

16

Question 2

$$\begin{aligned} a) \quad \underline{Z_1 Z_2} &= (6-j4)(3+j5) \\ &= 18 + j30 - j12 - j^2 20 \\ &= 38 + j18 \\ &= 42.05 \angle 25.35^\circ \end{aligned}$$

$$\begin{aligned} \underline{Z_1 + Z_2} &= (6-j4) + (3+j5) \\ &= 9 + j \\ &= 9.06 \angle 6.34^\circ \end{aligned}$$

$$\begin{aligned} \frac{\underline{Z_1 Z_2}}{\underline{Z_1 + Z_2}} &= \frac{42.05 \angle 25.35^\circ}{9.06 \angle 6.34^\circ} \\ &= 4.64 \angle 19.01^\circ \\ &= 4.39 + j1.51 \end{aligned}$$

$$\begin{aligned} Z_T &= \left[\frac{\underline{Z_1 Z_2}}{\underline{Z_1 + Z_2}} \right] + Z_3 \\ &= (4.39 + j1.51) + (1.61 - j0.51) \\ &= 6 + j \end{aligned}$$

12

$$\begin{aligned} b) \quad i) \quad X_L &= 2\pi FL \\ &= 2\pi \times 60 \times 0.6 \\ &= 226.19 \angle 90^\circ \Omega \end{aligned}$$

$$\begin{aligned} Z &= R + jX_L \\ &= 75 + j226.19 \Omega \\ &= 238.3 \angle 71.66^\circ \Omega \end{aligned}$$

2

(14)

$$\text{ii)} \quad I_L = \frac{V}{Z} = \frac{120 \angle 0^\circ}{238.3 \angle 71.66^\circ} \\ = 0.5 \angle -71.66^\circ \text{ A}$$

2

$$\text{iii)} \quad V_R = I_L R = (0.5 \angle -71.66^\circ)(75 \angle 0^\circ) \\ = 37.5 \angle -71.66^\circ \text{ V} \\ = 11.8 - j35.6 \text{ V}$$

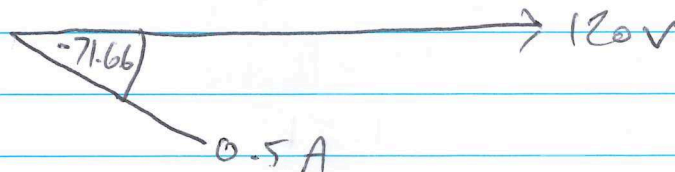
2

$$\text{iv)} \quad V_L = I_L X_L = (0.5 \angle -71.66^\circ)(226.19 \angle 90^\circ) \\ = 113.1 \angle 18.34^\circ \text{ V} \\ = 107.4 + j35.5 \text{ V}$$

2

$$\text{c)} \quad V_S = V_R + V_L = (11.8 - j35.6) + (107.4 + j35.5) \\ = 119.2 - j0.1 \text{ V}$$

d)



X

6

Question 3

d)

$$i) I_L = \frac{V}{Z} = \frac{50 \angle 30^\circ}{14.4 \angle 56.3^\circ} = 3.5 \angle -26.3^\circ \text{ A}$$

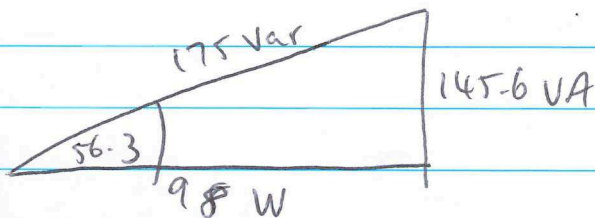
3

$$ii) S = VI = (50 \angle 30^\circ)(3.5 \angle 26.3^\circ) = 175 \angle 56.3^\circ \text{ Var}$$

$$P = VI \cos \theta = 175 \cos 56.3^\circ = 98 \text{ W}$$

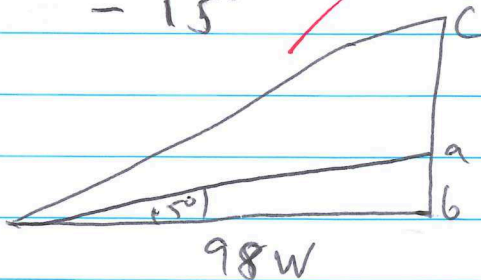
$$Q = VI \sin \theta = 175 \sin 56.3^\circ = 145.6 \text{ VA}$$

3



$$p.f. = \cos \theta = \cos 56.3^\circ = 0.55$$

$$iii) \theta = \cos^{-1}(0.966) = 15^\circ$$



$$\tan 15^\circ = \frac{ab}{98}$$

$$98 \tan 15^\circ = ab$$

$$ab = 26.26$$

$$Q = bC - ab = 145.6 - 26.26 = 119.34 \text{ VA}$$

10

$$iv) C = \frac{Q}{2\pi f V_{rms}^2} = \frac{119.34}{2\pi \times 2000 \times 50^2} = 3.8 \mu F$$

4

(20)

$$6) \quad P = \sqrt{3} V_L I_L \cos \theta$$

$$I_L = \frac{P}{\sqrt{3} V_L \cos \theta}$$

$$= \frac{\cancel{24} 21000}{\sqrt{3} \times 415 \times 0.7}$$

$$= 41.7$$

$$I_p = \frac{I_L}{\sqrt{3}} = \frac{41.7}{\sqrt{3}} = 24.1 \text{ A}$$

$$\cos \theta = 0.7$$

$$\theta = \cos^{-1}(0.7)$$

$$= 45.6^\circ$$

$$I_{RY} = 24.1 \angle 45.6^\circ \text{ A}$$

$$I_{YB} = 24.1 \angle 120 - 45.6 = 24.1 \angle -165.6^\circ \text{ A}$$

$$I_{BR} = 24.1 \angle 120 - 45.6 = 24.1 \angle 74.4^\circ \text{ A}$$

3

3

Question 5

a) Remove the load

$$\begin{aligned} I_1 &= \frac{(6+j0) + (2+j5)}{(4+j3) + (3-j7)} \\ &= \frac{8+j5}{7-j4} \\ &= 9.4 \angle 32^\circ \\ &= 8.06 \angle -29.7^\circ \\ &= 1.17 \angle 61.7^\circ \end{aligned}$$

$$\begin{aligned} E_{AB} &= E_1 - (I_1)(Z_1) \\ &= 6+j0 - (1.17 \angle 61.7^\circ)(5 \angle 36.9^\circ) \\ &= 6+j0 - (5.85 \angle 98.6^\circ) \\ &= (6+j0) - (-0.87 + j 5.78) \\ &= 6.87 - j 5.78 \end{aligned}$$

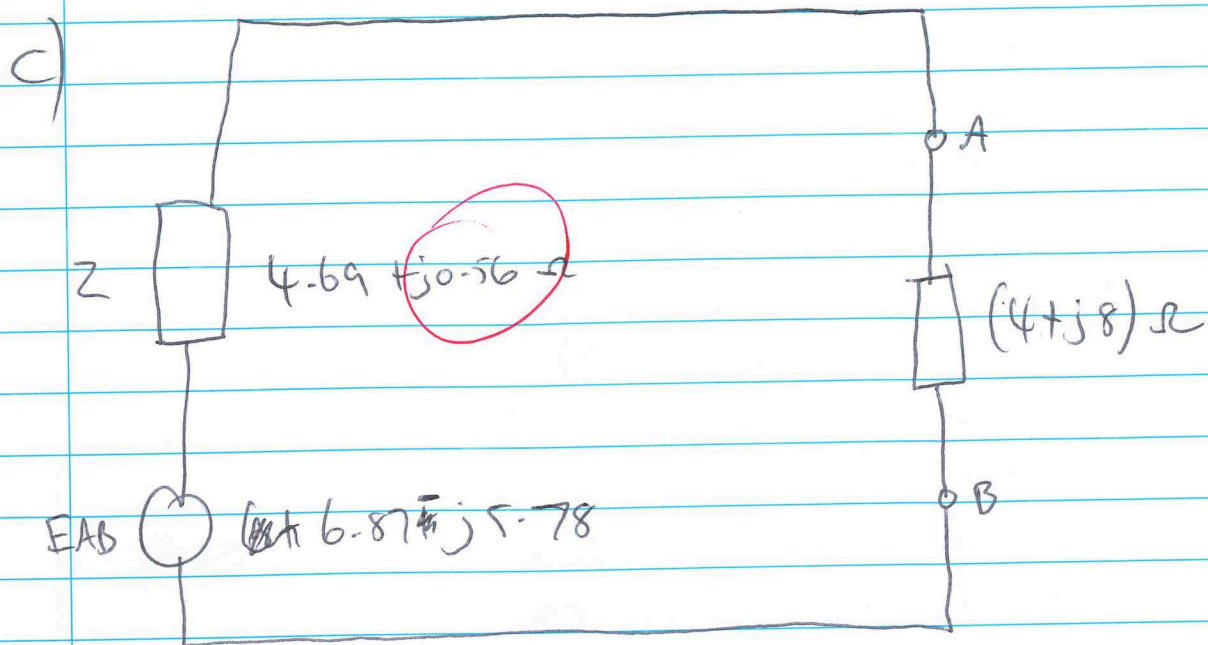
7

b) Remove the load

$$\begin{aligned} Z &= \frac{(4+j3)(3-j7)}{(4+j3) + (3-j7)} = \frac{12 - j 28 + j 9 - j^2 21}{7-j4} \\ &= \frac{33 - j 19}{7-j4} \\ &= 38.08 \angle -22.93^\circ \\ &= 8.06 \angle -29.7^\circ \\ &= 4.72 \angle 6.77^\circ \Omega \\ &= 4.69 + j 0.56 \Omega \end{aligned}$$

method ok

5



d)

$$\begin{aligned}
 I_L &= \frac{E_{AB}}{Z_L + Z} \\
 &= \frac{8.98 \angle -40.08}{(4.69 + j0.56) + (4 + j8)} \\
 &= \frac{8.98 \angle -40.08}{8.69 + j8.56} \\
 &= \frac{8.98 \angle -40.08}{12.19 \angle 44.57} \\
 &= 0.74 \angle -84.65 \text{ A}
 \end{aligned}$$

method
OK
knock
on
error