

May Exam

by Keefe Montebon

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LOCATION: SWANSEA

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LEVEL 4

LEFEL 4

EXAMINATION PERIOD
MAY 2020

CYFNOD ARHOLIADAU
MAI 2020

MODULE CODE: ACDB4002 & ACDA4006
Electrical and Electronic Principles

TIME: 2 HOURS

ANSWER ALL QUESTIONS

Equipment or materials required – Calculator, Graph paper

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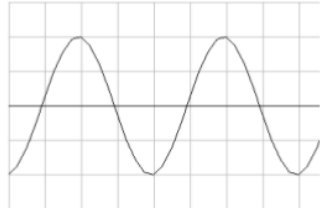
FORMULA SHEET AND GRAPH PAPER ARE AFTER QUESTIONS

DETACH GRAPH PAPER AND PLACE IN YOUR ANSWER BOOK
WRITE YOUR STUDENT NUMBER AND QUESTION NUMBER ON
ANY GRAPH PAPER USED



ANSWER ALL QUESTIONS

1. An oscilloscope display shows the above voltage waveform. The oscilloscope settings are shown in the box next to the waveform.



Oscilloscope settings:
2V/div
10ms/div

- a) Estimate the period of the waveform

[1 Mark]

$$4 \text{ div} \times 10\text{ms/div} = 40 \text{ ms}$$

- b) From the estimated period, determine its frequency

[1 Mark]

$$1/0.04 = 25 \text{ Hz}$$

- c) Determine its peak to peak amplitude

[1 Mark]

$$4 \text{ div} \times 2 \text{ V} = 8 \text{ V}$$

- d) Determine the RMS value of the waveform

[2 Marks]

$$8/2 \times 0.7071 = 2.8284 \text{ V}$$



2. The charging equation for a series resistor/capacitor network is given by:

$$V_c = V_s(1 - e^{-t/\tau}) \quad \text{where } V_c \text{ is the voltage across the capacitor and } V_s \text{ is the battery voltage.}$$

Assuming the following: $R = 100\text{k}$, $C = 20\mu\text{F}$ and $V_s = 10\text{V}$:

- a) Calculate V_c at time $t = 4$ seconds.

[3 Marks]

$$100\text{k} \times 20\mu\text{F} \times 10 \times 10^{(-6)} = 8; \text{ time constant} = 8$$

$$10\text{V}(1 - e^{(-4/8)}) = 3.934\text{V}$$



- b) Sketch a labelled graph that would represent the charging curve.

[5 Marks]

- c) What is the stored energy within the capacitor after it is fully charged?

[3 Marks]

- d) Calculate the time taken for the stored energy within the capacitor to reach 0.25mJ
[4 Marks]
3. State the 7 basic logic functions, their Boolean equations, truth tables and logic symbols.
[7 Marks]



4. For the circuit shown in Fig Q4. Determine the following:

a. Total circuit resistance

[4 Marks]

$$100 + 310 = 410$$

$$1 / 1/150 + 1/750 = 1/125 \sim 8 \times 10^{-3}$$

$$1 / 1/270 + 1/330 = 2/297 \sim 6.734006734 \times 10^{-3} \sim 0.006734$$

$$R7 = 470$$

$$1/125 + 2/297 + 410 + 470 = 880.0147 \sim 880.015 = R_t$$

b. Total circuit current

[2 Marks]

$$15V / 880.015 = 13200.225$$

c. Current flowing through R6

[2 Marks]

$$150/750 + 150 \times 13200.225 = 1980038.45$$

d. Total power delivered by the battery

[2 Marks]

$$13200.225 \times 15 = 198003.825 \text{ mW}$$

e. Power dissipated by R7

[4 Marks]

f. R4 is replaced by a wire link. What is the new circuit current?

[4 Marks]

$$100 + 310 = 410$$

$$1/1/150 + 1/750 + 1/270 = 85.443$$

$$470 + 410 + 85.443 = 965.443 = R_t$$

$$15V / 965.443 = 144181.64557$$

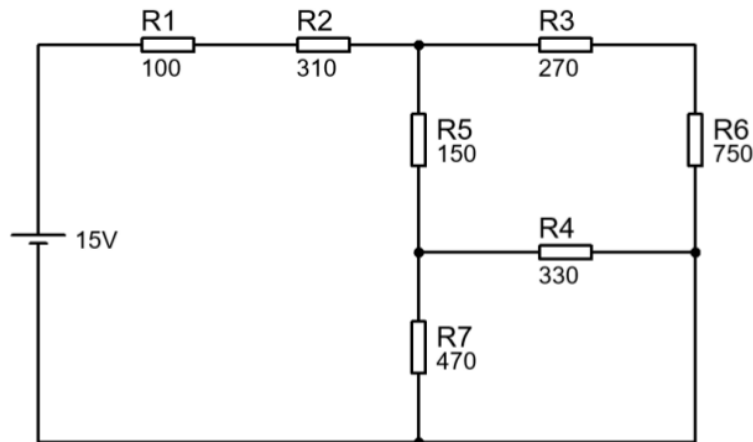


Fig. Q4

5. For the circuit shown in Fig Q5, calculate the current flowing through the 30Ω resistor.

[5 Marks]

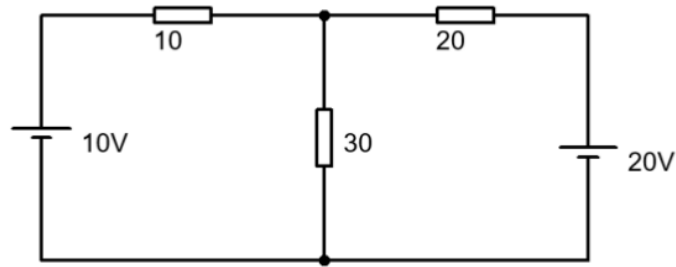


Fig. Q5

$$I_1 + I_2 + I_3 = 0$$

$$I_1 = \frac{10V - V_x}{10}$$

$$I_2 = \frac{20V - V_x}{20}$$

$$I_3 = \frac{0V - V_x}{30}$$

$$\frac{10 - V_x}{10} + \frac{20 - V_x}{20} + \frac{V_x}{30}$$

$$N = 12V$$

$$I_1 = 10 - 12/10 = -1/5 \text{ A}$$

$$I_2 = 20 - 12/20 = 0.4 \text{ A}$$

$$I_3 = 12/30 = -0.4 \text{ A}$$

$$I_3 = 0.6 \text{ A; Current flow}$$

Diwedd/End

Formulae Sheet

		$R_T = R_1 + R_2 + \dots + R_n$ $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$ $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_n}$ $C_T = C_1 + C_2 + \dots + C_n$ $L_T = L_1 + L_2 + \dots + L_n$ $\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \dots + \frac{1}{L_n}$	$V_{out} = V_{in} \frac{R_B}{R_A + R_B}$ $I = I_{in} \frac{R_B}{R_A + R_B}$ $X_C = \frac{1}{2\pi fC}$ $X_C = -j \frac{1}{\omega C}$ $X_L = 2\pi fL$ $X_L = j\omega L$
$Z = R + j(X_L - X_C)$ $ Z = \sqrt{R^2 + (X_L - X_C)^2}$	$\omega = 2\pi f$ $X_T = X_L - X_C$	$\varphi = \tan^{-1} \frac{X_T}{R}$ $pf = \cos \varphi$	$f_{res} = \frac{1}{2\pi\sqrt{LC}}$
$V_C = V_s(1 - e^{-t/\tau})$ $I_C = \frac{V}{R}(e^{-t/RC})$ $V_C = V_0(e^{-t/\tau})$ $I_C = -\frac{V}{R}(e^{-t/RC})$ $\tau = RC$	$\tau = \frac{L}{R}$ $V_L = V(e^{-Rt/L})$ $V_L = -V(e^{-Rt/L})$ $I_L = \frac{V}{R}(1 - e^{-Rt/L})$ $I_L = \frac{V}{R}(e^{-Rt/L})$	$f = \frac{1}{2\pi RC}$ $A_V = 20 \log \frac{V_{out}}{V_{in}}$ $A_P = 10 \log \frac{P_{out}}{P_{in}}$ $E = \frac{1}{2} CV^2$ $E = \frac{1}{2} LI^2$	$Q = \frac{X_L}{R}$ $Q = \frac{X_C}{R}$ $Q = \frac{f_R}{f_U - f_L}$ $Q = \frac{1}{R} \sqrt{\frac{L}{C}}$
$V_B = \frac{RB2}{(RB1 + RB2)} \times V_{CC}$ $V_E = V_B - 0.7$ $I_C = I_E$ $V_C = V_{CC} - (I_C \times R_C)$ $A_v = \frac{v_c}{v_b}$ $V_E = 10\%V_{CC}$ $R_{IN} = \frac{1}{\frac{1}{RB_1} + \frac{1}{RB_2} + \frac{1}{(h_{FE} \times R_E)}}$ $R_{OUT} = R_C$ $A_V \approx -\frac{R_C}{R_E}$		$V_{out} = -\frac{R2}{R1} \times V_{in}$ $V_{out} = \left[1 + \frac{R2}{R1}\right] \times V_{in}$ $V_{out} = \frac{R2}{R1} \times [V_2 - V_1]$ $V_{out} = -\frac{R2}{R1} \times [V_1 + V_2]$ $V_{out} = -\left[\frac{R}{R1} \times V_1 + \frac{R}{R2} \times V_2 + \dots + \frac{R}{Rn} \times V_n\right]$	

Detach this page and place in answer book

Student Number Question Number

May Exam

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

22/100

PAGE 1



Comment 1

Total marks = 11

Marks Available = 50

$11/50 \times 100 = 22\%$

PAGE 2



Comment 2

Question 1

a) 1 Mark

b) 1 Mark

c) 1 Mark

d) 2 Marks

Q 1 total = 5 Marks



Comment 3

Question 2

a) 2 Marks - incorrect time constant (2 sec)

b) 0 Marks

c) 0 Marks

d) 0 Marks

Q2 total 2 Marks

PAGE 3



Comment 4

Question 3 - 0 Marks

PAGE 4



Comment 5

Question 4

a) 0 Marks - incorrect resistor grouping

b) 0 Marks - You multiplied instead of divided.

c) 0 Marks - incorrect resistor grouping - answer a bit high: you need to sanity check your answers.

d) 1 Mark - incorrect answer propagated through, incorrect units

e) 0 Mark

f) 0 Marks - incorrect resistor grouping, you also multiplied instead of divided

Q4 total = 1 mark

PAGE 5



Comment 6

Question 5

3 Marks - Take more care with the method. You should have equated to zero where you had:

$$(10-V_x)/10 + (20-V_x)/20 + V_x/30 = 0$$

Then algebraically solved for V_x and finally ohms law for $I_3 = 0.364 \text{ A}$

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