

Exam

by Michael Peck

FILE	17976_MICHAEL_PECK_EXAM_246301_1464188922.DOCX (6.09M)		
TIME SUBMITTED	11-JUN-2020 11:16AM (UTC+0100)	WORD COUNT	103
SUBMISSION ID	130510426	CHARACTER COUNT	525

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

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**



MIKE PECK 1907404

1907404

Q1

(a) Given that 1 horizontal div = 10ms and +pk to +pk distance ≈ 4 div

$$\therefore T, \text{ period} = 4 \times (10 \times 10^{-3})s \\ = \underline{\underline{0.04s}}$$

(b)

$$\text{When frequency, } f = \frac{1}{T} = \frac{1}{0.04} = \underline{\underline{25 \text{ Hz}}}$$

(c) Peak to Peak amplitude = ≈ 4 div, when 1 div = 2V

$$\therefore \text{pk to pk voltage} = 4 \times 2V$$

$$\text{Amplitude Peak to Peak Voltage} = \underline{\underline{8V}}$$

(d)

$$\text{When } V_{\text{RMS}} = V_{\text{pk}} \times \frac{1}{\sqrt{2}} \quad \text{or} \quad \frac{V_{\text{pk}}}{\sqrt{2}}$$

$$\text{and } V_{\text{pk}} = \frac{V_{\text{pk to pk}}}{2} = \frac{8V}{2} = 4V$$

$$\therefore V_{\text{RMS}} = \frac{4V}{\sqrt{2}} = 2\sqrt{2}V \text{ or } 2.83V \text{ to 2d.p.}$$

Q2.

$$R = 100\text{ k}\Omega, C = 20\text{ }\mu\text{F} \text{ and } V_s = 10\text{ V}$$

(a)

$$\text{If } V_c = V_s (1 - e^{-\frac{t}{\tau}}), \text{ where } \tau = RC = (100 \times 10^3 \Omega) \times (20 \times 10^{-6} \text{ F})$$
$$= 2$$

$$\text{and } t = 4\text{ s}$$

$$V_c = 10 \times (1 - e^{-\frac{4}{2}})$$
$$= 10 \times (1 - e^{-2})$$

$$\therefore \underline{V_c \text{ at } t=4\text{ s} = 8.65\text{ V to 2 d.p.}}$$

(b) Please See graph.

(c) When fully charged $V_c = V_s = 10\text{ V}$ and $C = 20\text{ }\mu\text{F}$

Then energy ~~charged~~ stored when fully charged is given as follows:

$$E = \frac{1}{2} C V_c^2$$

$$= \frac{1}{2} \times (20 \times 10^{-6} \text{ F}) \times (10\text{ V})^2$$

$$= 1 \times 10^{-3} \text{ J}$$

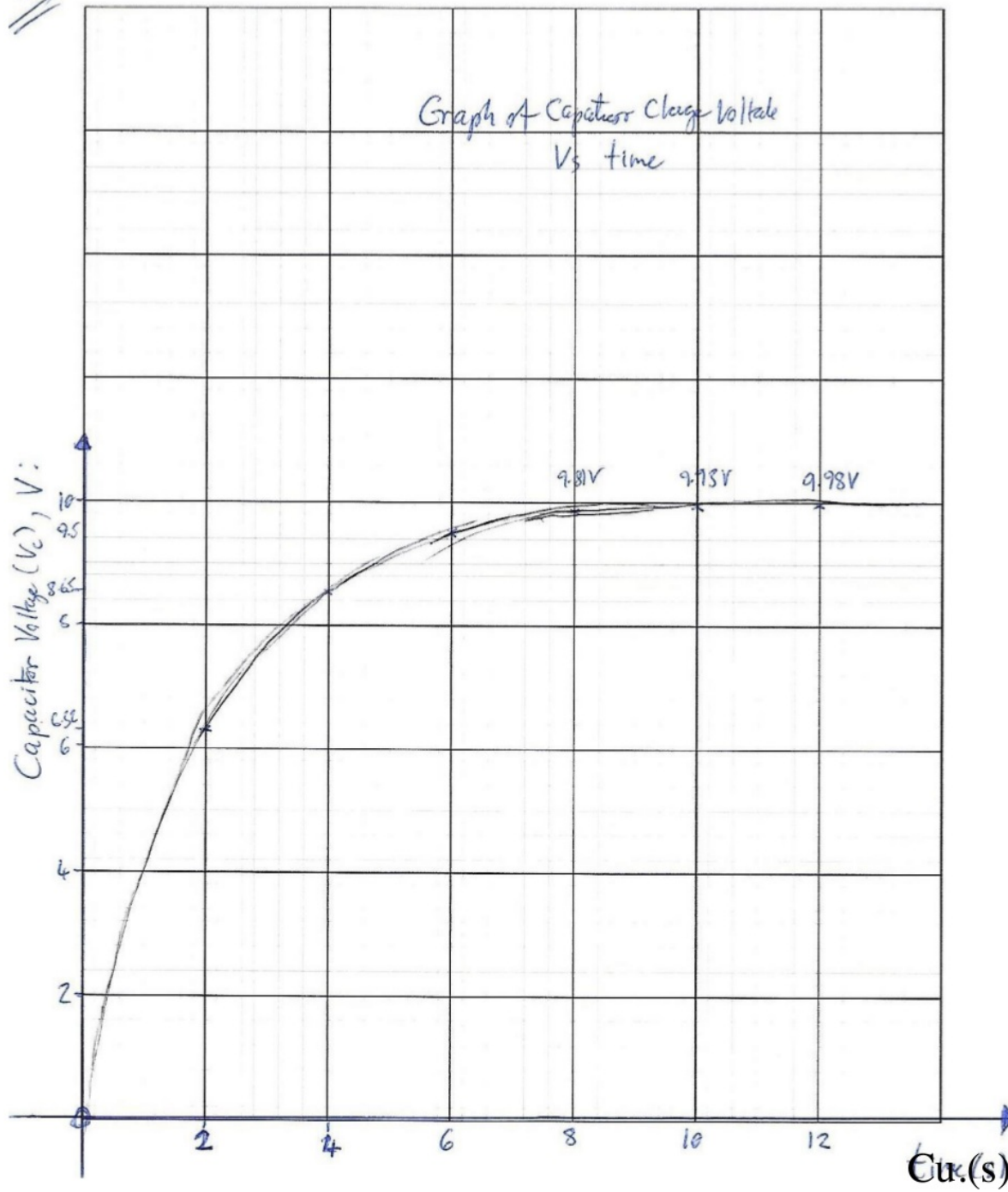
$$= \underline{\underline{1\text{ mJ}}}$$

②

Detach this page and place in answer book

Student Number 1907404 Question Number 26

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Q2 cont...

(d) If $E_{\text{stored}} = \frac{1}{2} C V_c^2$ and $V_c = V_s (1 - e^{-\frac{t}{\tau}})$

t can be calculated by finding V_c and rearranging for t , as before:

$$0.25 \times 10^{-3} \text{ J} = \frac{1}{2} C V_c^2$$

$\times 2$

$$0.50 \times 10^{-3} \text{ J} = C V_c^2$$

$\times 2$

$\div C$

$\downarrow$

$$25 = V_c^2$$

$\div C$

$$(20 \times 10^{-6} \text{ F})$$

$\sqrt{}$

$\downarrow$

$$5 = V_c$$

$\sqrt{}$

$\downarrow$

Then as $V_c = V_s (1 - e^{-\frac{t}{\tau}})$, when $\tau = RC = 2$ and $V_s = 10\text{V}$

$$5 = 10 (1 - e^{-\frac{t}{2}})$$

$\div 10$

$$0.5 = 1 - e^{-\frac{t}{2}}$$

$\div 10$

$+ e^{-\frac{t}{2}}$

$$e^{-\frac{t}{2}} + 0.5 = 1$$

$+ e^{-\frac{t}{2}}$

-0.5

$$e^{-\frac{t}{2}} = 0.5$$

-0.5

$\ln$

$$-\frac{t}{2} = -0.6931471806$$

$\ln$

$\times -2$

$$\therefore t = 1.386294361 \text{ s}$$

$\times -2$

(3)

Q3

The seven types of logic function and Boolean equations are as

91/91/3

TYPE

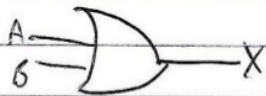
BOoLERN

A-MD

4

5

OR



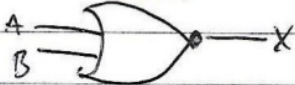
$$X = A + B$$

NAND



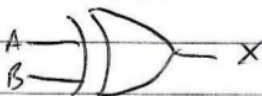
$$X = \overline{A \cdot B}$$

NOR



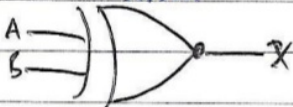
$$X = \overline{A + B}$$

XOR



$$X = A \oplus B$$

XNOR



$$X = \overline{A \oplus B}$$

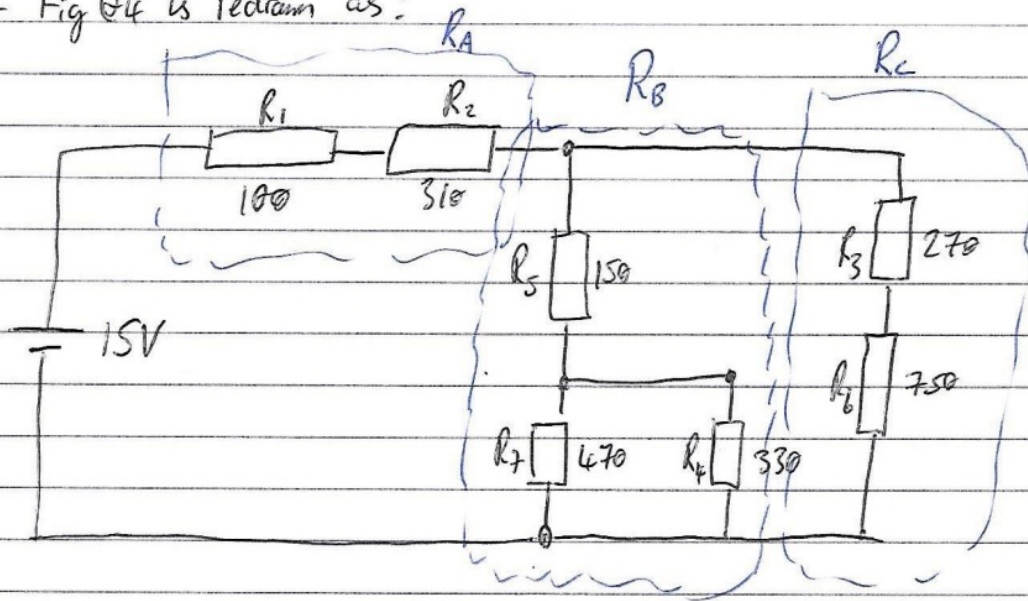


NOT



$$X = \overline{A}$$

Q4
(a) If Fig Q4 is redrawn as:



Total Circuit resistance, R_T , Can be calculated as follows:

$$R_T = R_A + \left(\frac{1}{R_B} + \frac{1}{R_C} \right)^{-1} \quad (1)$$

$$\text{When } R_A = R_1 + R_2 = (100 + 310) \Omega = 410 \Omega$$

$$R_B = R_5 + \left(\frac{1}{R_7} + \frac{1}{R_4} \right)^{-1} \Rightarrow 150 + \left(\frac{1}{470} + \frac{1}{330} \right)^{-1}$$

$$R_B \Rightarrow 343.875 \Omega$$

$$R_C = R_3 + R_6 = 270 + 750 = 1020 \Omega$$

Subs: R_A , R_B and R_C into Equation (1) gives:

$$\therefore \underline{R_T} = 410 \Omega + \left(\frac{1}{343.875} + \frac{1}{1020} \right)^{-1}$$

$$= \underline{\underline{667.1734946 \Omega = 667.17 \Omega \text{ to 2 d.p.}}}$$

(5)

4(b)

$$\text{When } V_s = I_s R_T, I_s = \frac{V_s}{R_T} \text{ and } V_s = 15V, R_T = 667.17\Omega$$
$$= \frac{15}{667.17}$$

$$\underline{\text{Total Circuit Current} = 0.02248290755 \text{ A or } 22.48 \text{ mA to 2d.p.}}$$

(c)

To calculate the current through R_b the voltage must be found, first at R_A , then R_C then finally (I_{R_b}) as follows:

$$V_{R_A} = I_s R_A \text{ when } I_s = 22.48 \text{ mA and } R_A = 410\Omega$$
$$= 9.217992096V$$

$$\therefore R_C = 15V - 9.217992096V$$

$$V_{R_C} = 5.782007904V$$

$$\text{Then } I_{R_C} \text{ or } I_{R_b} = \frac{V_{R_C}}{R_C} = \frac{5.782007904V}{1020}$$

$$\underline{\text{Current through } R_b = 5.6686352 \times 10^{-3} \text{ A or } 5.67 \text{ mA to 2d.p.}}$$

(d)

$$\underline{\text{Total power delivered}} = \frac{V_s^2}{R_T} \text{ when } V_s = 15V \text{ and } R_T = 667.17\Omega$$
$$= \frac{15^2}{667.17}$$
$$= \underline{0.3372436133 \text{ Watts or } 337.24 \text{ mW}}$$

(b)

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(e)

Given $V_{R_C} = V_{R_B} = 5.782007904V$ and $R_B = 345.875\Omega$

$$I_{R_B} = \frac{V_{R_B}}{R_B} = 0.01681427235A$$

$$\therefore V_{R_7} = V_{R_5} - V_{R_B} = 5.782007904V - (0.01681427235 \times 150)$$

$$V_{R_7} = 3.259867052V$$

$$\therefore \text{Power dissipated by } R_7 = \frac{V_{R_7}^2}{R_7}$$

$$= \frac{(3.25986...V)^2}{470}$$

$$= \underline{\underline{0.02261007065 \text{ Watts or } 22.6mW}}$$

(f)

If R_4 is replaced by a wire link then $R_T = R_5 + R_7$

$$= 410 + \left(\frac{1}{620} + \frac{1}{1020} \right)^{-1}$$

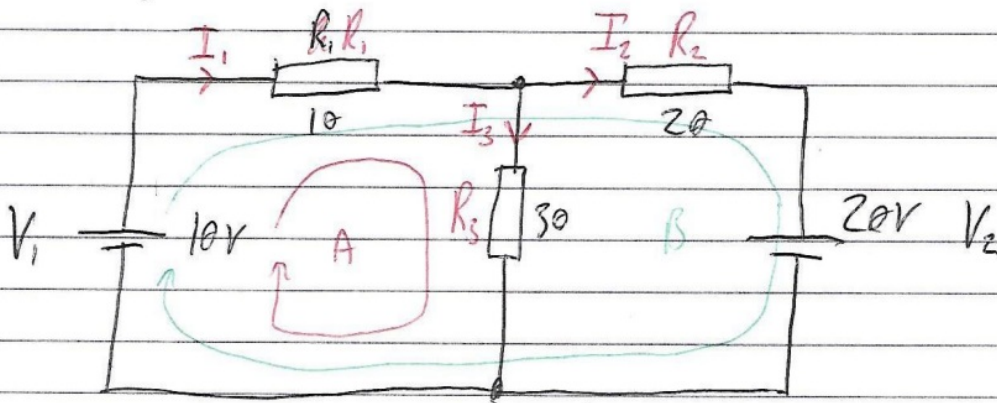
$$R_T = 795.6094561\Omega$$

When $V_S = 15V$

$$\text{New circuit current, } I_S = \frac{V_S}{R_T} = \frac{15}{795...} = \underline{\underline{18.85mA \text{ to 2d.p.}}}$$

Q5

Using Kirchhoff's Laws. the circuit below is:



Loop A:

$$V_1 - (I_1 R_1) - (I_3 R_3) = 0V \quad \text{Using Kirchhoff Voltage Law} \quad (1)$$

Then taking into account V_2 but ignoring R_3 loop B gives:

$$V_1 - (I_1 R_1) - (I_2 R_2) - V_2 = 0V \quad (2)$$

$$\text{and Kirchhoff's Current Law gives: } I_1 = I_2 + I_3 \quad (3)$$

Transposing (3) to make I_3 the subject gives: $I_3 = I_1 - I_2$,
Substituting into eq (1) gives:

$$V_1 - (I_1 R_1) - (I_1 R_3) + I_2 R_3 = 0 \quad (4)$$

When $V_1 = 10V$, $R_1 = 10\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$ and $V_2 = 20V$

$$\text{Equation (4) becomes: } 10V - (10I_1) - (30I_1) + 30I_2 = 0$$

$$\text{Simplifying to: } 10V - 40I_1 + 30I_2 = 0 \quad (5)$$

$$\text{equation (2) becomes: } 10V - 10I_1 - 20I_2 - 20V = 0$$

$$\therefore -10V - 10I_1 - 20I_2 = 0 \quad (6)$$

(8)

Equations (5) and (6) become:

$$10V = 40I_1 - 30I_2 \quad (7)$$

$$-10V = 10I_1 + 20I_2 \quad (8)$$

To solve (7) $\times 4$:

$$\therefore 10V = 40I_1 - 30I_2$$

$$-40V = 40I_1 + 80I_2$$

$$50V = \quad \quad -110I_2$$

$$\therefore I_2 = -0.45A$$

Subs I_2 into (8) gives:

$$-10V = 10I_1 + 20I_2$$

$$-10 = 10I_1 + 20(-0.45)$$

$$= -0.09A$$

$\therefore$ Current through the 30Ω resistor $\Rightarrow I_3 = I_1 - I_2$

$$= -0.09 - (-0.45)$$
$$= \underline{\underline{0.36A}}$$

Exam

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

90/100

PAGE 1



Comment 1

Total marks 45

Marks Available 50

$45/50 \times 100 = 90\%$

PAGE 2



Comment 2

Question 1

a) 1 Mark

b) 1 Mark

c) 1 Mark

d) 1 Mark - should use peak voltage not peak to peak voltage

Q1 total 4 Marks

PAGE 3

PAGE 4

PAGE 5

Comment 3



Question 2

- a) 3 Marks
- b) 5 Marks
- c) 3 Marks
- d) 4 Marks

Q2 total 15 Marks

PAGE 6



Comment 4

AND gate and boolean equation present and correct on original emailed pdf document but removed in pdf to word conversion required for submission.



Comment 5

Question 3 - 5 Marks

No truth tables given.

PAGE 7

PAGE 8

PAGE 9



Comment 6

Question 4

- a) 4 Marks
- b) 2 Marks
- c) 2 Marks
- d) 2 Marks
- e) 4 Marks
- f) 2 Marks - if R4 is shorted, R7 is also shorted

Q4 total 16 Marks



Comment 7

Question 5 - 5 Marks