

Electronic and Electrical Principles

Online Exam

ACDB4002&ACDB4006

Start time 13:00

Duration: 2 Hours

Friday May 15th 2020

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PRINCIPLES EXAM

ACDB 4002 + ACDB 4006

1. OSCILLOSCOPE SETTINGS

2V/div

10ms/div

a) PERIOD OF WAVEFORM

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

b) $f = 1/T$

$$1/40 \times 10^{-3} = 25\text{Hz}$$

c) PEAK TO PEAK = 8V

$$1) \text{ RMS} = 1/\sqrt{2} \times 4 = 2.828$$

2.

$$V_c = V_s (1 - e^{-t/\tau}) \quad R = 100\text{k} \quad C = 20\mu\text{F} \quad V_s = 10\text{V}$$

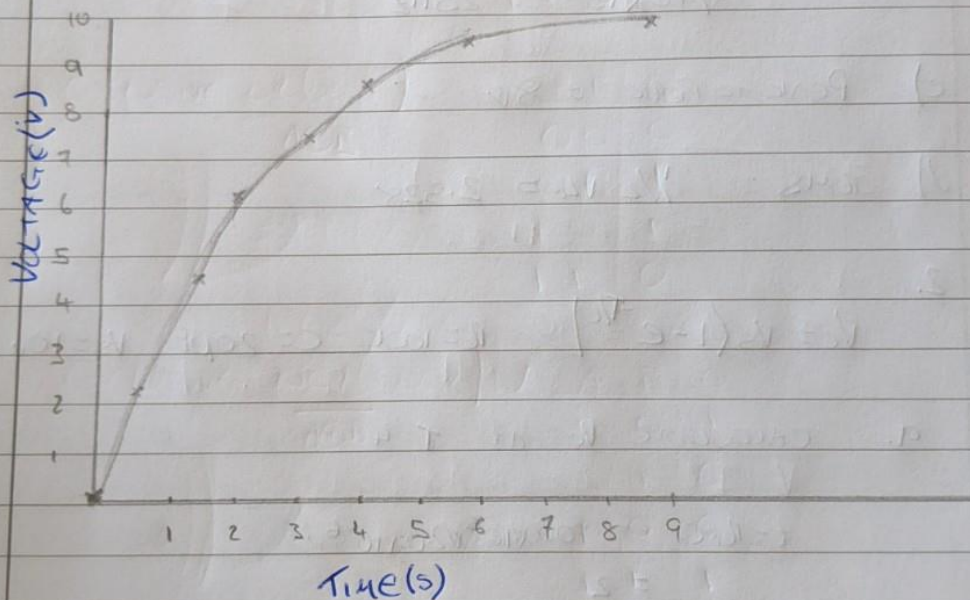
a. CALCULATE V_c AT $t = 4$

$$t = R \times C = 100 \times 10^3 \times 20 \times 10^{-6} \\ = 2$$

$$V_c = 10(1 - e^{-4/2}) \\ = 8.647\text{V}$$

b)

TIME	VOLTS
0	0V
0.5	2.2
1.2	4.5
2	6.3
3.2	7.9
4	8.6
6	9.5
9	9.85



c) STORED ENERGY

$$E = \frac{1}{2} CV^2$$

$$= \frac{1}{2} \times 20 \times 10^{-6} \times 10^2$$

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

d)

$$E = \frac{1}{2} CV^2$$

$$V = \sqrt{\frac{E}{\frac{1}{2}C}}$$

$$V = \sqrt{\frac{1 \times 10^{-3}}{\frac{1}{2} \times 20 \times 10^{-6}}}$$

$$V = 10$$

$$V_c = V_0(e^{\frac{-t}{\tau}})$$

$$= -\ln\left(\frac{V_c}{V_0}\right) \times \tau = T$$

$$T = -\ln\left(\frac{10}{10}\right) \times 2$$

$$T = 0.1$$

3)

AND GATE

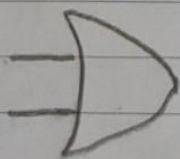
~~A~~ A.B



A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

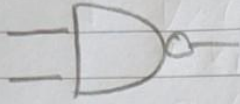
OR GATE

A+B



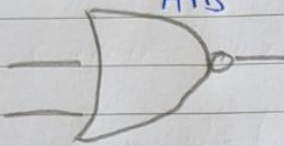
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

NAND GATE
 $\overline{A \cdot B}$ $A \cdot B$



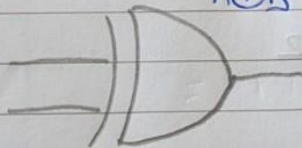
A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

NOR GATE
 $\overline{A + B}$



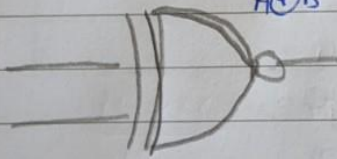
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

EXCLUSIVE OR (XOR)
 $A \oplus B$



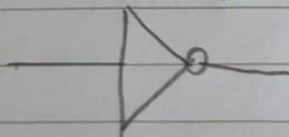
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

EXCLUSIVE NOR (XNOR)
 $\overline{A \oplus B}$



A	B	Q
0	0	1
0	1	0
1	0	0
1	1	1

INVERTER (NOT)
 $\overline{A}$



A	Q
0	1
1	0

4 a) TOTAL RESISTANCE

$$\begin{aligned} R_3 + R_6 &= 270 + 750 = 1020 \Omega \\ R_5 + R_4 &= 150 + 330 = 480 \Omega \end{aligned} \quad \text{PARALLEL}$$

$$\frac{1020 \times 480}{1020 + 480} = 326.4 \Omega$$

$$326.4 + R_7 = 326.4 + 470 = 796.4 \Omega$$

$$R_1 + R_2 = 100 + 310 = 410 \Omega$$

$$410 + 796.4 = 1206.4 \Omega$$

b. CIRCUIT CURRENT

$$\begin{aligned} I &= V/R \\ &= 15 / 1206.4 \\ &= 12.43 \text{ mA} \end{aligned}$$

c. CURRENT THROUGH R_6

$$\begin{aligned} V &= I \times R \\ &= 12.43 \text{ mA} \times 750 \\ &= 9.325 \\ &= I = V/R \\ &= 9.325 / 750 \end{aligned}$$

$$\begin{aligned} \frac{480}{480 + 1020} \times 12.43 \text{ mA} \\ = 3.978 \text{ mA} \end{aligned}$$

d) TOTAL POWER

$$P = V \times I$$
$$15 \times 12.43 \text{ mA}$$
$$= 0.186 \text{ W}$$

e) POWER BY ~~DIS~~ R_F

CURRENT THROUGH R_F

$$V_{OUT} = \frac{15}{18} \left(\frac{796.4}{796.4 + 410} \right)$$

$$= 9.902 \text{ V}$$

$$P = 9.902^2 / 796.4$$
$$= 0.123 \text{ W}$$

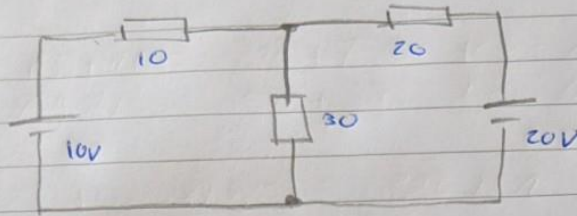
f)

$$\frac{15 \times 16}{15 + 16} = \frac{150 \times 750}{150 + 750} = 125 \Omega$$

$$410 + 125 + 470 = 1005 \Omega$$

$$I = V/R$$
$$= 15 / 1005$$
$$= 14.92 \text{ mA}$$

5.



$$I_1 + I_2 = I_3$$

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

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

$$I_3 = \frac{V_x}{30}$$

$$\frac{V_x}{30} = \frac{10V - V_x}{10} + \frac{20V - V_x}{20} \quad \times 20$$

$$\frac{20V_x}{30} = \frac{20(10V - V_x)}{10} + \frac{20(20V - V_x)}{20}$$

$$0.66V_x = 20V - 2V_x + 20V - V_x$$

$$0.66V_x + 2V_x + V_x = 40$$

$$3.66V_x = 40$$

$$V_x = \frac{40}{3.66} = 10.928V$$

$$I_1 = \frac{10.928}{10} =$$

$$I_3 = \frac{10.928}{30} = 0.364A$$