

Stan Collins - 202249 Exam

by Stan Joseph Collins

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Electrical & Electronic Principles

Jan 2022

Stan Collins
2022429

1)

a) $R_{1,2} = 410\Omega$
 $R_{3,6} = 270 + 750 = 1020\Omega$
 $R_{4,7} = \left(\frac{1}{470} + \frac{1}{330}\right)^{-1} = 193.875\Omega$
 $R_{4,5,7} = 193.875 + 150 = 343.875\Omega$
 $R_{2,6,4,5,7} = \left(\frac{1}{1020} + \frac{1}{343.875}\right)^{-1} = 257.173\Omega$
 $R_T = 410 + 257.173\Omega = 667.173\Omega$

b) $I_T = \frac{V}{R_T} = \frac{15}{667.173} = 22.483\text{mA}$

c) $I_{R3} = 22.483 \times 10^{-3} \times \frac{750}{343.875 + 1020} = 5.664\text{mA}$

d) $P_T = \frac{V^2}{R_T} = \frac{15^2}{667.173} = 337.244\text{mW}$

e) $I_{R5} = I_T \times \frac{1020}{343.875 + 1020} = 16.814\text{mA}$
 $\therefore I_{R4} = I_{R5} \times \frac{470}{470 + 330} = 9.878\text{mA}$
 $\therefore P = I_{R4}^2 R_4 = (9.878 \times 10^{-3})^2 \times 330 = 32.202\text{mW}$

f) R7 becoming a wire shorts R4 $\therefore R_{4,5,7} = R_5 = 150$
 $\therefore R_T = \left(\frac{1}{1020} + \frac{1}{150}\right)^{-1} + 410\Omega = 540.769\Omega$
 $\hookrightarrow I_T = \frac{V}{R_T} = \frac{15}{540.769} = 27.738\text{mA}$

(2)

a) Period $\approx 400 \text{ ms}$

b) frequency $= \frac{1}{400 \times 10^{-3}} = 2.5 \text{ Hz}$

c) Peak to Peak amplitude $= 4 \times 500 \times 10^{-3} = 2 \text{ V}$

d) R.M.S $= 0.707 \times 1 = 0.707 \text{ V}$

(3)

a) $V_c = V_0 (e^{-t/RC})$

$R = 40 \text{ k}\Omega$ $V_0 = 12 \text{ V}$
 $C = 10 \mu\text{F}$

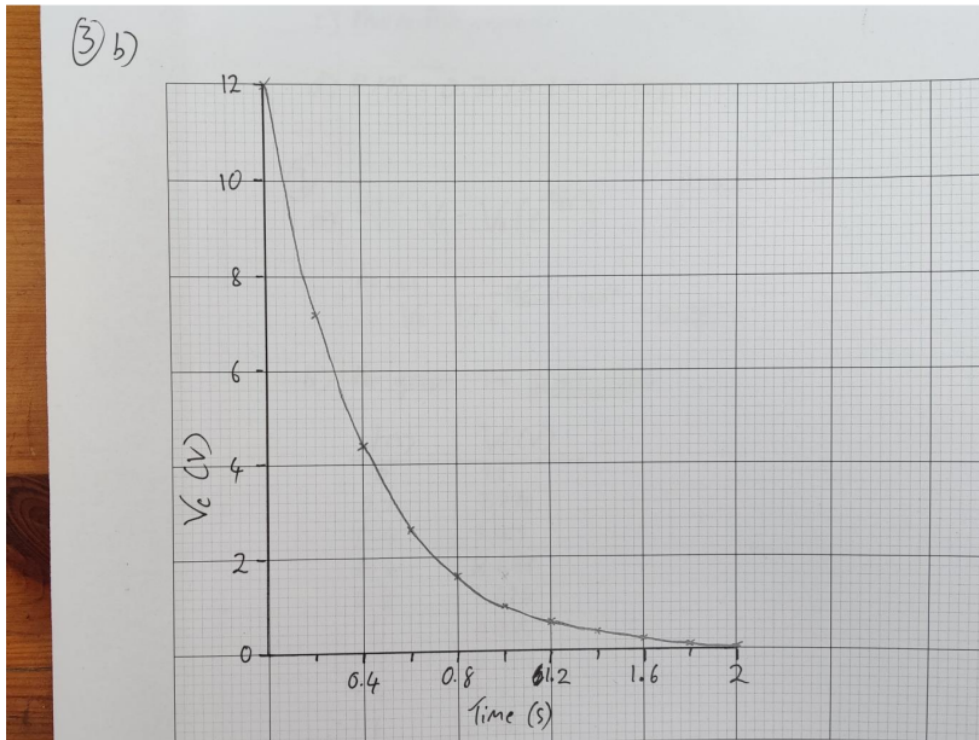
$t = 1.6 \text{ s}$

$\therefore V_c = 12 e^{-\frac{1.6}{40 \times 10^3 \times 10 \times 10^{-6}}} = 0.220 \text{ V}$

b) For graph, see graph paper

$t(\text{s})$	$V_c(\text{V})$
0	12
0.2	7.278
0.4	4.415
0.6	2.678
0.8	1.624
1	0.985
1.2	0.597
1.4	0.362
1.6	0.220
1.8	0.133
2	0.081

Question 3B – Graph. NOTE: Values for graph can be found on previous page



③ c) $E = \frac{1}{2} CV^2$

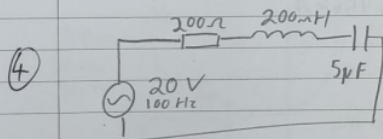
$$E = 0.5 \times 10 \times 10^{-6} \times 12^2 = 720 \mu J$$

d) $E = 0.1 mJ = \frac{1}{2} CV^2$

$$\therefore V = \sqrt{\frac{2E}{C}} = \sqrt{\frac{0.2 \times 10^{-3}}{10 \times 10^{-6}}} = 2\sqrt{5} = 4.472 V = V_c$$

$$\therefore 2\sqrt{5} = 12 e^{-\frac{t}{RC}} \quad \therefore \ln\left(\frac{\sqrt{5}}{6}\right) = -\frac{t}{RC}$$

$$\hookrightarrow t = -RC \ln\left(\frac{\sqrt{5}}{6}\right) = -40 \times 10^{-3} \times 10 \times 10^{-6} \times \ln\left(\frac{\sqrt{5}}{6}\right) = 0.395 s$$



a) $X_L = 2\pi fL = 2\pi \times 100 \times 200 \times 10^{-3} = 40\pi \Omega = 125.664 \Omega$

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 100 \times 5 \times 10^{-6}} = 318.310 \Omega$$

$$|Z| = \sqrt{200^2 + (X_L - X_C)^2} = \sqrt{200^2 + (40\pi - 318.310)^2} = 277.692 \Omega$$

b) $I_T = \frac{V}{Z} = \frac{20}{277.692} = 72.022 mA$

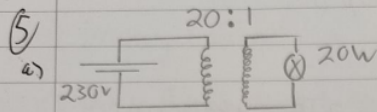
c) $\phi = \tan^{-1}\left(\frac{X_L}{R}\right) = \tan^{-1}\left(\frac{40\pi - 318.310}{200}\right) = -43.927^\circ$
 current leads voltage by 43.927°

d) $V_R = IR = 72.022 \times 10^{-3} \times 200 = 14.404 V$

e) $V_C = IX_C = 72.022 \times 10^{-3} \times 318.310 \Omega = 22.925 V$

f) $V_L = IX_L = 72.022 \times 10^{-3} \times 125.664 = 9.051 V$

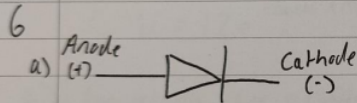
④ g) $f_{res} = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{200 \times 10^{-3} \times 5 \times 10^{-6}}} = 159.155 \text{ Hz}$



b) $V_s = V_p \times \frac{1}{20} = 230 \times \frac{1}{20} = 11.5 \text{ V}$

$I_s = \frac{P}{V_s} = \frac{20}{11.5} = 1.739 \text{ A}$

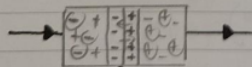
c) $I_p = \frac{P}{V_p} = \frac{20}{230} = 86.956 \text{ mA}$



b) Forward Biased Diode:

The forward current flows across the diode, but requires a small voltage, of $\sim 700 \text{ mV}$ to make the current flow.

As a result, the depletion region narrows

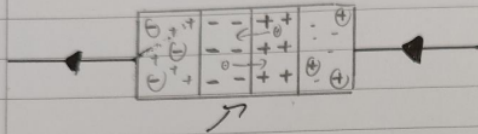


Depletion Zone: The region where electrons and 'holes' combine and cancel each other, leaving no free carriers

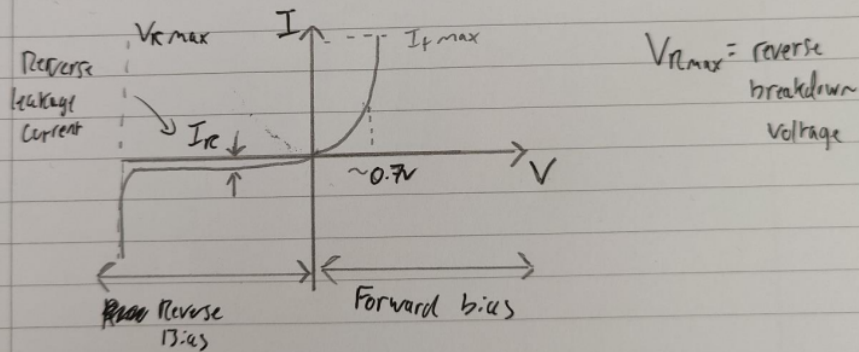
⑥ b) Reverse Bias :

No current flows, but a small reverse leakage current.

The depletion zone widens, as the free carriers are pulled away from the centre



Depletion Zone wider than before



Diodes may be considered a switch, acting almost as a short circuit in forward bias, and an open circuit in reverse bias.

END/ Diwedd

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GRADEMARK REPORT

FINAL GRADE

100

/100

GENERAL COMMENTS

Instructor

Total 70 marks out of 70

$70 / 70 \times 100 = 100\%$

Well Done !!

Q1 - 18 Marks

- a) 4 Marks
- b) 2 Marks
- c) 2 Marks
- d) 2 Marks
- e) 4 Marks
- f) 4 Marks

Q2 - 5 Marks

- a) 1 Mark
- b) 1 Mark
- c) 1 Mark
- d) 2 Marks

Q3 - 15 Marks

- a) 3 Marks

b) 5 Marks

c) 3 Marks

d) 4 Marks

Q4 - 14 Marks

a) 2 Marks

b) 2 Marks

c) 2 Marks

d) 2 Marks

e) 2 Marks

f) 2 Marks

g) 2 Marks

Q5 - 6 Marks

a) 2 Marks

b) 2 Marks

c) 2 Marks

Q6 - 12 Marks

a) 2 Marks

b) 10 Marks

