

Jacob Smith Exam answers

by Jake Ian Smith

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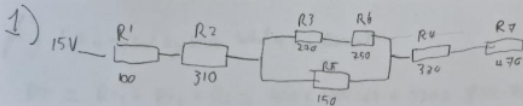
Word count: 119

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Jacob Smith

Electrical and electronic principles (OEM) exam ACAD4006

14th January 2022

1) 

a) Total Resistance

$$R_{T1} = R_1 + R_2 = 100 + 310 = 410 \Omega$$
$$R_{T2} = R_3 + R_6 = 270 + 250 = 520 \Omega = \frac{1020 \times 150}{1020 + 150} = 130.769 \Omega$$
$$R_{T3} = R_4 + R_7 = 320 + 470 = 790 \Omega$$
$$R_T = R_{T1} + R_{T2} + R_{T3} = 410 + 130.769 + 790 = 1340.769$$

b) Total Current

$$I = \frac{V}{R} = \frac{15}{1340.769} = 0.011187 A = 11.187 \text{ mA}$$

c) Current through R3

$$I_{R3} = I \times \frac{(R_3 + R_6)}{(R_3 + R_6) + R_5} = 0.011187 \times \frac{(270 + 250)}{(270 + 250) + 150} = 1.161 \text{ mA}$$

d) Total power delivered by Battery

$$P = IV = 0.011187 \times 15 = 0.168 \text{ W}$$
$$P = \frac{V^2}{R} = \frac{15^2}{1340.769} = 0.168 \text{ W}$$

e) Power dissipated by R4

$$V_{R4} = V \times \left(\frac{R_4}{R_T} \right) = 15 \times \left(\frac{320}{1340.769} \right) = 6.049 \text{ V}$$
$$P_{R4} = \frac{V^2}{R} = \frac{6.049^2}{320} = 0.1133 \text{ W} = 113.3 \text{ mW}$$

f) R7 is replaced by wire. What is the current

$$R_T = R_{T1} + R_{T2} + R_4 = 410 + 130.769 + 320 = 870.769 \Omega$$
$$I = \frac{V}{R} = \frac{15}{870.769} = 0.017226 A = 17.226 \text{ mA}$$

2

a) Period of Wave form

$$F = \frac{1}{T} = \frac{1}{400} = 2.5 \text{ Hz}$$

$$1 \text{ box} = 100 \text{ m/s}$$

$$4 \text{ boxes} = 1 \text{ wave} = \frac{1}{2.5} = 0.4 \text{ ms}$$

$$100 \times 4 = 400 \text{ ms}$$

b) Calculate Frequency

$$F = \frac{1}{T} = \frac{1}{400} = 2.5 \text{ Hz}$$

c) Calculate Peak to Peak Amplitude

$$1 \text{ box} = 500 \text{ mV}$$

$$500 \times 4 = 2000 \text{ mV} = 2 \text{ V}$$

$$\text{PK to PK} = 4 \text{ boxes}$$

d) Calculate RMS

$$V_{\text{RMS}} = \frac{V_{\text{PK}}}{\sqrt{2}} = \frac{1}{\sqrt{2}} = 0.707 \text{ V}$$

3

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

$$R = 40k \quad C = 10\mu F \quad V_0 = 12V$$

a) Calculate V_c at $T = 1.6$ Seconds

$$\tau = R \times C = 40000 \times 0.000010 = 0.4s$$

$$V_c = V_0 (e^{-\frac{T}{\tau}}) = 12 (e^{-\frac{1.6}{0.4}}) = 0.2198V$$

b) See graph paper

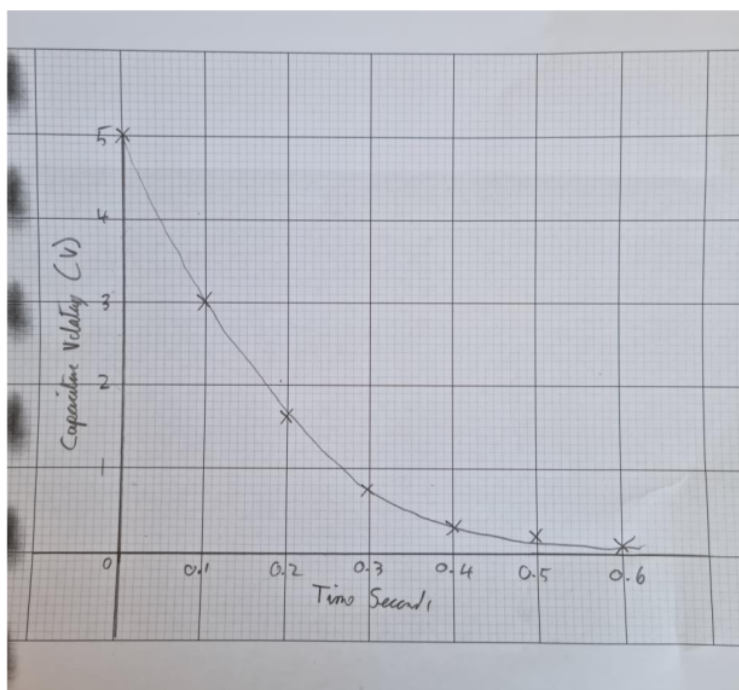
c) Total stored energy

$$E = \frac{1}{2} C V^2 = \frac{1}{2} \times 10 \times 10^{-6} \times 12^2 = 7.2 \mu J$$

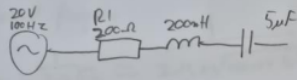
d) Calculate Time for E to reach $0.1mJ$

$$Q = CV e^{-\frac{T}{RC}}$$

$$I_c = -\frac{V}{R} (e^{-\frac{T}{RC}}) = -\frac{12}{40000} (e^{-\frac{T}{40000 \times 10 \times 10^{-6}}}) =$$



4



a) Total impedance

$$X_L = 2\pi f L = 2\pi \times 100 \times (200 \times 10^{-3}) = 125.663 \Omega$$

$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 100 \times (5 \times 10^{-6})} = 318.309 \Omega$$

$$Z = R + (X_L - X_C) = 200 + (125.663 - 318.309) = 200 - 192.646$$

$$|Z| = \sqrt{200^2 + 192.646^2} = \sqrt{40000 + 37112.461} = \sqrt{77112.461} = 277.691 \Omega$$

b) Total Current Supply

$$I = \frac{V}{Z} = \frac{20}{277.691} = 0.072 \text{ A}$$

c) Phase difference between Supply and Current

$$\phi = \tan^{-1}\left(\frac{X_C}{R}\right) = \tan^{-1}\left(\frac{192.646}{200}\right) = 43.927^\circ$$

d) Voltage at R

$$V_R = IR = 0.072 \times 200 = 14.4 \text{ V}$$

e) Voltage at C

$$V_C = I \times X_C = 0.072 \times 318.309 = 22.918 \text{ V}$$

f) Voltage at L

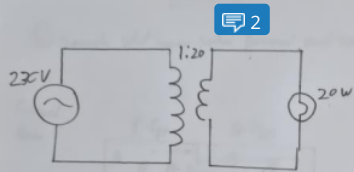
$$V_L = I \times X_L = 0.072 \times 125.663 = 9.048 \text{ V}$$

g) Resonant frequency

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

5 230 V Step down transformer, 20 W Lamp, Ratio 1/20

a) Sketch circuit



b) Calculate Secondary Current

$$V_s = \frac{N_s}{N_p} = \frac{V_p}{V_p} \quad \frac{1}{20} = \frac{V_s}{230}$$

$$V_s = \frac{N_s}{N_p} \times V_p = \frac{1 \times 230}{20} = 11.5 \text{ V}$$

c) Primary Current from Supply

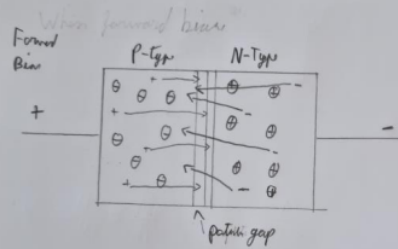
$$I_p = \frac{L}{V} = \frac{20}{230} = 0.087 \text{ A}$$

6

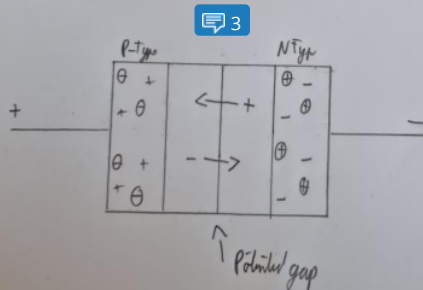
a) Draw Symbol for rectifier diode



b) Describe what happens when forward and reverse biased



Reverse Bias



b)

When Forward bias is applied to a diode the electrons begin to move from the N-type region of the diode into the P-type region. This decreases the size of the potential gap between N-type and P-type regions and By doing this it allows the current to flow through the diode as it has formed a positive and negative region within it.

When negative bias is applied the electrons within the N-type region move towards the negative side of the region thus increasing the potential gap between the N-type region and the P-type region. When this happens, it is harder for current to flow through the diode.

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GRADEMARK REPORT

FINAL GRADE

67 / 100

GENERAL COMMENTS

Instructor

Total marks - 47 out of 70

$$47 / 70 \times 100\% = 67\%$$

Q1 - 12 Marks total

- a) 2 Marks (incorrect circuit used - R4 & R7 are not in series)
- b) 2 Marks (Error Carried Forward)
- c) 1 Mark (ECF - resistor values wrong way around in eqn)
- d) 2 Marks (ECF)
- e) 1 Mark - (ECF) - wrong resistor voltage, need to take voltage across ONLY R4 and not R4+R7
- f) 4 Marks (ECF)

Q2 - 5 Marks total

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

Q3 - 8 Marks total

- a) 3 Marks

b) 3 Marks - incorrect scale on both axis - should be 0 to 12V and 0 to 2 Seconds

c) 2 Marks

d) 0 Marks

Q4 - 14 Marks total

a) 2 Marks

b) 2 Marks

c) 2 Marks

d) 2 Marks

e) 2 Marks

f) 2 Marks

g) 2 Marks

Q5 - 4 Marks

a) 1 Mark - ratio wrong way around

b) 1 Mark - only secondary voltage calculated, no secondary current.

c) 2 Marks

Q6 - 4 Marks total

a) 2 Marks

b) 2 Mark



Comment 1

Right eqn, right numbers, wrong answer. $720\mu\text{J}$ not $7.2\mu\text{J}$

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Comment 2

Ratio wrong way around.

PAGE 7



Comment 3

Some words were needed to give the description of what happens. You can't leave it to diagrams - they can be interpreted in many ways.