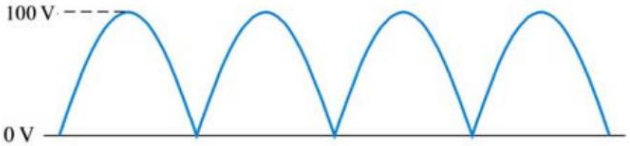
19EEE114 Electronic Circuits

Assignment #2 **SOLUTION**

Q1. Find the average value of the full-wave rectified voltage shown below.



Solution:

$V_{avg} = 2V_m/\pi = (2x100)/\pi = 63.69$ V

Q2. A diode with $V_F = 0.7$ V is connected as a half-wave rectifier. The load resistance is 470 Ω and the ac input is 12 V from the secondary of transformer. Determine the peak output voltage, peak load current and the diode peak reverse voltage.

Solution:

Vin = 1.414 x 12 = 16.968 V

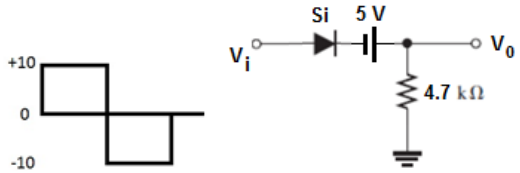
Vout = Vin – V_F = 16.968 – 0.7 = 16.268 V

I = 16.268/470 = 34.61 mA

PIV = Vpeak = 16.968 V

Q3. Determine the output waveform of the following circuits for the given input signals.

(a)



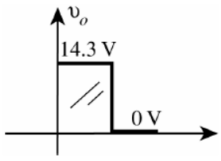
Sol:

Positive pulse of v_i:

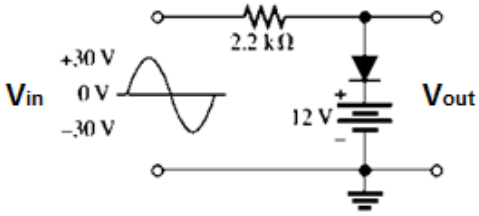
$V_o = 10\text{ V} - 0.7\text{ V} + 5\text{ V} = \mathbf{14.3\text{ V}}$

Negative pulse of v_i:

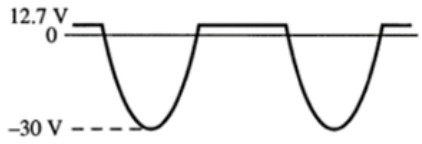
diode "open", $v_o = \mathbf{0\text{ V}}$



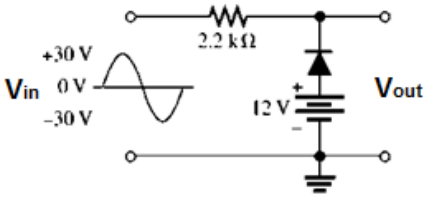
(b)



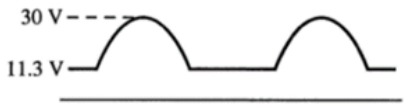
Sol:



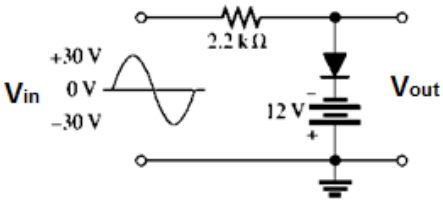
(c)



Sol:

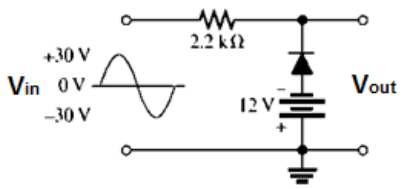


(d)



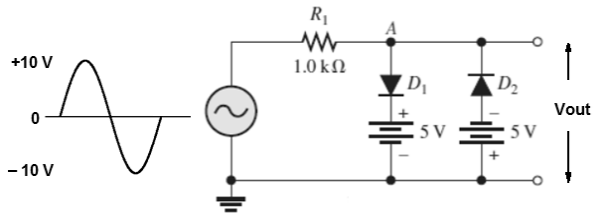
Sol:

(e)



Sol:

(f)



Sol:

Q4. For a certain Zener diode, V_Z = 10 V at I_{ZT} = 30mA. If Z_Z = 8Ω, what is the terminal voltage at I_Z = 50mA?

Sol:

V_Z = 10 V +(20mA)(8) = 10.16 V

Q5. A Zener regulator has an input voltage that may vary from 22 to 30 V. If the regulated output voltage is 12V and the load resistance varies from 140 Ω to 10 kΩ, what is the maximum allowable series resistance?

Sol:

$$R_{S(max)} = \left(\frac{V_{S(min)}}{V_Z} - 1\right) R_{L(min)}$$

$R_{S(max)}$ = (22/12 – 1)x140 = 117 Ω

As long as the series resistance is less than 117 Ω, the zener regulator will work properly under all operating conditions.

Q6. A Zener regulator has an input voltage ranging from 15 to 20 V and a load current ranging from 5 to 20 mA. If the Zener voltage is 6.8 V, what is the maximum allowable series resistance?

Sol:

$$R_{S(max)} = \frac{V_{S(min)} - V_Z}{I_{L(max)}}$$

$R_{S(max)}$ = (15 – 6.8)/20 mA = 410 Ω

If the series resistance is less than 410 Ω, the zener regulator will work properly under all conditions.

Q7. A Zener diode whose nominal voltage is 10 V at 10 mA has an incremental resistance of 50 Ω.

a) What is the value of V_{Z0} in the Zener model?

b) What voltage do you expect if the diode current is doubled?

Sol:

$V_Z = V_{Z0} + I_z r_z$

$10 = V_{Z0} + 50\ \Omega \times 10$ mA

a) V_{Z0} = 9.5 V

I_Z = 20 mA => V_Z = 9.5 + 20 mA x 50 = 10.5 V

b) V_Z = 10.5 V