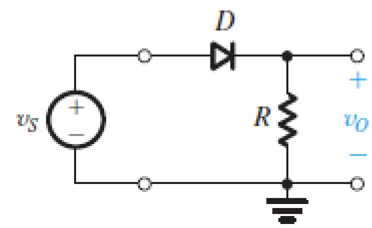
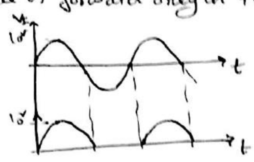
[1] In the circuit of Fig. 1, let v_I have a peak value of 10 V and $R = 1$ kΩ. Find the peak value of i_D and the dc component of v_o.



- Input signal is a sine wave with amp. 10V
- Diode is forward only in +ve half cycle



- Peak i_D at peak voltage 10V

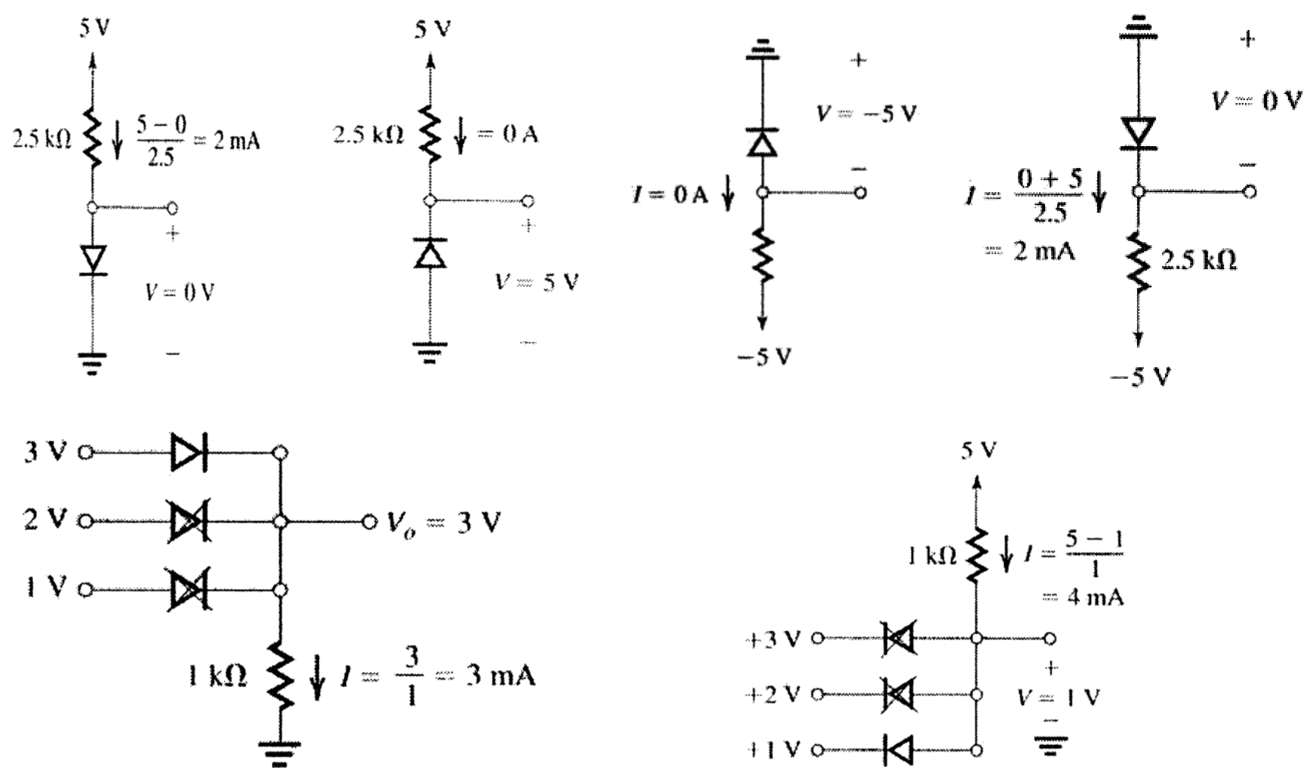
$\hat{i}_D = \frac{\hat{V}_I}{R} = 10mA$

- DC component of $V_o = \frac{10}{T}\int_0^T \sin(\omega t)dt$

$= \frac{10}{T}\int_0^{T/2} \sin(2\pi f t)dt = \frac{10}{T}\left(-\cos\frac{2\pi f T}{2} + \cos 0\right)$

$= \frac{10}{T}(2) = \frac{20}{T} \to 2\pi = \frac{20}{2\pi} = \boxed{\frac{10}{\pi}} = 3.18V$

[2] Find the values of I and V in the circuits shown in Fig. 2.



[3] A silicon junction diode has $v = 0.7$ V at $i = 1$ mA. Find the voltage drop at $i = 0.1$ mA and $i = 10$ mA.

Ans. 0.64 V; 0.76 V

[4] A zener diode exhibits a constant voltage of 5.6 V for currents greater than five times the knee current. I_{ZK} is specified to be 1 mA. The zener is to be used in the design of a shunt regulator fed from a 15-V supply. The load current varies over the range of 0 mA to 15 mA. Find a suitable value for the resistor R. What is the maximum power dissipation of the zener diode?

The minimum zener current should be

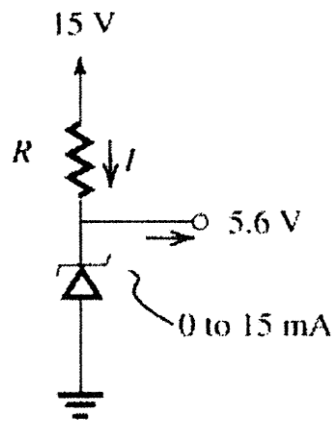
$5 \times I_{ZK} = 5 \times 1 = 5$ mA.

Since the load current can be as large as 15 mA, we should select R so that with $I_L = 15$ mA, a zener current of 5 mA is available. Thus the current should be 20 mA Leading to

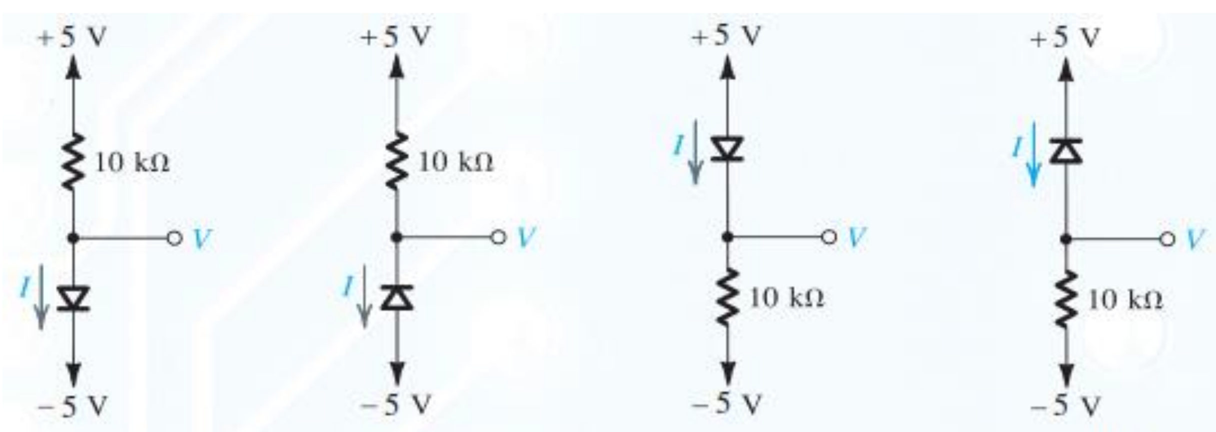
$$R = \frac{15 - 5.6}{20\text{ mA}} = 470\ \Omega$$

Maximum power dissipated in the diode occurs when $I_L = 0$ is

$$P_{max} = 20 \times 10^{-3} \times 5.6 = 112\text{ mV}$$



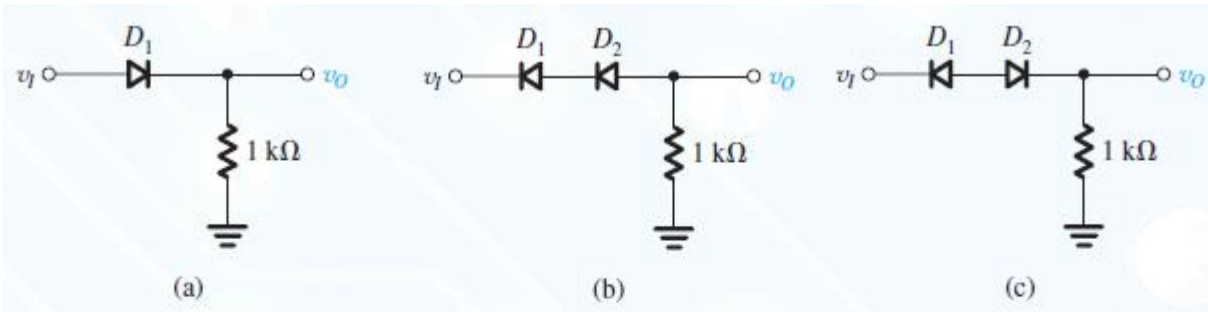
[5] For the circuits shown in Fig. 3 using ideal diodes, find the values of the voltages and currents indicated.

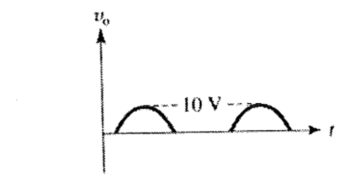


(a) (b) (c) (d)

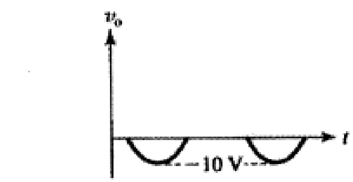
(a)	(b)	(c)	(d)
Diode is on	Diode is off	Diode is on	Diode is off
V = -5 Volt	V = 5 Volt	V = 5 Volt	V = -5 Volt
$I = (5-(-5))/10^4 = 1$ mA	I = 0	$I = (5-(-5))/10^4 = 1$ mA	I = 0

[6] In each of the ideal-diode circuits shown in Fig. 4, v_i is a 1-kHz, 10-V peak sine wave. Sketch the waveform resulting at v_o. What are its positive and negative peak values?

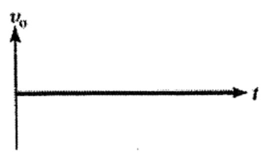




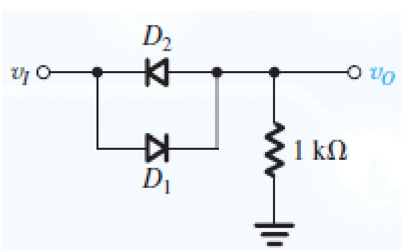
$V_{p+} = 10\text{ V}$ $V_{p-} = 0\text{ V}$
$f = 1\text{ kH}_3$

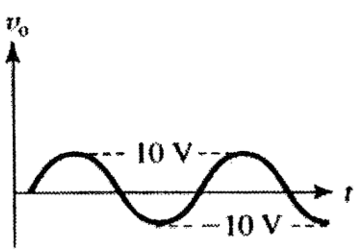


$V_{p+} = 0\text{ V}$ $V_{p-} = -10\text{ V}$
$f = 1\text{ kH}_3$

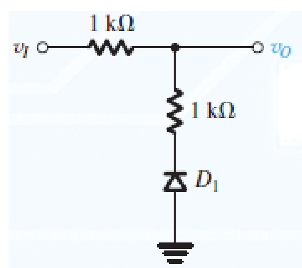


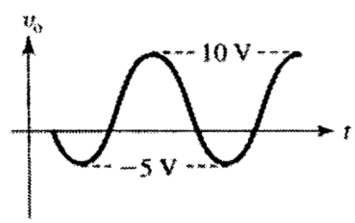
$v_O = 0\text{ V}$
Neither D_1 nor D_2 conducts so there is no output.





$V_{p+} = 10\text{ V}$ $V_{p-} = -10\text{ V}$ $f = 1\text{ kH}_3$
D_1 conducts when $v_I > 0$ and D_2 conducts when $v_I < 0$. Thus the output follows the input.





$V_{p+} = 10\text{ V}$ $V_{p-} = -5\text{ V}$ $f = 1\text{ kH}_3$
When $v_I > 0$, D_1 is cutoff and v_O follows v_I
When $v_I < 0$, D_1 is conducting and the circ
becomes a voltage divider where the negati
peak is

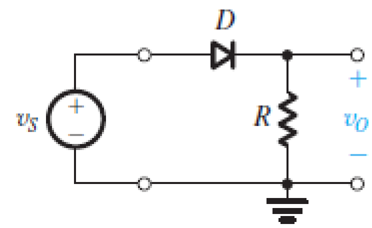
$$\frac{1\text{ k}\Omega}{1\text{ k}\Omega + 1\text{ k}\Omega} \bullet -10\text{ V} = -5\text{ V}$$

[7] For the rectifier circuit of Fig. 5, let the input sine wave have 120-V rms value and assume the diode to be ideal. Select a suitable value for *R* so that the peak diode current does not exceed 50 mA. What is the greatest reverse voltage that will appear across the diode?

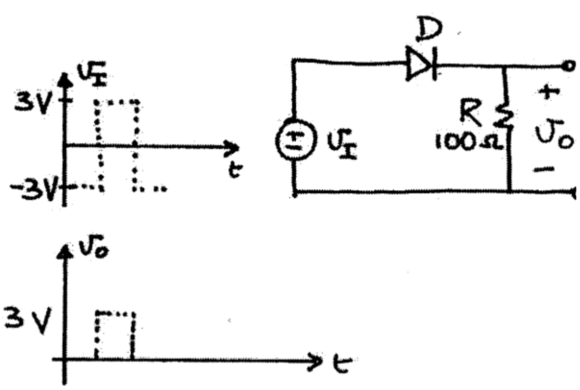
$$R \geq \frac{120\sqrt{2}}{50} \geq 3.4\ \text{k}\Omega$$

The largest reverse voltage appearing across the diode is equal to the peak input voltage

$$120\sqrt{2} = 169.7\ \text{V}$$



[8] A symmetrical square wave of 3-V peak-to-peak amplitude and zero average is applied to a circuit resembling that in Fig. 1 and employing a 100-Ω resistor. What is the peak output voltage that results? What is the average output voltage that results? What is the peak diode current? What is the average diode current? What is the maximum reverse voltage across the diode?



$$v_{O,\text{peak}} = 3\text{V}$$

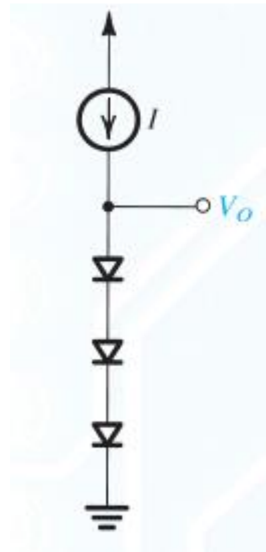
$$v_{O,\text{avg}} = \frac{1}{T}\int v_O\, dt = \frac{1}{T}\left[3\,\frac{T}{2}\right] = 3/2\ \text{V}$$

$$i_{D,\text{peak}} = 3/100 = 30\ \text{mA}$$

$$i_{D,\text{avg}} = \frac{3/2}{100} = 15\ \text{mA}$$

The maximum reverse diode voltage is 3 V

[9] The circuit in Fig. 6 utilizes three identical diodes having $I_S = 10^{-16}$ A. Find the value of the current *I* required to obtain an output voltage $V_O = 2.4$ V. If a current of 1 mA is drawn away from the output terminal by a load, what is the change in output voltage?



∵ 3diodes are identical

∴ voltage across each diode is $\frac{V_o}{3}$

$$I_1 = I_S e^{\frac{V_D}{V_T}} = 10^{-16} e^{\frac{V_o/3}{0.026}} = 3.81mA$$

if load takes 1mA → $I_2 = 3.81 - 1 = 2.81mA$

$$\frac{I_2}{I_1} = e^{\frac{(V_{D2}-V_{D1})}{3V_T}}$$

$$\Delta V = 3V_T \ln \frac{I_2}{I_1} = -22.8 mV$$