Problem 1

a) Possible cases:
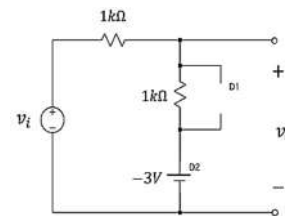
	D1	D2
Case 1	OFF	Zener
Case 2	OFF	ON
Case 3	ON	ON
Case 4	OFF	OFF

b)

Case 1: D1 OFF, D2 Zener

$$v_o = -3 + \frac{v_i + 3}{2} \Rightarrow v_o = \frac{v_i - 3}{2}$$

$$\frac{v_i + 3}{2k} < 0 \Rightarrow v_i < -3$$
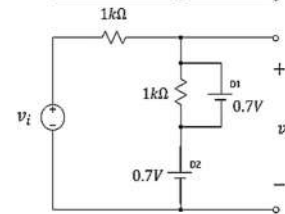
Case 2: D1 OFF, D2 ON

$$v_o = 0.7 + \frac{v_i - 0.7}{2} \Rightarrow v_o = \frac{v_i + 0.7}{2}$$

$$0 \le \frac{v_i - 0.7}{2k} \le \frac{0.7}{1k} \Rightarrow 0.7 \le v_i < 2.1$$
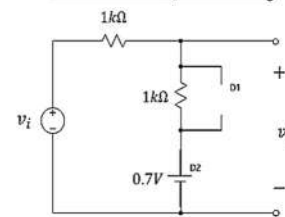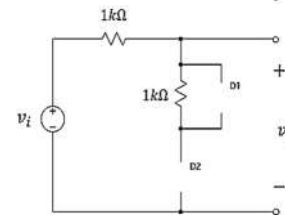
Case 3: D1 ON, D2 ON

$$v_o = 1.4\,V$$

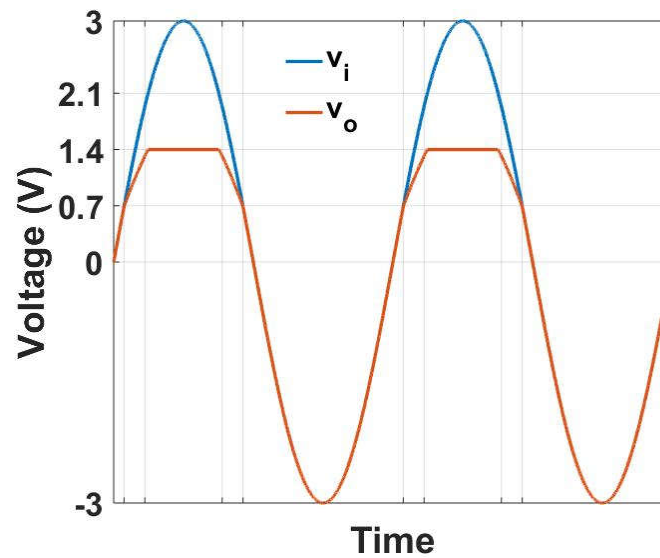$$\frac{v_i - 1.4}{1k} \ge \frac{0.7}{1k} \Rightarrow v_i \ge 2.1$$
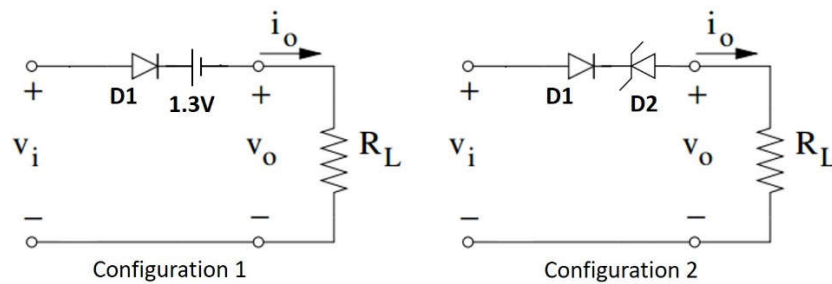
Case 4: D1 OFF, D2 OFF

$$v_o = v_i$$

$$\frac{v_i + 3}{2k} \not\le 0 \ and \ \frac{v_i - 0.7}{2k} \not> 0 \Rightarrow -3 \le v_i < 0.7$$

c)

Problem 2

(a)

Configuration 1   Configuration 2

(b) $R_L = 1k\Omega$

Case 1: D1 ON (configuration 1) **OR** D1 ON, D2 Zener (Configuration 2)

$$v_o = v_i - 0.7 - 1.3 \Rightarrow \boxed{v_o = v_i - 2}$$

$$i_o > 0 \Rightarrow \frac{v_i - 2}{R_L} > 0 \Rightarrow \boxed{v_i > 2}$$

Case 2: D1 OFF (configuration 1) **OR** D1 OFF (Configuration 2)

$$i_o = 0 \Rightarrow \boxed{v_o = 0}$$

$$i_o = 0 \Rightarrow \frac{v_i - 2}{R_L} \leq 0 \Rightarrow \boxed{v_i \leq 2}$$