

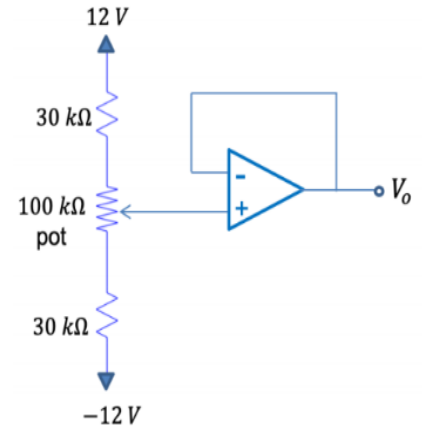
1. This is a voltage follower circuit. Here,

$$V_o = V_+ = -12 + \frac{30k + R_{pot}}{160k} \times 24$$

As R_{pot} can vary from 0 to 100k Ω , so, output V_o can vary from

-7.5V to 7.5V.

Change in each turn = $\frac{15}{10} =$ **1.5 V**



2. $\beta = 100, V_{Do} = 0.7 V, V_{sat} = 0.2 V$

From KVL,

$$V_B = -I_B \times 10k \quad (2.1)$$

$$V_E = V_B - V_{BE} \quad (2.2)$$

$$V_C = 5 - I_C \times 4k \quad (2.3)$$

We can also write,

$$I_E = 1 mA \quad (2.4)$$

The transistor is not in cutoff as there is a current source attached to emitter.

Let's assume BJT is in active mode. Then,

$$V_{BE} = 0.7 V;$$

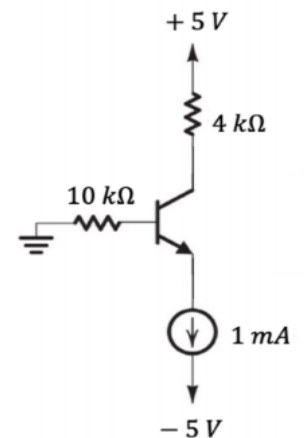
$$I_B = \frac{I_E}{\beta + 1} = 9.9 \mu A; \quad I_C = 990.1 \mu A$$

From (2.2) and (2.3) we can get,

$$V_B = -0.099 V; \quad V_E = -0.799 V; \quad V_C = 1.0396 V$$

Here,

$$V_{CE} > V_{Do} \Rightarrow \text{Correct Assumption}$$



3. (a)

(i) There can be 3 different combinations

D1 ON, D2 OFF ($v_i \geq 3.7\text{ V}$):

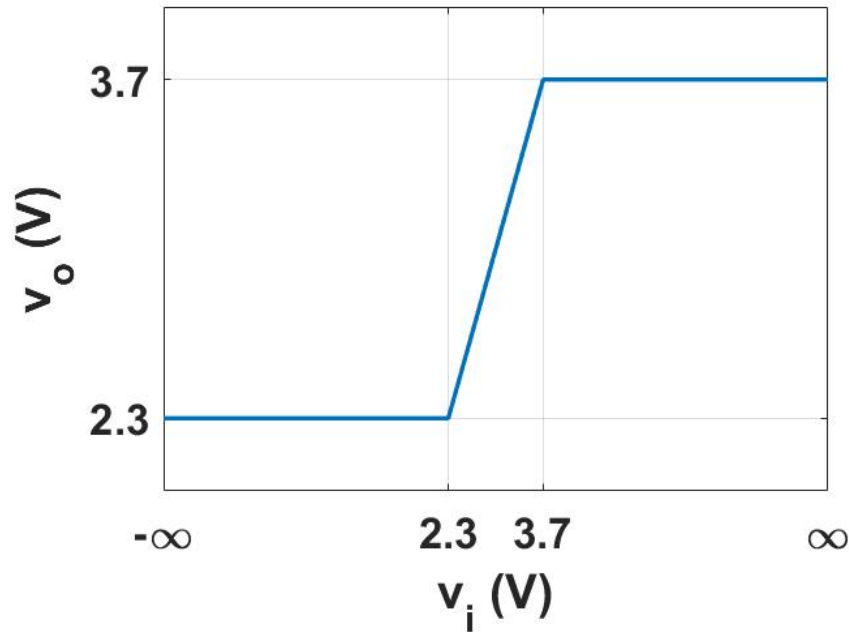
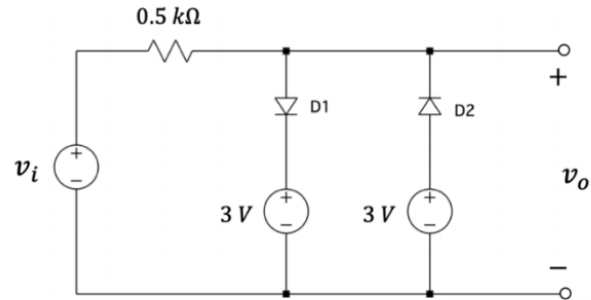
$$v_o = 3.7\text{ V} \quad (3.1)$$

D1 ON, D2 OFF ($v_i \leq 2.3\text{ V}$):

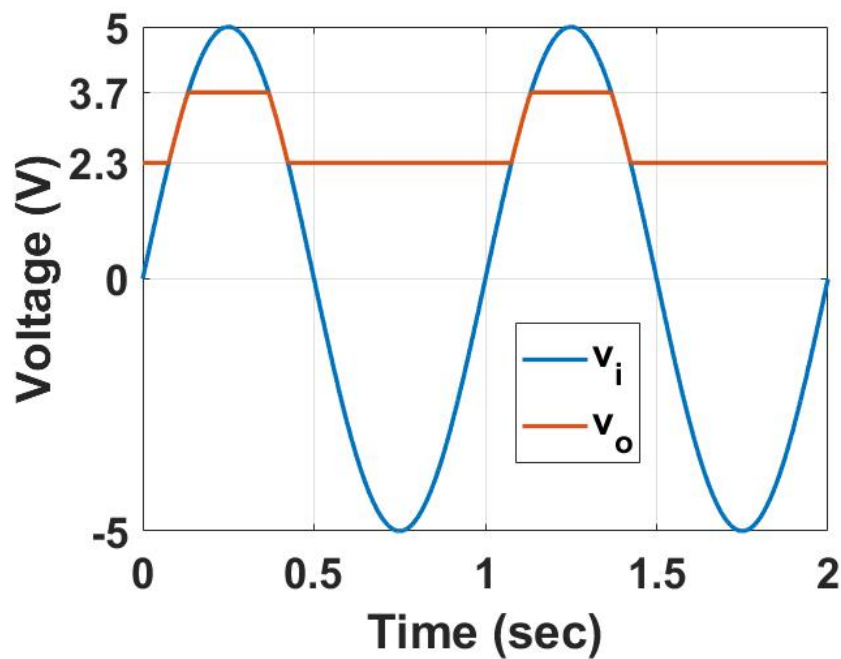
$$v_o = 2.3\text{ V} \quad (3.2)$$

Both D1 and D2 OFF ($2.3\text{ V} < v_i < 3.7\text{ V}$):

$$v_o = v_i \quad (3.3)$$



(ii) Input and output curve is shown for 1Hz signal.



(b)

