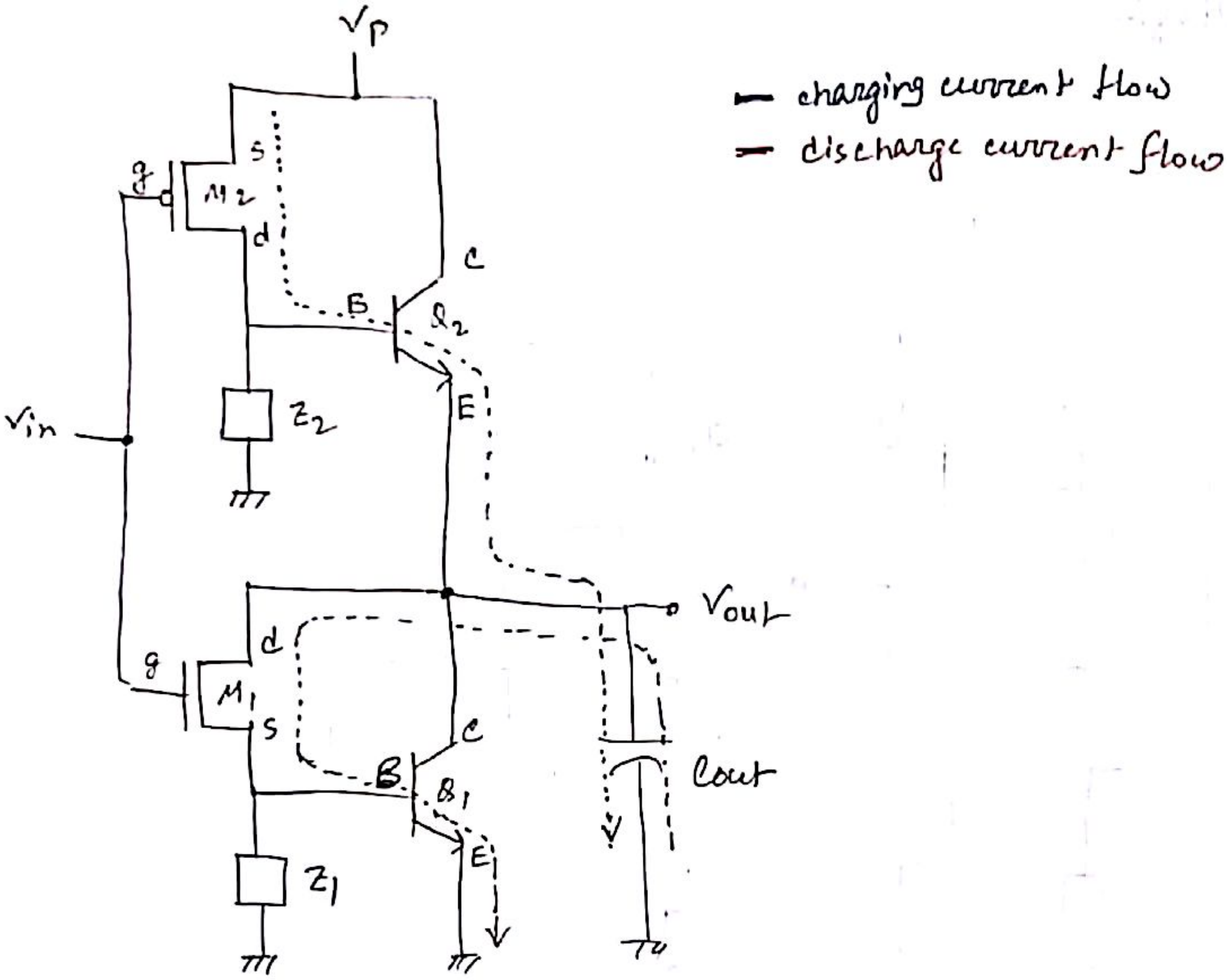


(I) $V_{in} = 0$

M_1, Q_1 off

M_2, Q_2 on → Cout will be charged.

$$V_{out}(high) = V_P - V_{sd}(sat) - V_{BE}(on)$$
$$= 5 - 0.2 - 0.5$$
$$= 4.3\,V$$

(II) $V_{in} = 1$

M_2, Q_2 off

M_1, Q_1 on → Cout will be discharged.

$$V_{out}(low) = V_{ds}(sat) + V_{BE}(on) = 0.2 + 0.5 = 0.7$$

Output voltage swing $= V_{out}(high) - V_{out}(low)$

$= [V_P - V_{sd}(sat) - V_{BE}(on)] - [V_{ds}(sat) + V_{BE}(on)]$

$$= V_p - 2V_{BE}(on) - V_{sd}(sat) - V_{ds}(sat)$$

$$= V_p - 2V_{BE}(on) - 2V_{sd}(sat)$$

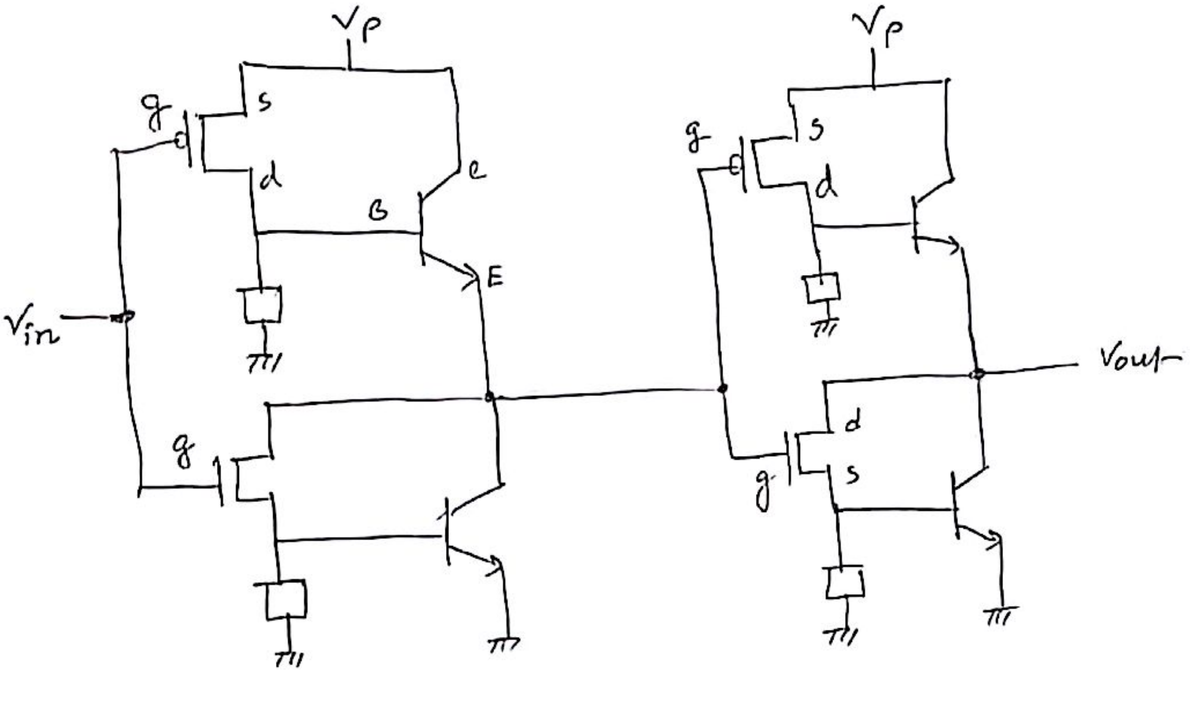
$$\left[V_{sd}(sat) = V_{ds}(sat) = 0.2 \right]$$

$$= 5 - 2 \times 0.5 - 2 \times 0.2$$

$$= 3.6V$$

So. Output voltage swing : 3.6 V

(b) Noise Margin:-



PMOS

$$V_{sg} = V_s - V_g = V_p - V_g = V_p - [V_p - V_{sd}(sat) - V_{BE}(on)]$$

$$= V_{sd}(sat) + V_{BE}(on)$$

$$= 0.2 + 0.5 = 0.7$$

$V_{sg} > V_{tp} = 1$, In this case → Noise margin = $(1 - 0.7) = \boxed{0.3V}$