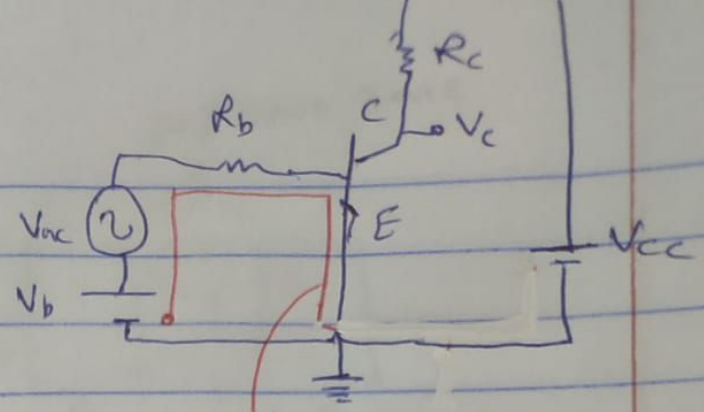


I A) $V_b + V_{ac} - I R_b + 0 = V_{BE}$

$1 + 0.3\cos t - I R_b = 0.7$

$I = \dfrac{1 + 0.3\cos t - 0.7}{R_b}$

$I = \dfrac{0.3 + 0.3\cos t}{200}$ mA

$\max(I) = \dfrac{0.3 + 0.3}{200}$ mA $= \dfrac{0.6}{200}$ mA

~~$= 0.0065$ mA~~ $= 3\,\mu A$

~~$= 6.5\,\mu A$~~

This is I_B

B) $I_B + I_C = I_E$

$I_C = \beta I_B = 200\left(\dfrac{0.3 + 0.3\cos t}{200}\right)$

$I_C = 0.3 + 0.3\cos t$ mA

$I_E = I_B + I_C$

$= \dfrac{0.3 + 0.3\cos t}{200} + 0.3 + 0.3\cos t$

$= \left(\dfrac{1}{200} + 1\right)(0.3 + 0.3\cos t)$

$I_E = 0.3015 + 0.3015\cos t$ mA

C) $V_{cc} - I_c R_c = V_c$

$20 - (10K)(0.3 + 0.3\cos t)\,mA = V_c$

$V_c = 17 - 3\cos t$ Volt

$\max(V_c) = 17 + 3 = 20$ Volt (when $\cos t = -1$)

D) $\min(V_c) = 17 - 3 = 14$ Volt (when $\cos t = 1$)

2 A) $V_2 = V_3 = 0$

$V_1 = I R_1 \Rightarrow I = \frac{V_1}{R_1}$

$V_2 = -I R_2$

$\boxed{V_2 = -V_1 \frac{R_2}{R_1}} = -40 V_1$

B) $V_2 = V_3 = 0$

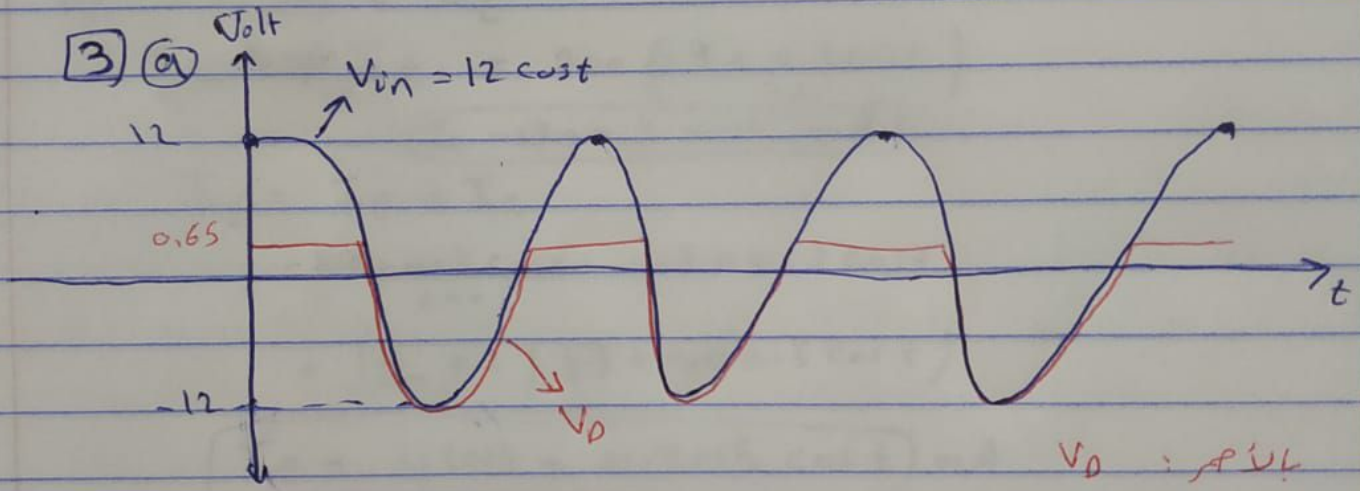
$V_1 = I R_1$

$V_2 = -I R_2 + V_d$

$= -V_1 \frac{R_2}{R_1} - 0.7$

$\boxed{V_2 = -40 V_1 - 0.7}$

3 (a)



V_D : الجهد على الثنائي

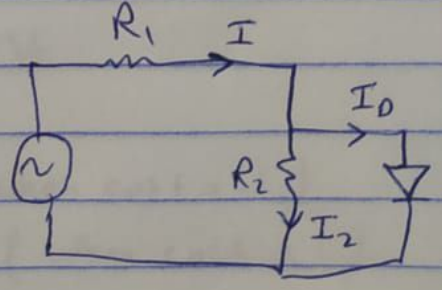
V_{in} : جهد الدخل

(b) $V_D = V_2 = 0.65$ Volt

$V_1 = V_{in} - V_2$

$= 12 \cos t - 0.65$ Volt

$I_1 = \frac{V_1}{R_1} = \frac{1}{20}(12 \cos t - 0.65)$ mA

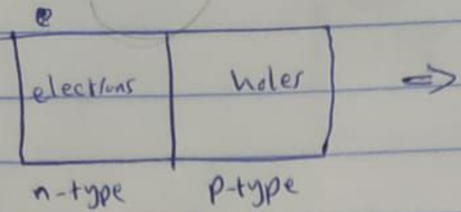


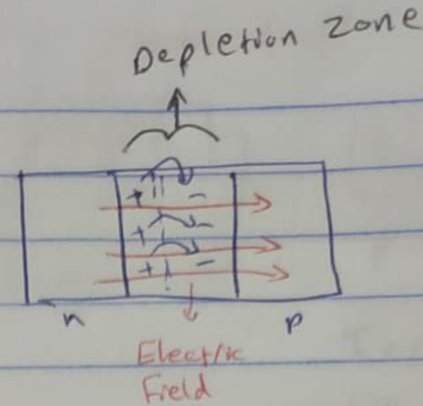
(c)

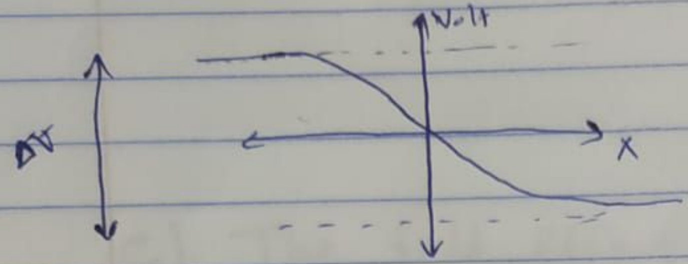
$I_2 = \frac{V_2}{R_2} = \frac{0.65}{10} = 0.065$ mA

$I_D = I_1 - I_2 = \frac{1}{20}(12 \cos t - 0.65) - 0.065$ mA

4 A) The diode:







This field prevent electrons from going right. However, they may be electrons having high energy and go right. This current is I_g (generation)

I_{ge} , I_{gh}
electrons holes

Also, they may be electrons in holes' area and holes in electrons' area. With the electric field, a current is created. It's called I_r (recombanation)

I_{re}, I_{rg}

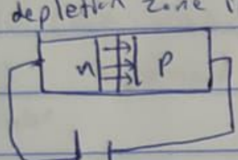
$I_g + I_s = 0$ When $V_b = 0$

$I_g = I_{g0} \exp\left(\frac{-eV}{k_B T}\right)$

I_s = constant

When connecting with battery:

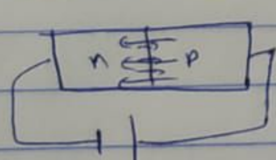
depletion zone increases



– reverse biased junction

يتكون مجال كهربائي خارجي يقوي
المجال الأصلي وفي نفس الاتجاه.
بالتالي: ما فيه تيار
No conduction

forward bias

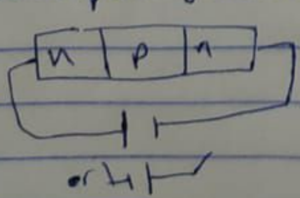


depletion zone decreases

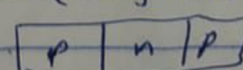
No depletion zone if: $V_{Ext} \geq V_d = \Delta V$

B) The bipolar junction transistor: (using both n and p types)

(BJT)



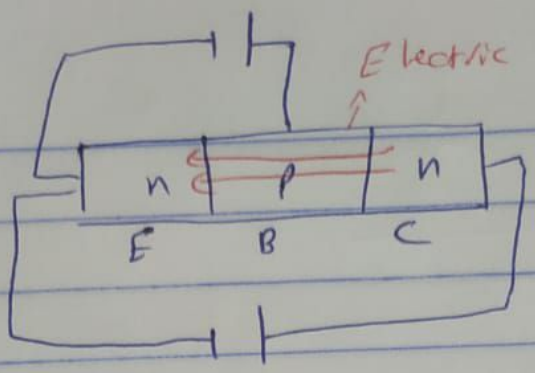
or



↓
reverse blasel
no current

* We need 2 batteries to make the current flow.

B)



$I_{CE} = \beta I_{BE}$

$\beta \sim 100 - 500$

$I_{CE} \gg I_{BE}$

بالتالي، يضخم التيار

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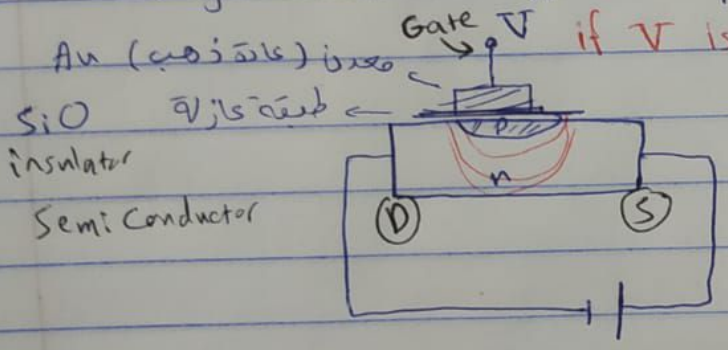
c) The field Effect Transistor (FET):

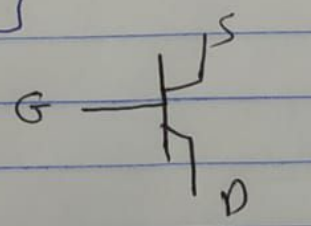
using either n-type or p-type



if V is -ve (depletion zone increase)

if V is +ve (depletion zone disappear)

$\vec{E} = \frac{\Delta V}{d}$



$I_{SD} \propto V_G$

E) Plot $V_c(t)$:

$V_c = 17 - 3\cos t$