

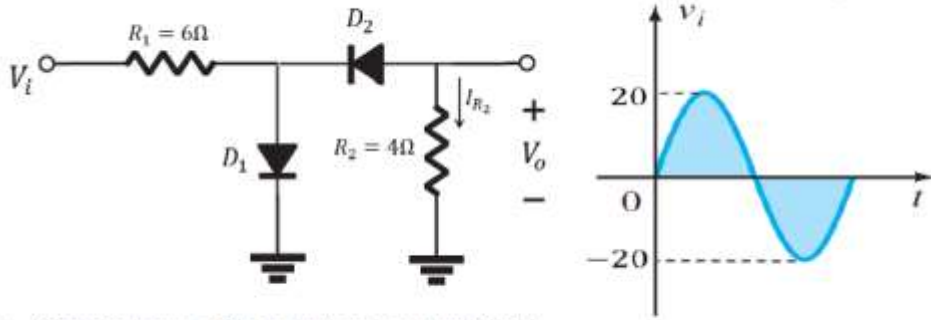
$$V_{D1} = V_{D2} = V = 0$$

$$S_i \rightarrow V = 0,7$$

$$G_e \rightarrow V = 0,3$$

Soal 1: [25 poin]

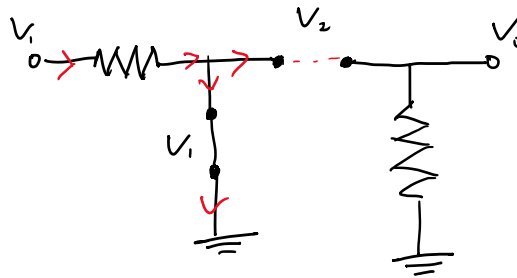
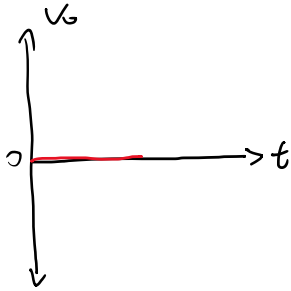
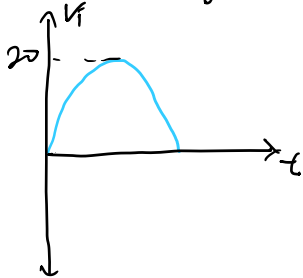
Diketahui rangkaian berikut dengan D1 dan D2 ideal, dan grafik V_i sebagai berikut.



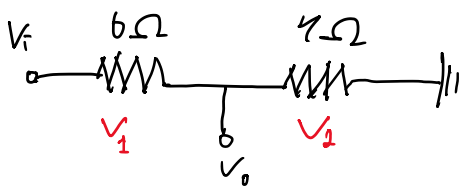
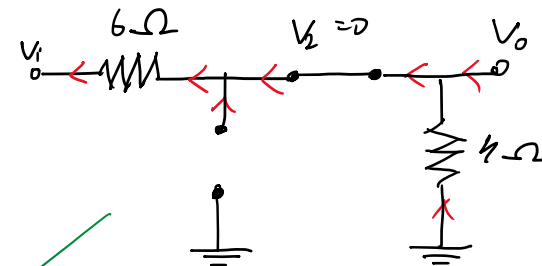
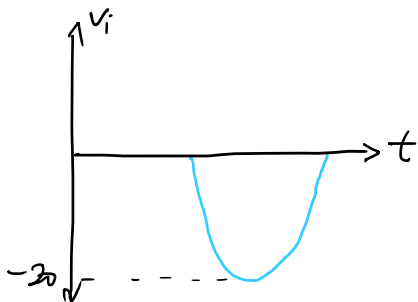
a. Gambarkan grafik gelombang output (V_o)!

b. Hitung nilai tegangan output (V_o) dan arus pada R_2 (I_{R2}) saat nilai $V_i = -5$ V!

a. * Arus maju



* Arus mundur



$$V_1 = \frac{R_1}{R_1 + R_2} \cdot V_i$$

$$= \frac{6}{6 + 4} \cdot -20$$

$$= -12 \text{ V}$$

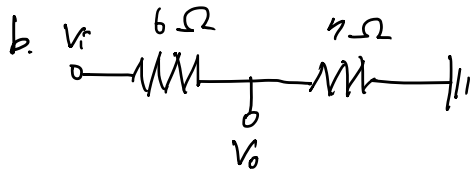
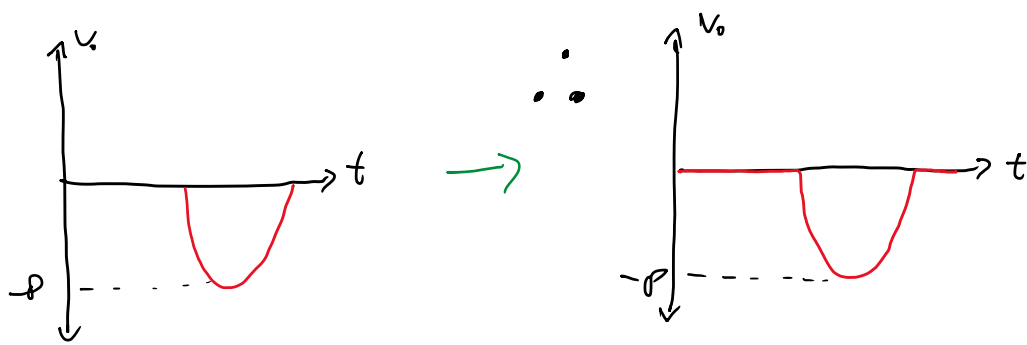
$$V_o = V_i - V_1$$

$$V_o = -20 - (-12)$$

$$V_o = -8 \text{ V}$$

$$R = 6 + 4 = 10 \Omega$$

$$I = \frac{V}{R} = \frac{-20}{10} = -2 \text{ A}$$



$$V_o = V_2 = I \cdot R_2 = -0,5 \cdot 4$$

$$V_o = -2V$$

$$R = 10 \Omega$$

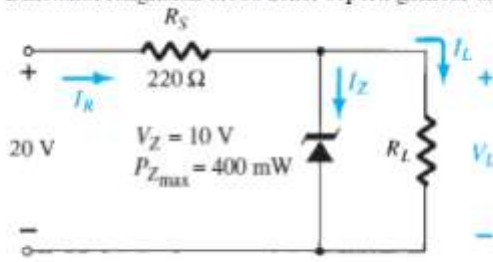
$$I = \frac{V}{R} = \frac{-5}{10} = -0,5 A$$

$$V_1 = \frac{6}{10} \cdot -5V = -3V$$

$$\begin{aligned} V_2 &= V_i - V_1 \rightarrow V_o = V_i - V_1 \\ &= -5 - (-3) \\ &= -2V \end{aligned}$$

Soal 2: [25 point]

Diketahui rangkaian dioda zener seperti gambar dibawah.

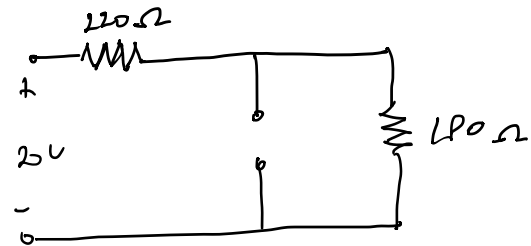


Hitunglah nilai dari I_R , I_Z , I_L , dan V_L jika :

a. $R_L = 180 \Omega$

b. $R_L = 470 \Omega$

$$a. V = \frac{R_L \cdot V_i}{R + R_L} = \frac{180 \cdot 20V}{220 + 180} = 9V$$



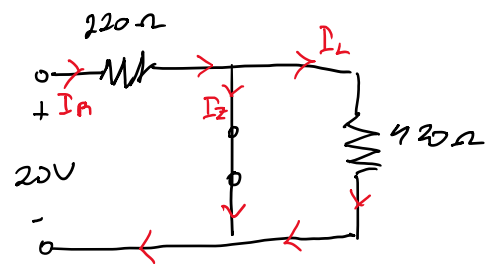
$$V = 9 < V_Z = 10V \rightarrow D_Z : \text{off}$$

$$I_Z = 0$$

$$I_R = I_L = \frac{V}{R_T} = \frac{20}{220 + 180} = 0,05 A$$

$$V_L = \frac{R_L}{R + R_L} \cdot V_i = R_L \cdot I_L = 180 \cdot 0,05 = 9V$$

$$b. V = \frac{R_L \cdot V_i}{R + R_L} = \frac{470 \cdot 20}{220 + 470} = 13,62 V$$



$$V = 13,62V > V_Z = 10V \rightarrow D_Z : \text{on}$$

$$V_L = V_Z = 10V$$

$$V_R = V_i - V_L = 20 - 10 = 10V$$

$$I_R = \frac{V_R}{R} = \frac{10V}{220} = 45,45 \text{ mA}$$

$$I_L = \frac{V_L}{R_L} = \frac{10V}{470} = 21,28 \text{ mA}$$

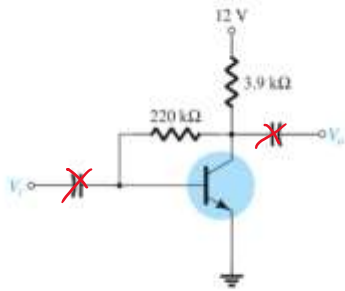
$$I_Z = I_R - I_L = 45,45 - 21,28 = 24,17 \text{ mA}$$

$$I_R = I_Z + I_L$$

Analisis DC : Collector Feedback

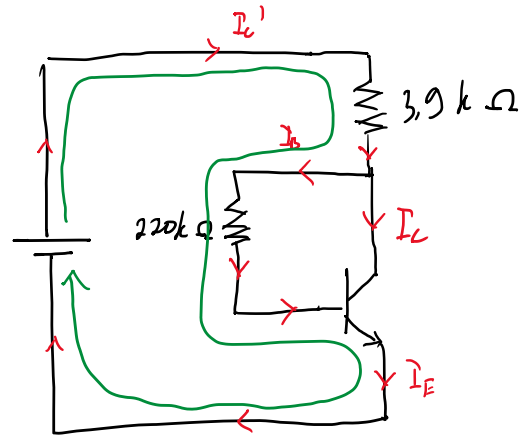
Soal 3: [25 poin]

Diketahui rangkaian BJT sebagai berikut dengan $\beta = 120$.



- Hitung nilai arus di base, emitter, dan collector!
- Hitung nilai tegangan V_{CE} !

$V_{CC} = 12V$



a. $\sum V = 0$

$$V_{CC} - I_C' R_C - I_B R_B - V_{BE} = 0$$

$$12 - \beta I_B 3,9k - I_B 220k - 0,7 = 0$$

$$11,3 = I_B (120 \cdot 3,9k + 220k)$$

$$I_B = \frac{11,3}{600k}$$

$$I_B = 16,42 \mu A$$

$$I_C' = \beta I_B = 120 \cdot 16,42 \mu A$$

$$I_C' = 1,97 mA$$

$$I_C = I_C' - I_B$$

$$= 1,97 mA - 16,42 \mu A$$

$$\approx 1,95 mA$$

$$I_E = I_C' = 1,97 mA$$

b. $V_{CE} = V_{CC} - I_C' (R_C + R_B)$

$$= V_{CC} - I_C' R_C$$

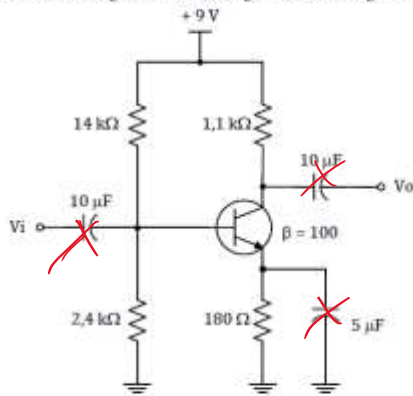
$$= 12 - 1,97 mA \cdot 3,9k\Omega$$

$$= 12 - 7,683$$

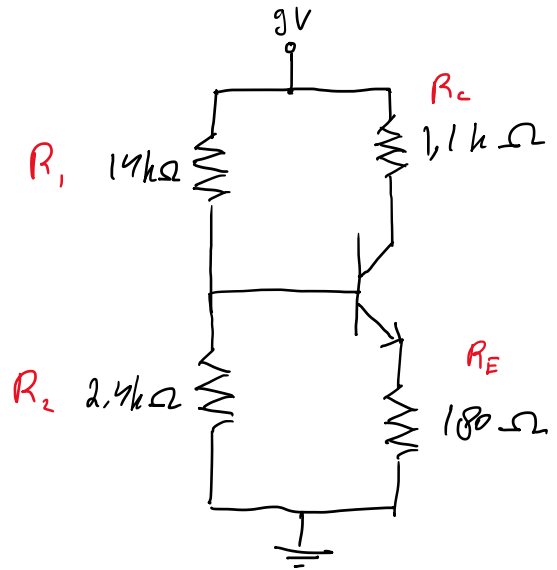
$$= 4,317 V$$

Soal 4: [25 poin]

Diketahui rangkaian BJT sebagai berikut dengan $r_o = \infty$.



- a. Hitung nilai I_E dan nilai r_e !
 b. Hitung Z_i , Z_o , dan penguatan yang terjadi pada rangkaian diatas!
 c. Hitung frekuensi cut-off rendahnya!



a. $I_B = \frac{V_B - V_{BE}}{R_B + (\beta + 1)R_E}$ 0,7V

$$R_B = R_1 \parallel R_2$$

$$= 14k\Omega \parallel 2,4k\Omega$$

$$= \frac{14k \cdot 2,4k}{14k + 2,4k}$$

$$= 2048,78 \Omega$$

$$I_B = \frac{V_B - V_{BE}}{R_B + (\beta + 1)R_E}$$

$$= \frac{1,32 - 0,7}{2048,78 + (101) \cdot 180}$$

$$= \frac{0,62}{20228,78}$$

$$I_B = 30,65 \mu A$$

$$I_E = (\beta + 1) I_B = (101) \cdot 30,65 = 3,09 \text{ mA}$$

$$R_B = R_1 \parallel R_2$$

$$V_B = \frac{R_2}{R_1 + R_2} V_{CC}$$

$$V_B = \frac{R_2}{R_1 + R_2} V_{CC} = \frac{2,4k}{14k + 2,4k} \cdot 9V$$

$$= \frac{6}{41} \cdot 9$$

$$= 1,32 \text{ V}$$

$$r_e = \frac{26 \text{ mV}}{I_E}$$

$$r_e = \frac{26 \text{ mV}}{3,09 \text{ mA}}$$

$$= 8,4 \Omega$$

$$\begin{aligned}
 b. \quad Z_i &= (R_1 \parallel R_2) \parallel \beta r_e \\
 &= R_B \parallel \beta r_e \\
 &= 2048,78 \parallel 100 \cdot 0,4 \\
 &= \frac{2048,78 \cdot 840}{2048,78 + 840}
 \end{aligned}$$

$$Z_i = 595,79 \, \Omega$$

$$\begin{aligned}
 A_v &= - \frac{R_c \parallel r_o}{r_e} \\
 &= - \frac{R_c}{r_e} \rightarrow \text{karena } r_o \geq 10 R_c \\
 &= - \frac{1,1 \, k}{0,4} \\
 &= -130,95
 \end{aligned}$$

$$\begin{aligned}
 A_i &= \frac{\beta (R_1 \parallel R_2) r_o}{(r_o + R_c)(R_1 \parallel R_2 + \beta r_e)} \\
 &= \frac{\beta (R_1 \parallel R_2)}{R_1 \parallel R_2 + \beta r_e} \\
 &= \frac{\beta R_B}{R_B + \beta r_e} \\
 &= \frac{100 \cdot 2048,78}{2048,78 + 100 \cdot 0,4} \\
 &= 70,92
 \end{aligned}$$

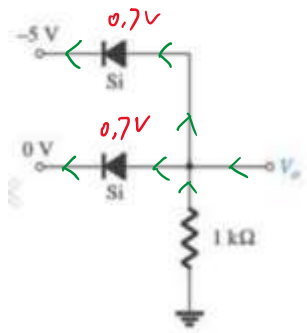
$$Z_o = R_c \parallel r_o$$

$$Z_o = 1,1 \, k \parallel \infty \rightarrow \text{karena } r_o \geq 10 R_c$$

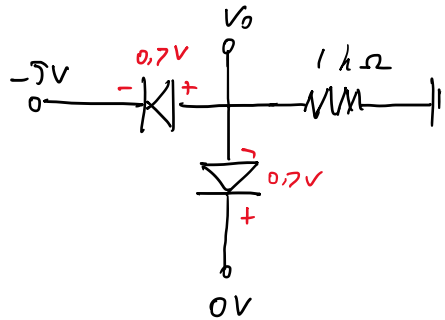
$$Z_o \cong R_c$$

$$Z_o = 1,1 \, k \, \Omega$$

Pada rangkaian logika dioda di bawah besarnya V_o adalah:

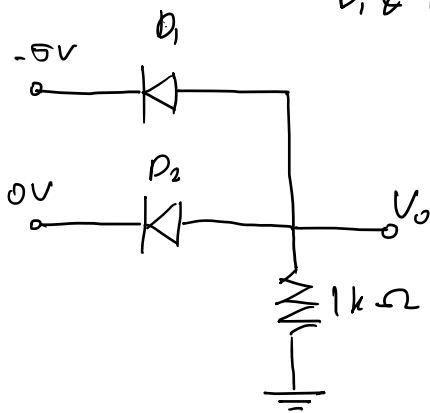


Gerbang OR negatif



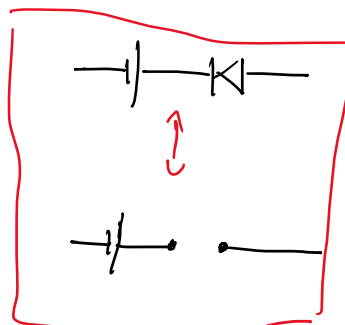
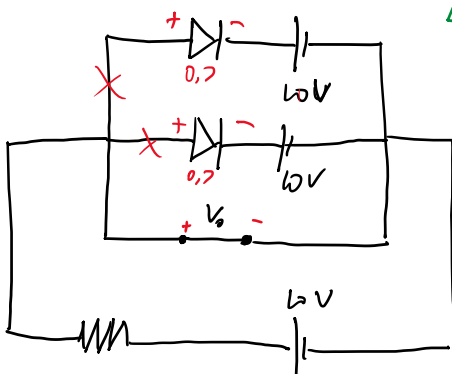
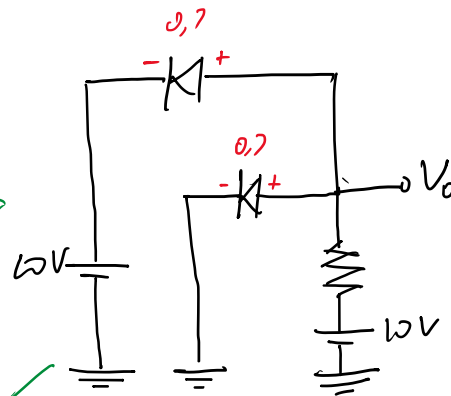
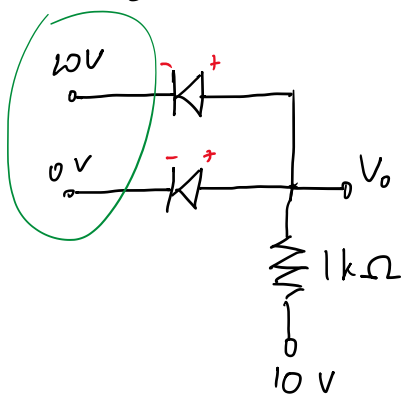
$$\begin{aligned} V_o &= V_i - V_D \\ &= -5 - (-0,7) \\ &= -4,3V \end{aligned}$$

D_1 & D_2 ideal $\rightarrow V_{D1} = V_{D2} = 0V$



$$\begin{aligned} V_o &= V_i - V_{D1} \\ &= -5 - 0 \\ &= -5V \end{aligned}$$

Gerbang AND



$$V_o = 0,7V$$