

Exercise 4.14

For the four-resistor bias circuit we have:

$$R_B = \frac{1}{1/R_1 + 1/R_2}$$

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

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

$$V_{CE} = V_{CC} - R_C I_C - R_E I_E$$

- (a) An increase in  $R_C$  has no effect on  $I_C$  (provided that operation remains in the active region).
- (b) An increase in  $R_E$  decreases  $I_B$  and  $I_C$ .
- (c) An increase in  $R_1$  decreases  $V_B$ ,  $I_B$  and  $I_C$ .
- (d) An increase in  $R_2$  increases  $V_B$ ,  $I_B$  and  $I_C$ .
- (e) An increase in  $\beta$  increases  $I_C$ .

Exercise 4.15

- (a) An increase in  $R_C$  reduces  $V_{CE}$ .
- (b) An increase in  $R_1$  increases  $V_{CE}$ .
- (c) An increase in  $R_2$  decreases  $V_{CE}$ .
- (d) An increase in  $\beta$  decreases  $V_{CE}$ .

Exercise 4.26

$$V_o = V_{CC} = 3 \text{ V} \quad \text{for } V_{in} < 0.7 \text{ V}$$

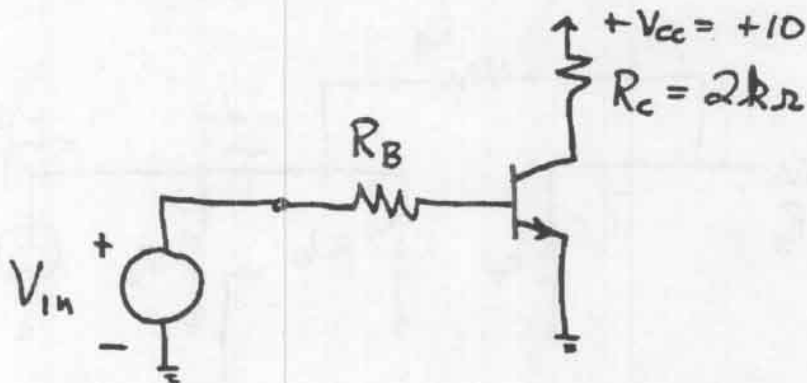
$$V_o = V_{CC} - R_C \beta [(V_{in} - 0.7) / R_B]$$

$$= 3 - 0.4\beta (V_{in} - 0.7) \quad \text{for } V_{in} > 0.7 \text{ and } V_o > 0.2$$

$$V_o = 0.2 \quad \text{otherwise}$$

The plots are shown in Figure 4.44 in the book.

Exercise 4.27



For the BJT to be in saturation, we must have:

$$\beta I_B > I_C$$

$$\beta(V_{in} - 0.7)/R_B > (V_{CC} - 0.2)/R_C$$

Substituting values and rearranging, we find

$$R_B < 8.16 \text{ k}\Omega$$