CHAPTER NO. 18(ELECTRONICS)

Question 18.1:- The current flowing into the base of a transistor is 100 μA. Find its collector current I_C, its emitter current I_E and the ratio I_C/I_E, if the value of current gain β is 100.

Solution:- Base current = $I_B = 100\ \mu A = 100 \times 10^{-6}$ A = 0.1 mA

Current gain = β = 100

Collector current = $I_C = \beta I_B = (100)(100 \times 10^{-6})$

$I_C = 1 \times 10^{-2}$ A $= 10 \times 10^{-3}$ A

<u>$I_C = 10$ mA</u>

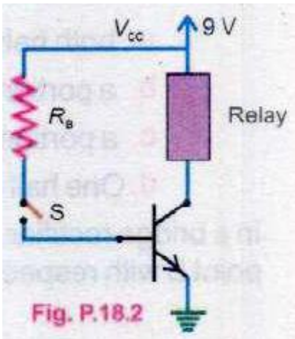
Emitter current = $I_E = I_C + I_B$ = 10 mA + 0.1 mA

<u>$I_E = 10.1$ mA</u>

The ratio of currents = I_C/I_E = 10 mA/10.1 mA

<u>$I_C/I_E = 0.99$</u>

Question 18.2:- Fig.P.18.2 shows a transistor which operates a relay as the switch S is closed. The relay is energized by a current of 10 mA. Calculate the value of R_B which will just make the relay to operate. The current gain β of the transistor is 200. When the transistor conducts, its V_{BE} can be assumed to be 0.6 V.



Solution:- Power supply voltage = V_{CC} = 9 V

Relay current = I_C = 10 mA = 0.01 A

Current gain = β = 200

Potential drop between base and emitter = V_{BE} = 0.6 V

We can find I_B by using the relation $I_C = \beta I_B$

$I_B = I_C/\beta = 0.01/200 = 0.00005$ A $= 50 \times 10^{-6}$ A = 50 μA

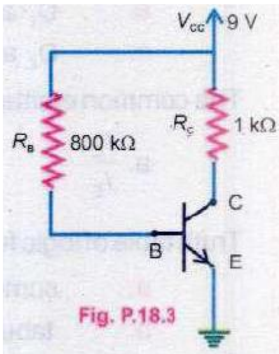
Applying Kirchhoff's second rule to base loop gives $V_{CC} = I_B R_B + V_{BE}$

$R_B = (V_{CC} - V_{BE})/I_B = (9 - 0.6)/(50 \times 10^{-6})$

$R_B = 0.168 \times 10^6\ \Omega = 168 \times 10^3\ \Omega$

<u>$R_B = 168$ kΩ</u>

Question 18.3:- In circuit (Fig.P.18.3), there is negligible potential drop between B and E, if β is 100. Calculate (i) base current (ii) collector current (iii) potential drop across R_C (iv) V_{CE}.



Solution:- Current gain = β = 100

Base resistance = R_B = 800 kΩ $= 800 \times 10^3\ \Omega$

Collector resistance = R_C = 1 kΩ $= 1 \times 10^3\ \Omega$

Power supply voltage = V_{CC} = 9 V

Potential drop between base and emitter = V_{BE} = 0 V

(i) Applying Kirchhoff's second rule across base loop gives $V_{CC} = I_B R_B + V_{BE}$

$I_B = (V_{CC} – V_{BE})/R_B$

$I_B = (9 – 0)/(800 \times 10^3) = 0.01125 \times 10^{-3}$ A

$I_B = 11.25 \times 10^{-6}$ A

$I_B = 11.25$ μA

(ii) Collector current = $I_C = \beta I_B = (100) (11.25 \times 10^{-6}) = 1.125 \times 10^{-3}$ A

$I_C = 1.125$ mA

(iii) Potential drop across $R_C = I_C R_C = (1.125 \times 10^{-3}) (1 \times 10^3)$

Potential drop across R_C = 1.125 V

(iv) Applying Kirchhoff's second rule across collector loop gives $V_{CC} = I_C R_C + V_{CE}$

$V_{CE} = V_{CC} – I_C R_C = 9 – (1.125 \times 10^{-3}) (1 \times 10^3)$

$V_{CE} = 9 – 1.125$

$V_{CE} = 7.875$ V

Question 18.4:- Calculate the output of the op-amp circuit shown in Fig.P.18.4.

Solution:- R_2 = 20 kΩ

R_1 = 10 kΩ

R_1' = 4 kΩ

V_1 = +5 V

V_2 = -2 V

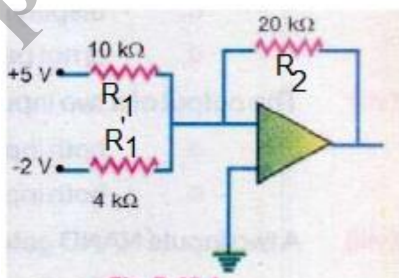


Fig. P. 18.4

There are two input voltages V_1 and V_2. We have to find output voltages due to both input separately and then them.

In an amplifier, $V_{out} = G V_{in}$ where G is voltage gain. For op-amp in inverting configuration, $G = -R_2/R_1$

$V_{out} = (-R_2/R_1) V_1 + (-R_2/R_1') V_2 = (-20/10) (5) + (-20/4)(-2)$

$V_{out} = -10 + 10$

$V_{out} = 0$ V

Question 18.5:- Calculate the gain of non-inverting amplifier shown in Fig.P.18.5.

Solution:- R_2 = 40 kΩ

R_1 = 10 kΩ

Gain on non-inverting amplifier = $G = 1 + \frac{R_2}{R_1}$

$G = 1 + (40/10) = 1 + 4$

G = 5

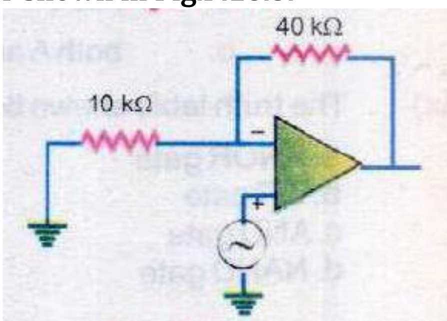


Fig. P. 18.5