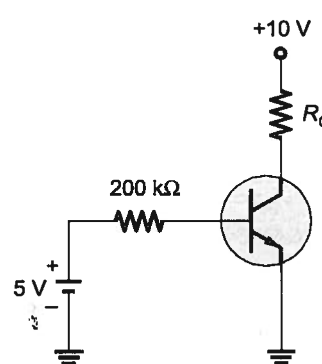
4 BJT Biasing

Multiple Choice Questions

Q.1 A silicon transistor with $V_{BE_{sat}} = 0.8$ V, $\beta_{dc} = 100$ and $V_{CE_{sat}} = 0.2$ V is used in the circuit shown below:

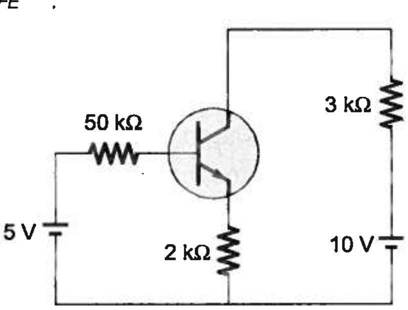


What is the minimum value of R_C for which transistor is in saturation?

(a) 4286 Ω (b) 4667 Ω
(c) 5000 Ω (d) 1000 Ω

[ESE-2004 (EE)]

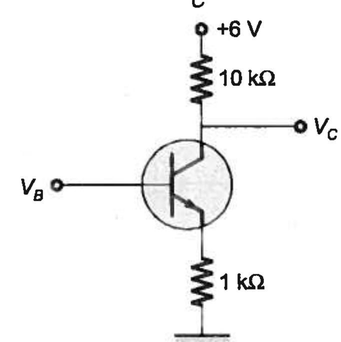
Q.2 For the circuit shown in figure, assume $\beta = h_{FE} = 100$. The transistor is in



(a) Active region and $V_{CE} = 5$ V
(b) Saturation region
(c) Active region and $V_{CE} = 1.42$ V
(d) Cut-off region

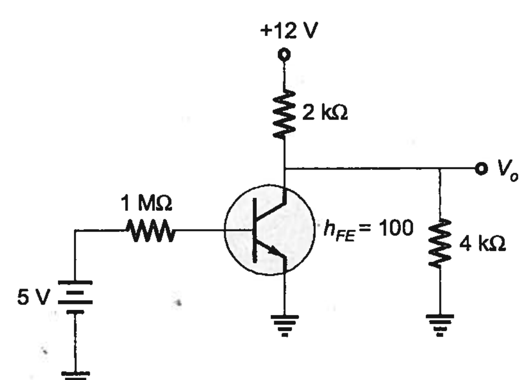
[ESE-2005 (EE)]

Q.3 For the transistor in circuit shown in figure $\beta = 200$. Determine V_C in the circuit if $V_B = 2$ V



(a) –7 V (b) 1.5 V
(c) 2.6 V (d) none

Q.4 Consider the NPN transistor circuit shown below:

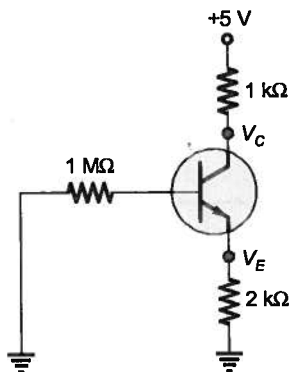


What if the output voltage V_0 in the above circuit?

(a) 0 V (b) 12 V
(c) 9 V (d) 7.5 V

[ESE-2004]

Q.5 Consider the following circuit:

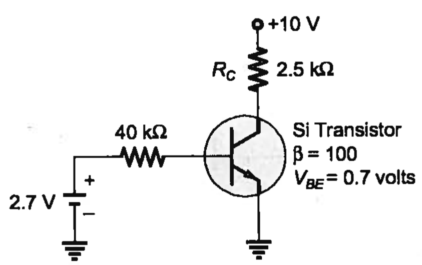


What is voltage difference between collector and emitter (V_{CE}) in the above circuit?

(a) 10/3 V (b) 0 V
(c) 5 V (d) 3 V

[ESE-2004]

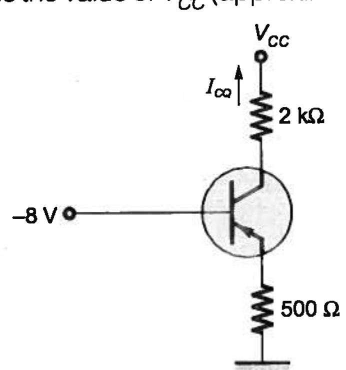
Q.6 In the circuit shown



the transistor is biased at

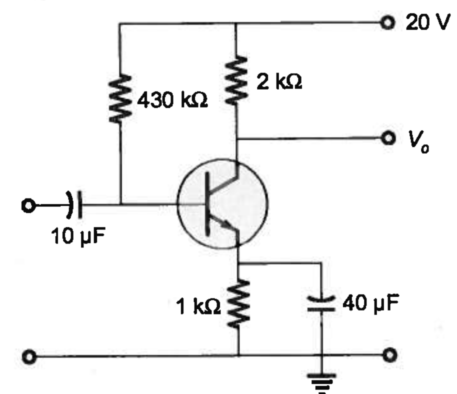
(a) 0 mA (b) 5 mA
(c) 3.9 mA (d) ∞

Q.7 The transistor circuit shown in the figure given below is to function as an amplifier. If I_{CQ} = 3 mA, what is the value of V_{CC} (approximate)?



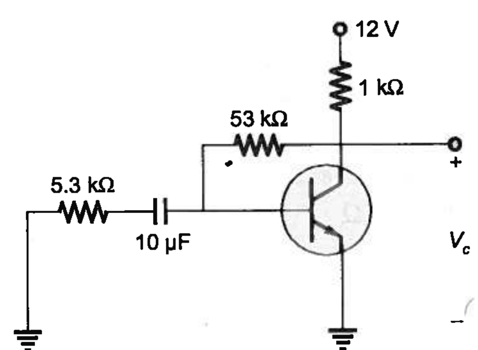
(a) 15 V (b) –15 V
(c) –10 V (d) –13.5 V

Q.8 The circuit using a BJT with β = 50 and V_{BE} = 0.7 V is shown in the figure. The base current I_B and collector voltage V_C are respectively



(a) 43 μA and 11.4 Volts
(b) 40 μA and 16 Volts
(c) 45 μA and 11 Volts
(d) 50 μA and 10 Volts

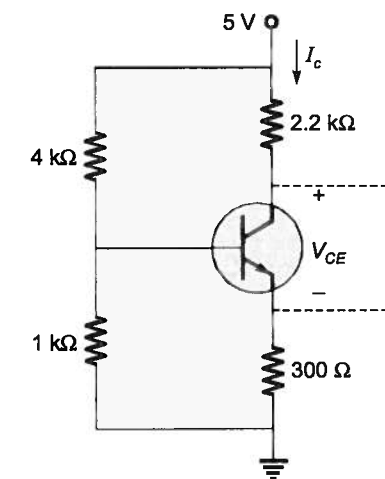
Q.9 In the transistor amplifier circuit shown in the figure below, the transistor has the following parameters:
$\beta_{dc} = 60$, $V_{BE} = 0.7$ V, $h_{ie} \to \infty$, $h_{fe} \to \infty$
The capacitance C_C can be assumed to be infinite.



(i) Find V_{CE}
(a) 3 V (b) 1.5 V
(c) 6 V (d) 7.5 V

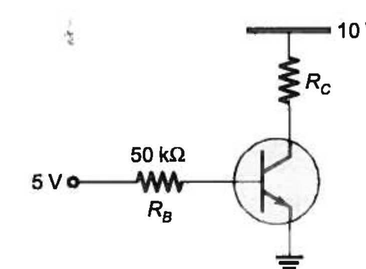
(ii) If β_{dc} is increased by 10%, the collector-to-emitter voltage drop
(a) increases by less than or equal to 10%
(b) decreases by less than or equal to 10%
(c) increases by more than 10%
(d) decreases by more than 10%

Q.10 Assuming that the β of the transistor is extremely large and V_{BE} = 0.7 V, I_C and V_{CE} in the circuit shown in the figure are



(a) I_C = 1 mA, V_{CE} = 4.7V
(b) I_C = 0.5 mA, V_{CE} = 3.75V
(c) I_C = 1 mA, V_{CE} = 2.5V
(d) I_C = 0.5 mA, V_{CE} = 3.9V

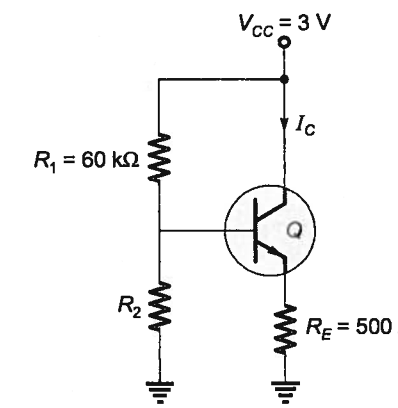
Q.11 In the circuit shown, the silicon BJT has β = 50. Assume V_{BE} = 0.7 V and $V_{CE(sat)}$ = 0.2 V. Which one of the following statements is correct?



(a) For R_C = 1 kΩ, the BJT operates in the saturation region
(b) For R_C = 3 kΩ, the BJT operates in the saturation region
(c) For R_C = 20 kΩ, the BJT operates in the cut-off region
(d) For R_C = 20 kΩ, the BJT operates in the linear region

[GATE-2014]

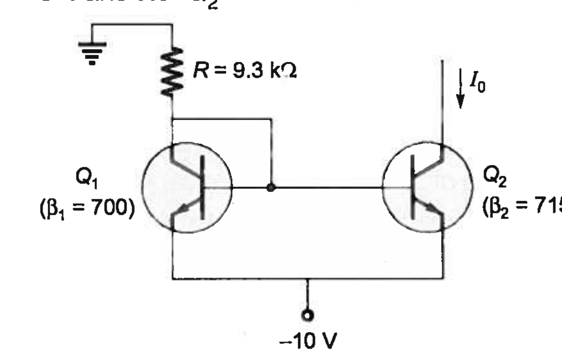
Q.12 In the circuit shown below, the silicon npn transistor Q has a very high value of β. The required value of R_2 in kΩ to produce I_C = 1 mA is



(a) 20 (b) 30
(c) 40 (d) 50

[GATE-2013]

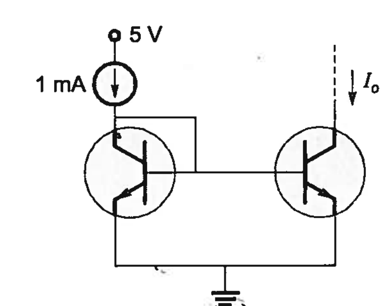
Q.13 In the silicon BJT circuit shown below, assume that the emitter area of transistor Q_1 is half that of transistor Q_2



The value of current I_o is approximately

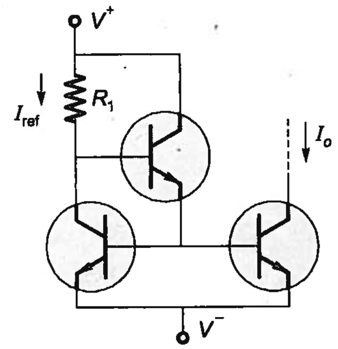
(a) 0.5 mA (b) 2 mA
(c) 9.3 mA (d) 15 mA

Q.14 In the current mirror circuit shown below. The transistor parameters are V_{BE} = 0.7 V, β = 50 and early voltage is infinite. Assume transistor are matched



(a) 1.04 mA (b) 1.68 mA
(c) 962 μA (d) 432 μA

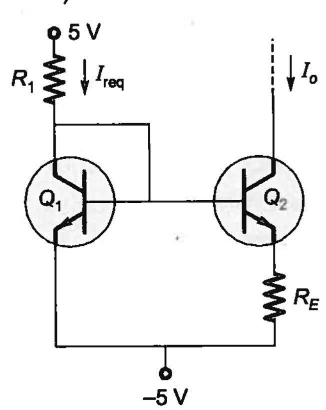
Q.15 Consider the basic three transistor current source in figure below. Assume all transistors are matched with finite gain and early voltage $V_A = \infty$. The expression for I_o is



(a) $\dfrac{I_{req}}{1+\dfrac{2}{1+\beta}}$ (b) $\dfrac{I_{req}}{1+\dfrac{1}{2+\beta}}$

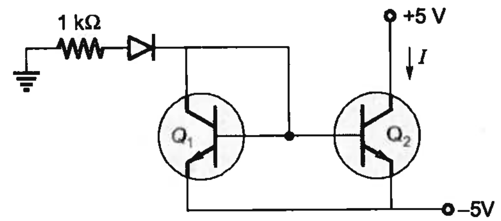
(c) $\dfrac{I_{req}}{1+\dfrac{2}{\beta(1+\beta)}}$ (d) $\dfrac{I_{req}}{1+\dfrac{1}{\beta(2+\beta)}}$

Q.16 Consider the wilder current source shown below. Both of transistor are identical and $\beta >> 1$ and $V_{BE_1} = 0.7$ V. The valve of resistance R_1 and R_E to produce $I_{req} = 1$ mA and $I_0 = 12$ μA is ($V_T = 26$ mV)



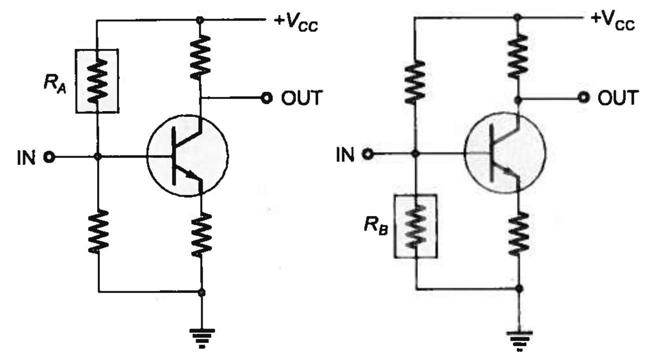
(a) 9.3 kΩ, 18.23 kΩ
(b) 9.3 kΩ, 9.58 kΩ
(c) 15.4 kΩ, 16.2 kΩ
(d) 15.4 kΩ, 34.4 kΩ

Q.17 Two perfectly matched silicon transistor are connected as shown in the figure. Assuming the β of the transistors to be very high and the forward voltage drop in diodes to be 0.7 V, the value of current is



(a) 0 mA (b) 3.6 mA
(c) 4.3 mA (d) 5.7 mA

Q.18 In the following two non-linear transistor biasing circuits,



the resistors,

(a) R_A and R_B, both have negative temperature coefficient
(b) R_A and R_B, both have positive temperature coefficient
(c) R_A has negative temperature coefficient and R_B has positive temperature coefficient
(d) R_A has positive temperature coefficient and R_B has negative temperature coefficient

Q.19 To avoid thermal runaway in the design of an analog circuit, the operating point of the BJT should be such that it satisfies the condition

(a) $V_{CE} = ½\ V_{CC}$ (b) $V_{CE} \le ½\ V_{CC}$
(c) $V_{CE} > ½\ V_{CC}$ (d) $V_{CE} \le 0.78\ V_{CC}$

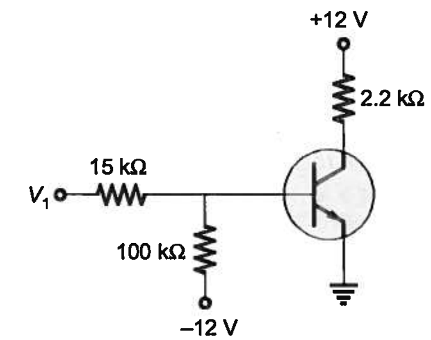
Q.20 The condition to be satisfied to prevent thermal runaway in a transistor amplifier where (P_c = Power dissipated at Collector, T_j = Junction temperature, T_A = Ambient temperature, θ = Thermal resistance) is

(a) $\dfrac{\delta P_c}{\delta T_j} > \dfrac{1}{\theta}$ (b) $\dfrac{\delta P_c}{\delta T_A} < \dfrac{1}{\theta}$

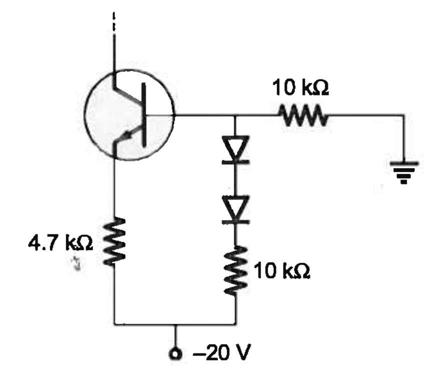
(c) $\dfrac{\delta P_c}{\delta T_j} < \dfrac{1}{\theta}$ (d) $\dfrac{\delta P_c}{\delta T_A} > \dfrac{1}{\theta}$

Numerical Data Type Questions

Q.21 For the transistor shown below, β = 30 and V_{CEQ} = 6 V. The value of V_1 is ______ Volt.

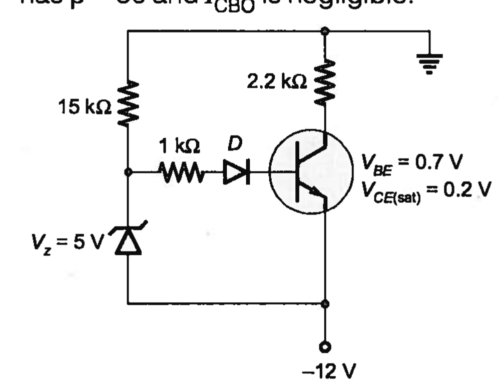


Q.22 In the bipolar current source of figure shown below, the diode voltage and transistor base-emitter voltage are equal



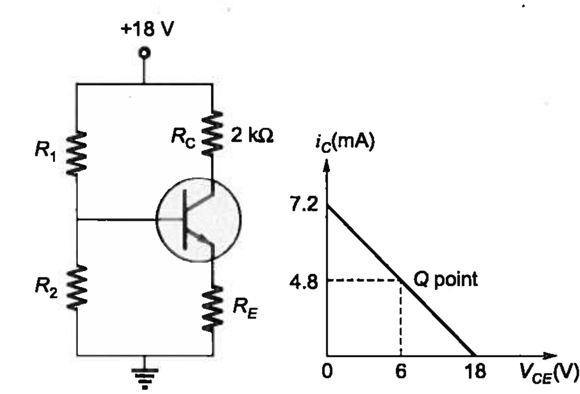
If base current is neglected, then collector current is ____ mA.

Q.23 The transistors used in the circuit shown below has β = 30 and I_{CBO} is negligible.



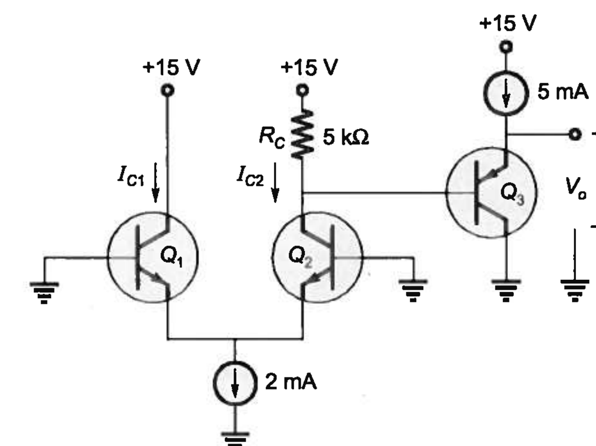
If the forward voltage drop of diode is 0.7 V, then the current through collector will be____ mA.

Q.24 The transistor circuit and its DC load line is shown in figure given below.

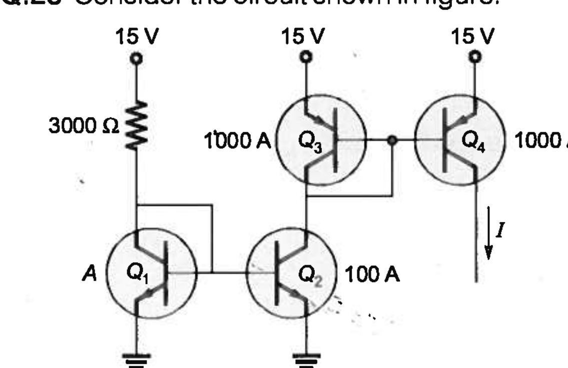


For the transistor, β = 120. What is the value of emitter resistance (R_E) at Q-point (in kΩ)?

Q.25 In the circuit shown below assume that the transistors Q_1 and Q_2 have identical characteristics. All of the transistor operate in active region and β = 100. The value of output voltage V_o is ______ volts.



Q.26 Consider the circuit shown in figure.



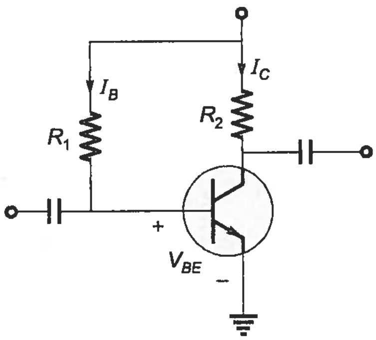
All the transistors have $\beta = \infty$, and $V_{BEactive} = 0.7$ for n-p-n BJT Q_1 and Q_2. The transistor Q_1 and Q_2 are exactly same, the only difference is that cross-section area of Q_2 = 100 times the cross-section area of Q_1. Q_3 and Q_4 are p-n-p BJT the cross-section area of Q_3 is equal to cross-section area of Q_4 that is equal to 1000 times the cross-section area of Q_1. The value of I is _____ A.

Try Yourself

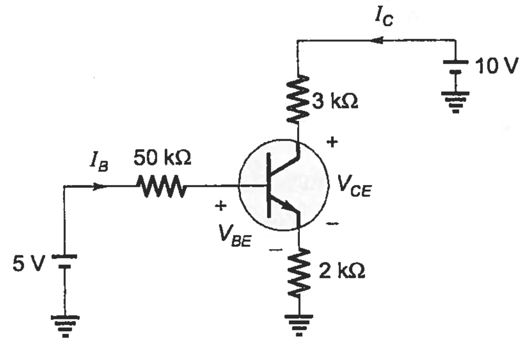
T1. In the circuit shown below, $\beta = 150$, $V_{BE} = 0.7$ V and it is operating at Q-point (3 V, 1.5 mA). If β increases to 200, the new operating point will be

(a) 2.88 V, 1.56 mA (b) 5.40 V, 3.50 mA

(c) 3.55 V, 4.60 mA (d) 1.06 V, 2.46 mA



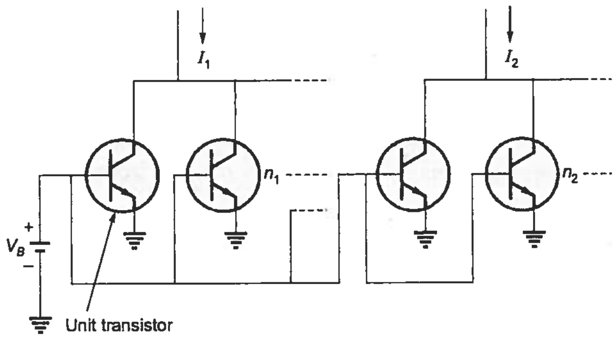
T2. In circuit shown transistor has $\beta = 100$. $V_{BE(sat)} = 0.8$ V and $V_{CE(sat)} = 0.2$ V. Then the region of operation



(a) active region (b) saturation region

(c) cut-off region (d) reverse-active region

T3. An integrated circuit requires two current sources; $I_1 = 0.2$ mA and $I_2 = 0.3$ mA. Assuming that only integer multiples of a unit bipolar transistor having $I_s = 3 \times 10^{-16}$ amp can be placed in parallel, and only a single voltage source V_B is available, the minimum number of unit transistor required for the circuit are



	n_1	n_2
(a)	1	2
(b)	2	3
(c)	4	6
(d)	8	12