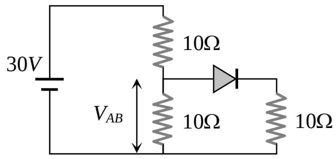
1. Find V_{AB}

(a) 10 V

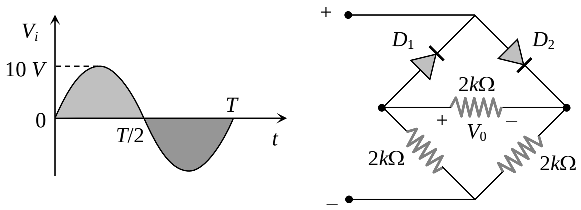
(b) 20 V

(c) 30 V

(d) None of these



2. In the circuit shown in figure the maximum output voltage V_0 is



(a) 0 V (b) 5 V

(c) 10 V (d) $\frac{5}{\sqrt{2}}V$

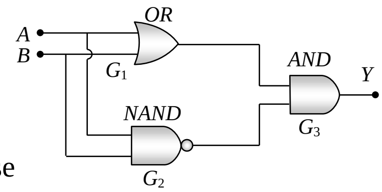
3. The following configuration of gate is equivalent to

(a) NAND

(b) XOR

(c) OR

(d) None of these



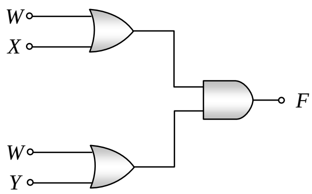
4. The diagram of a logic circuit is given below. The output F of the circuit is represented by

(a) $W.(X+Y)$

(b) $W\cdot(X\cdot Y)$

(c) $W+(X\cdot Y)$

(d) $W+(X+Y)$



5. The relation between I_p and V_p for a triode is

$$I_p = (0.125\, V_p - 7.5)\, mA$$

Keeping the grid potential constant at 1V, the value of r_p will be

(a) 8 $k\Omega$ (b) 4 $k\Omega$

(c) 2 $k\Omega$ (d) 8 $k\Omega$

6. A triode whose mutual conductance is 2.5 *m A*/*volt* and anode resistance is 20 *kilo ohm*, is used as an amplifier whose amplification is 10. The resistance connected in plate circuit will be

(a) 1 $k\Omega$ (b) 5 $k\Omega$

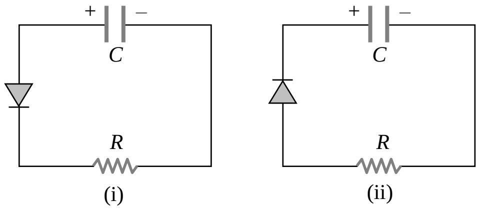
(c) 10 $k\Omega$ (d) 20 $k\Omega$

7. The slopes of anode and mutual characteristics of a triode are 0.02 $mA\ V^{-1}$ and 1 $mA\ V^{-1}$ respectively. What is the amplification factor of the valve

(a) 5 (b) 50

(c) 500 (d) 0.5

8. Two identical capacitors A and B are charged to the same potential V and are connected in two circuits at $t = 0$, as shown in figure. The charge on the capacitors at time $t = CR$ are respectively



(a) VC, VC (b) $\frac{VC}{e}, VC$

(c) $VC, \frac{VC}{e}$ (d) $\frac{VC}{e}, \frac{VC}{e}$

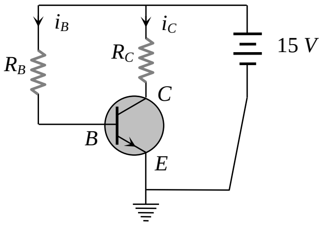
9. In the following common emitter circuit if $\beta = 100$, $V_{CE} = 7V$, V_{BE} = Negligible $R_C = 2\ k\Omega$ then I_B = ?

(a) 0.01 mA

(b) 0.04 mA

(c) 0.02 mA

(d) 0.03 mA

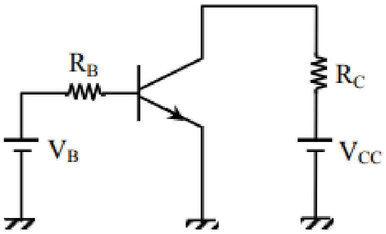


10. Mobility of electrons in a semiconductor is defined as the ratio drift velocity to the applied electric field. If, for an n-type semiconductor, the density of electrons is $10^{19} m^{-3}$ and their mobility is $1.6 m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n-type semiconductor contribution of holes is ignored) is close to:

(a) 2 Ωm (b) 4 Ωm

(c)0.4 Ωm (d) 0.2 Ωm

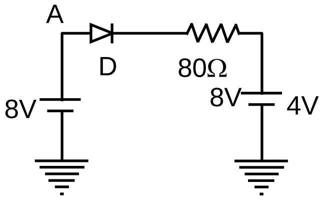
11. A common emitter amplifier circuit, built using an npn transistor, is shown in figure. Its dc current gain is 250, RC = 1kΩ and VCC = 10 V. What is the minimum base current for VCE to reach saturation ?



(a) 40 μA (b) 100 μA

(c) 7 μA (d) 10 μA

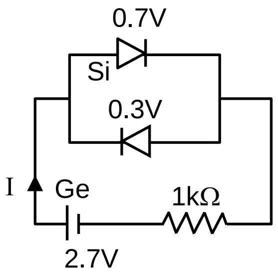
12. The resistance of the given diode in F.B. condition is 20 Ω and in R.B. condition it is 2500Ω the current in the circuit is :-



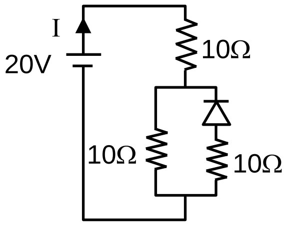
(a) 20 mA (b) 40 mA

(c) 50 mA (d) 10 mA

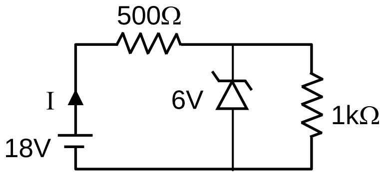
13. What is the value of current I in given circuits :-



(A)



(B)



(C)

(a) 2mA, 1A, 24mA (b) 2.4mA, 1.33A, 30mA

(c) 1.6 mA, 0.66A, 20mA (d) None

14. An amplifier is nothing but an oscillator with –

(a) positive feedback (b) high gain

(c) no feed back (d) negative feed back

15. In the case of constants α and β of a transistor

(a) $\alpha = \beta$ (b) $\beta < 1$ $\alpha > 1$

(c) $\alpha\beta = 1$ (d) $\beta > 1$ $\alpha < 1$

16. For a common emmiter circuit if $\frac{I_C}{I_E} = 0.98$ then current gain for common emitter circuit will be :

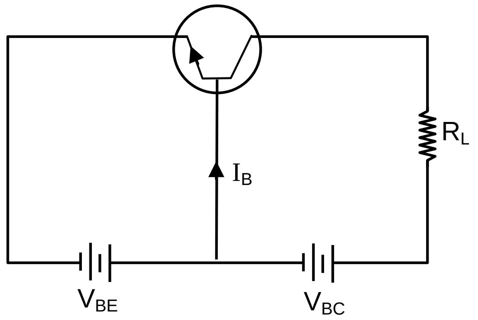
(a) 49 (b) 98

(c) 4.9 (d) 25.5

17. A n-p-n transistor conducts when

(a) both collector and emitter are positive with respect to the base
(b) collector is positive and emitter is negative with respect to the base
(c) collector is positive and emitter is at same potential as the base
(d) both collector and emitter are negative with respect to the base

18. In a common-base configuration of transistor. $\alpha = 0.98$, $I_B = 0.02$ mA, $R_L = 5$ kΩ. Output voltage across load is :



(a) 3.2 V (b) 4.9 V
(c) 5.2 V (d) 6.2 V

19. In a common emitter amplifier using output resistance of 5000 ohm and input resistance of 2000 ohm, if the peak value of input signal voltage is 10 mV and $\beta = 50$ then the calculated power gain will be

(a) 6.25×10^3 (b) 1.4
(c) 62.5 (d) 2.5×10^4

20. A transistor is operated in common emitter configuartion at constant collectr veltage $V_c = 1.5$ V such that a change in the base current from 100 μA to 150 μA produces a change in the collectro current from 5 mA to 10 mA. The current gain (β) is :-

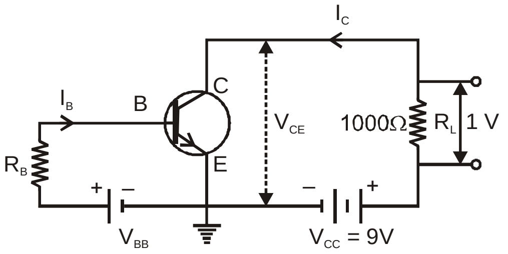
(a) 67 (b) 75
() 100 (d) 50

21. In a common base amplifier, the phase difference between the input signal voltage and output voltage is :

(a) $\frac{\pi}{4}$ (b) π

(c) zero (d) $\frac{\pi}{2}$

22. An N-P-N transistor is connected in common emitter configuration in which collector supply is 9V and the voltage drop across the load resistance of 1000Ω connected in the collector circuit is 1 V. If current amplification factor is (25/26), If the internal resistance of the transistor is 200Ω, then which of the following options is **incorrect**.



(a) $V_{CE} = 8$ V

(b) collector current is 1.0 mA

(c) voltage gain $\frac{50}{23}$, and power gain is 4.6

(d) emitter current is 2.04 mA

23. The A-C current gain of a transistor is β= 19. In its common-emitter configuration, What will be the change in the emitter current for a change of 0.4 mA in the base-current ?

(a) 7.6 mA (b) 7.2 mA
(c) 8 mA (d) 6.8 mA

24. In a common emitter n-p-n transistor circuit, it is found that ninety percent of emitted electrons reach the collector. If the collector current is 18 mA then

(a) Base current is 2 mA

(b) Emitter current is 20 mA

(c) Emitter current is 22 mA

(d) Both (a) & (b)

25. A 6 volt battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be -

(a) 2 volt (b) 3 volt (c) 1 volt (d) 1.5 volt

26. A standard cell of 1.08 V is balanced by the p.d. across 90 cms of a meter long wire supplied by a cell of emf 2V through a series resistor of resistance 2 Ω. If the internal resistance of cell in primary circuit is zero then the resistance per unit length of potentiometer wire is :

(a) 3 ohm/cm (b) 0.3 ohm/cm
(c) 3 ohm/m (d) 3 ohm/mm

27. If a semiconductor has an intrinsic carrier concentration of 1.41×10^{16} m^{-3}, when doped with 10^{21} m^{-3} phosphorus, then the concentration of holes at room temperature will be –

(a) 2×10^{21} (b) 2×10^{11} (c) 1.41×10^{10} (d) 1.41×10^{16}

28. For a tansistor working as common base amplifier, the emitter current is 7.2 mA. The current gain is 0.96. The collector current is -

(a) 0.96 × 7.2 mA (b) $\frac{0.96}{0.72}$ mA
(c) 0.96 – 7.2 mA (d) 7.2 A – 2 × 0.96 mA

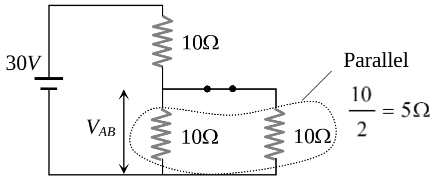
29. Given :$\beta = 80$ and $\Delta I_B = 250$ μA. The value of ΔI_C is -

(a) 80 × 250 μA (b) (250 – 80) μA
(c) (250 + 80) μA (d) $\frac{250}{80}$ μA

30. Knee voltage in Ge diode is of the order of -

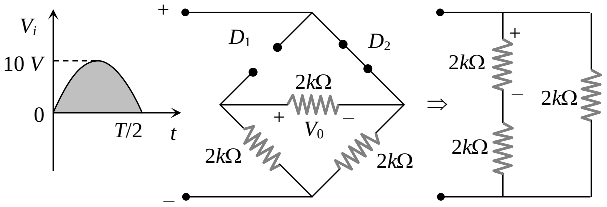
(a) 0.3 V (b) 0.7 V (c) 5 V (d) 100 V

1. (a) Diode is in forwards biasing hence the circuit can be redrawn as follows



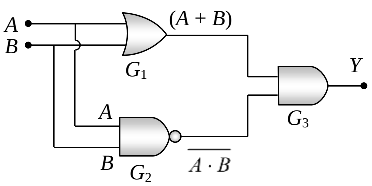
$$V_{AB} = \frac{30}{(10+5)} \times 5 = 10\ V$$

2. (b) For the positive half cycle of input the resulting network is shown below



$$\Rightarrow (V_0)_{max} = \frac{1}{2}(V_i)_{max} = \frac{1}{2} \times 10 = 5\ V.$$

3. (b)



$$Y = (A+B).\overline{AB}$$

The given output equation can also be written as

$Y = (A+B).(\bar{A}+\bar{B})$ (De morgan's theorem)

$= A\bar{A} + A\bar{B} + B\bar{A} + B\bar{B} = 0 + A\bar{B} + \bar{A}B + 0 = \bar{A}B + A\bar{B}$

This is the expression for XOR gate.

4. (c) Output of upper OR gate = $W + X$

Output of lower OR gate = $W + Y$

Net output $F = (W + X)(W + Y)$

$= WW + WY + XW + XY$ (Since $WW = W$)

$= W(1 + Y) + XW + XY$ (Since $1 + Y = 1$)

$= W + XW + XY = W(1 + X) + XY = W + XY$

5. (d) $i_p = [0.125\ V_p - 7.5] \times 10^{-3}\ amp$

Differentiating this equation *w.r.t.* V_p

$\frac{\Delta i_p}{\Delta V_p} = 0.125 \times 10^{-3}$ or $\frac{1}{r_p} = 0.125 \times 10^{-3} \Rightarrow r_p = 8\, k\Omega$

6. (b) $\mu = r_P \times g_m = 20 \times 2.5 = 50$

From $A = \frac{\mu R_L}{r_P + R_L} \Rightarrow r_P + R_L = \frac{\mu R_L}{A} = \frac{50 R_L}{10} = 5R_L$

$\Rightarrow 4R_L = r_p \Rightarrow R_L = \frac{r_p}{4} = \frac{20}{4} = 5k\Omega$

7. (b) The slope of anode characteristic curve $= \frac{1}{r_p}$

$\Rightarrow r_p = \frac{1}{0.02\, mA / V} = 50 \frac{V}{mA} = 50 \times 10^3 \frac{V}{A}$

The slope of mutual characteristic curve = g_m

= 1×10^{-3} *A/V*.

$\therefore \mu = r_p \times g_m = 50 \times 10^3 \times 10^{-3} = 50$.

8. (b) Time t = *CR* is known as time constant. It is time in which charge on the capacitor decreases to $\frac{1}{e}$ times of it's initial charge (steady state charge).

In figure (i) *PN* junction diode is in forward bias, so current will flow the circuit *i.e.*, charge on the capacitor decrease and in time t it becomes $Q = \frac{1}{e}(Q_o)$; where $Q_o = CV \Rightarrow Q = \frac{CV}{e}$

In figure (ii) *P-N* junction diode is in reverse bias, so no current will flow through the circuit hence change on capacitor will not decay and it remains same *i.e. CV* after time t.

9. (b) $V = V_{CE} + I_C R_L$

$\Rightarrow 15 = 7 + I_C \times 2 \times 10^3 \Rightarrow i_C = 4\, mA$

$\because \beta = \frac{i_C}{i_B} \Rightarrow i_B = \frac{4}{100} = 0.04\, mA$

10. (c) **JEE Main 2019**

As we know, current density,

$j = \sigma E = nev_d$

$\sigma = ne\frac{v_d}{E} = ne\mu$

$\frac{1}{\sigma} = \rho = \frac{1}{n_e e \mu_e} =$ Resistivity

$= \frac{1}{10^{19} \times 1.6 \times 10^{19} - 19 \times 1.6}$

or $P = 0.4\, \Omega m$

11. (a) **JEE Main 2019**

Given, $\beta = 250$

Voltage gain, $\frac{V_{CC}}{V_B} = \beta \frac{R_C}{R_B}$

$\frac{10}{V_B} = 250 \times \frac{10^3}{R_B}$

$\therefore \frac{V_B}{R_B} = \frac{1}{25 \times 10^3} = 40\ \mu A$

12. (b)

13. (a)(A) $I = \frac{2.7 \times 0.7}{1 \times 10^3} = 2mA$

(B) $I = \frac{20}{10+10} = 1A$

(C) $I = \frac{18-6}{500} = 24mA$

14. (a)

15. (d) α is the ratio of collector current and emitter current while β is the ratio of collector current and base current.

16. (a)

17. (b)

18. (b) $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$

$\beta = \frac{I_C}{I_B} \Rightarrow I_C = \beta I_B = 49 \times 0.02\ mA = 0.98\ mA$

$V_{Load} = I_C R_L = (0.98\ mA)\ [5K\Omega] = 4.9$ volt

19. (a)Power gain = current gain x voltage gain

Voltage gain = $\beta\ \frac{R_{out}}{R_{in}} = \frac{5}{2} \times 50$

so. Power gain = $50 \times 50 \times \frac{5}{2} = \frac{12500}{2} = 6250$

20. (c)

21. (c)

22. (c)

23. (c)By definition, the A-C current gain β is given by

$$\beta_{ac} = \frac{\Delta I_C}{\Delta I_B}$$

$\therefore \Delta I_C = \beta \times \Delta I_B = 19 \times 0.4\ mA = 7.6\ mA.$

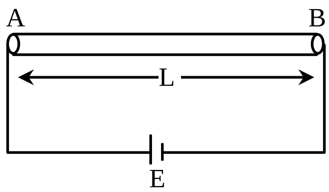
The emitter - current is the sum of the base- current and the collector-current ($i_E = i_B + i_C$)

$\therefore \Delta I_E = \Delta I_B + \Delta I_C = 0.4\ mA + 7.6\ mA = 8\ mA.$

24. (d)

25. **(c)**

$V_{AB} = E$



Potential gradient $K = \frac{V_{AB}}{L} = \frac{E}{L}$

$\therefore$ Potential difference across length ℓ is $V = K\ell$

$= \frac{E}{L} \times \ell = \frac{6}{3} \times 0.5 = 1$ volt

26. (c)

$E = \left(\frac{E_o}{L} \times \frac{R_w}{R_w + r + R_h}\right) \times \ell$ ($\because$ $r = 0$, $R_h = 2\ \Omega$)

$\therefore 1.08 = \left(\frac{2}{1m} \times \frac{R_w}{R_w + 2}\right) \times 0.90$ m

$\frac{1.08}{2 \times 0.90} = \frac{R_w}{R_w + 2}$

Hence : $0.6 = \frac{R_w}{R_w + 2}$

$0.6 R_w + 1.2 = R_w \Rightarrow 1.2 = 0.4 R_w \Rightarrow 3 = R_w$

$\therefore$ Resistance per unit length is 3Ω /meter

27. (d)

Phosphorus is pentavalent impurity. Its doping will not effect the concentration of holes. So number of holes will be equal to same as in intrinsic semiconductor. So $n_h = 1.41 \times 10^{16}\ m^{-3}$

28. (a)

$\alpha = \frac{i_C}{i_E}$

$i_C = \alpha\, i_E = 0.96 \times 7.2$ mA

29. (a)

$\Delta i_e = \beta \Delta i_B = 80 \times 250\ \mu A$

30. (b)

Theory