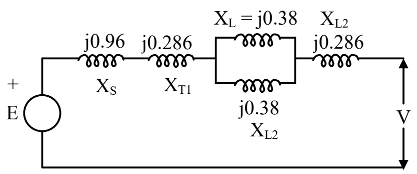


$X_T = j0.96 + j0.286 + j(0.38 \parallel 0.38) + j0.286$

$= 1.722$ pu

$P_0 = \dfrac{EV}{X}\sin\delta$

$P_0 = 1$ pu

Minimum value $\sin\delta = 1$

$E_{min} = \dfrac{PX}{V}$

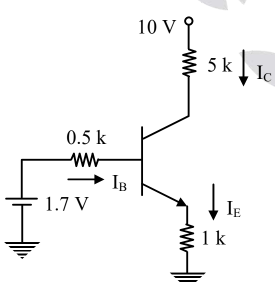
$E_{min} = \dfrac{1\times 1.722}{1} = 1.722$ pu

44. **Ans: (B)**

Sol: Given that $\beta = 100$

To calculate 'r_e' value, apply DC Analysis

Apply KVL to input loop



$1.7 - 0.5 \times 10^3 I_B - 0.7 - 10^3(1+\beta)I_B = 0$

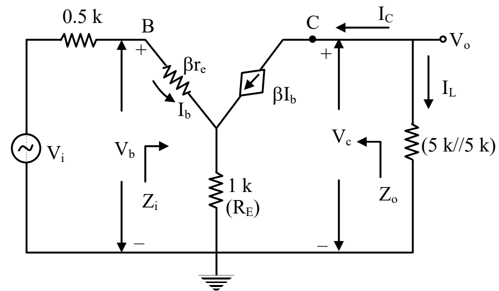
$I_B = \dfrac{1}{10^3(0.5+101)} = 9.852\ \mu A$

$I_E = (1+\beta)\ I_B = 0.995$ mA

$r_e = \dfrac{V_T}{I_E} = 25.12\ \Omega$

To calculate voltage gain apply AC Analysis

Voltage gain



$$A_V = \left(\frac{V_o}{V_b}\right) = \frac{-I_C(2.5k)}{I_b\left[\beta r_e + (1+\beta)R_E\right]}$$

$$A_V = \frac{-\beta\times 2.5\times 10^3}{\beta r_e + (1+\beta)R_E} = \frac{-100\times 2.5\times 10^3}{(2.512+101)\times 10^3}$$

$$= \frac{-250}{103.512}$$

$= -2.415$

Voltage amplification $A = A_v\left(\dfrac{z_i^1}{z_i^1 + R_s}\right)$

Where $Z_i^1 = Z_i = \beta r_e + (1+\beta)\ R_E$

$= 103.512\ k\Omega$

$A = -2.415\left(\dfrac{103.512}{104.012}\right)$

$= -2.4034$

$\therefore\ A = -2.4$

45. **Ans: (B)**

Sol: Given $\cos\theta = 0.8$

$\theta = \cos^{-1} 0.8 = 36.86°$

$P_1 = V_L\ I_L \cos(30 - 36.86)$

$P_2 = V_L\ I_L \cos(30 + 36.86)$

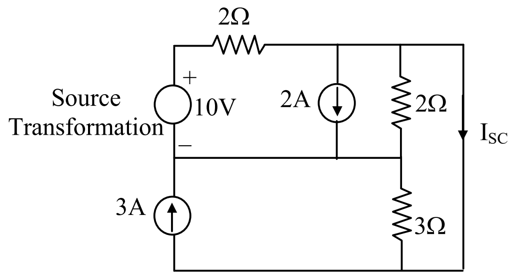
$P_1 = 208 \times 12 \cos(30 - 36.86)$

$P_1 = 2478W$

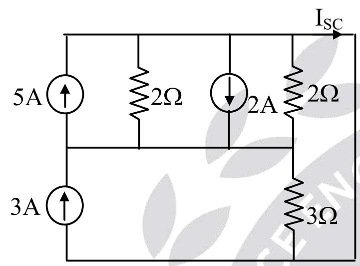
$P_2 = 208 \times 12 \cos(30 + 36.86) \Rightarrow P_2 = 980W$

46. Ans: 3 [Range 3]

Sol: Find out short circuit current (I_{SC})



⇒



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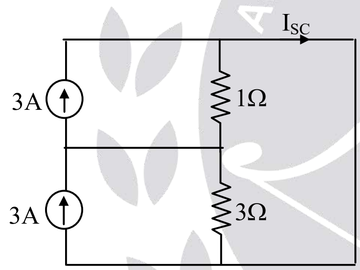
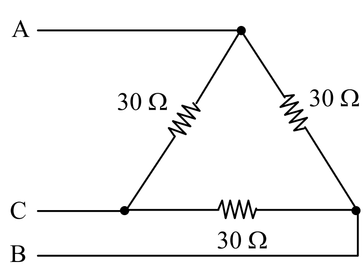


$\therefore$ I_{SC}= 3A

47. Ans: (B)

Sol: Convert delta connected load into star connected load.



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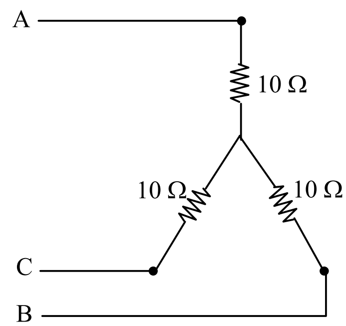


$\therefore$ In 120° conduction scheme,

$$V_{ph} = \frac{V_{dc}}{\sqrt{6}} = 163.3\,\text{V}$$

3-ϕ load power

$$P_0 = 3\left[\frac{V_{ph}^2}{R}\right] = 3\times\frac{163.3^2}{10} = 8\text{kW}$$

48. Ans: (C)

Sol: f(A, B, C, D) = Σm(1, 3, 4, 7, 9, 12, 14, 15)

$$= \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \bar{A}BCD$$
$$+ A\bar{B}\bar{C}D + AB\bar{C}\bar{D} + ABC\bar{D} + ABCD$$

$$= \bar{B}\bar{C}D(A+\bar{A}) + \bar{B}CD\bar{A} + B\bar{C}\bar{D}(A+\bar{A})$$
$$+ BCD(A+\bar{A}) + BC\bar{D}A$$

$$= \bar{B}\bar{C}D + \bar{B}CD\bar{A} + B\bar{C}\bar{D} + BCD + BC\bar{D}A \quad ....(1)$$

The output of the multiplexer = $m_0I_0 + m_1I_1 + m_2I_2 + m_3I_3 + m_4I_4 + m_5I_5 + m_6I_6 + m_7I_7$

$$= \bar{B}\bar{C}\bar{D}I_0 + \bar{B}\bar{C}DI_1 + \bar{B}C\bar{D}I_2 + \bar{B}CDI_3 + B\bar{C}\bar{D}I_4$$
$$+ B\bar{C}DI_5 + BC\bar{D}I_6 + BCDI_7$$

……….(2)

(1) = (2)

$\Rightarrow I_0 = 0, I_1 = 1, I_2 = 0, I_3 = \bar{A}, I_4 = 1, I_5 = 0,$

$I_6 = A, I_7 = 1$

49. Ans: (B)

Sol: All sheets will produce electric field at point P is –Ve Z direction.

$$E_T = \left[\frac{\sigma}{2\varepsilon_0} + \frac{2\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}\right](-\hat{Z})$$

$$= \frac{4\sigma}{2\varepsilon_0}(-\hat{Z}) = \frac{2\sigma}{\varepsilon_0}(-\hat{Z})$$

50. Ans: 50 [Range 50]

Sol: Peak to peak value of unknown ac voltage.

V_{P-P} = length of trace × deflection sensitivity

$V_{P-P} = 10 \times 10 = 100V$

Peak value of the voltage $= \frac{V_{P-P}}{2} = 50\text{Volt}$

51. Ans: (A)

Sol: $\frac{x(t)}{t} \leftrightarrow \int_s^\infty X(S)\,ds$

$x(t) = \sin at\,.\,u(t),\ X(S) = \frac{a}{s^2 + a^2}$

$$\int_s^\infty X(s)ds = \int_s^\infty \frac{a}{s^2 + a^2}ds$$

$$= a.\ \frac{1}{a}\tan^{-1}(s/a)\Big|_s^\infty$$

$= \tan^{-1}(\infty) - \tan^{-1}(s/a)$

$= \frac{\pi}{2} - \tan^{-1}(s/a)$

$= \cot^{-1}(s/a)$

$= \tan^{-1}(a/s)$

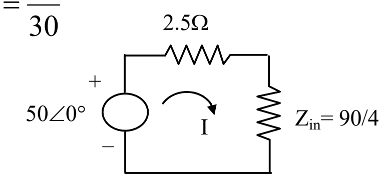
52. Ans: 90 [Range 90]

Sol: By using impedance transformation from output to input. The transformer are ideal (no power loss)

$$Z_{in} = \frac{Z_L}{k_1^2 k_2^2}$$

$k_1 = \frac{20}{1} = 20, k_2 = \frac{1}{30}$

$Z_L = 10\Omega$



$$Z_{in} = \frac{10 \times 30 \times 30}{20 \times 20} = \frac{90}{4}$$

I = 2A

This current is transformed input to output then $I_L = \frac{I_{in}}{k_1^2 k_2^2} = \frac{2 \times 30}{20} = 3A$

$P_{dissipated\ '10\Omega'} = I^2R = (3)^2 \times 10 = 90$ W

53. Ans: (3) [Range]

Sol: $(143)_5 = (x3)_y$

$\Rightarrow 1 \times 5^2 + 4 \times 5 + 3 = xy + 3$

$\Rightarrow xy = 45$

y > 3 and y > x

Possible solutions are

x = 1, y = 45

x = 3, y = 15

x = 5, y = 9

54. Ans: (B)

Sol: For uniform distribution, $f(x) = \frac{1}{b-a}$

for a < x < b

Here $f(x) = \frac{1}{0.5 - 0} = 2$

$$E(x^4) = \int_0^{0.5} x^4 f(x)dx = 1/80$$

55. Ans: 980 (Range: 978 to 982)

Sol: Developed power,

$$P = \frac{735.5}{75} \times Q \times W \times H \times \eta \text{ Watts}$$

Here,

Discharge of water (Q) = $1 m^3/s$,

Efficiency (η) =100% and

Water head (H) = 1m

$$\therefore \; P = \frac{735.5}{75} \times 1000 \times 10 \times 10 = 980\, kW$$

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