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Section :- F

Answers

1) a) Birds seating on a single live electric wire generally do not get electrical shock as there is no voltage difference in a single wire i.e. the live electric wire carries a constant voltage across the power lines, hence the potential difference across the feet of the birds will be negligible or zero, and hence current will not flow through the birds resulting in them **not** getting electrical shock.

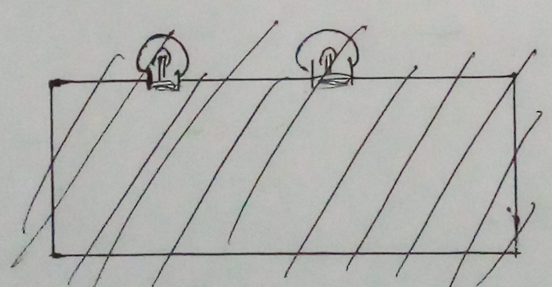
b) Now, Given that lamp A is rated with 200 W, 220 V and lamp B is rated with 100 W, 220 V.

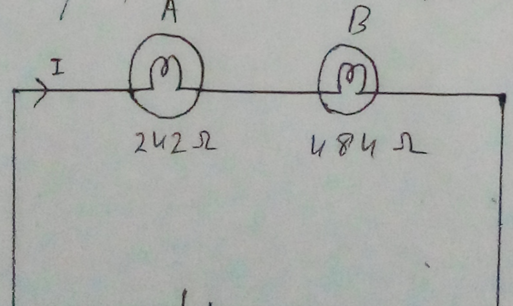
Therefore $R_A = \frac{(220)^2}{200} = 242\,\Omega$

and, $R_B = \frac{(220)^2}{100} = 484\,\Omega$

~~When~~

a) When connected in series across a 220 Volt supply





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Now, $I = \frac{220}{242+484}$

$= 0.303 A$

Now, since both the bulbs are in series hence the same ~~current~~ current will flow through them

$\therefore P_A = I^2 R_A$

$= (0.303)^2 \times 242$

$= 22.22 W$

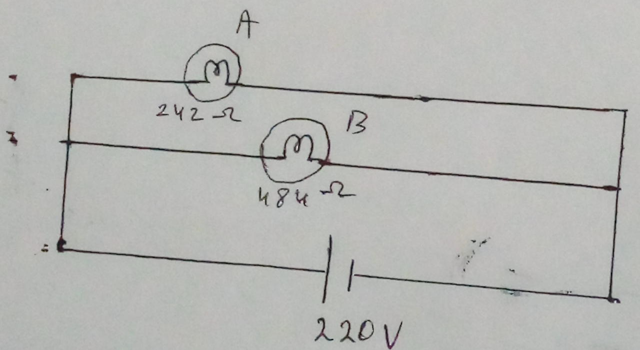
and $P_B = I^2 R_B$

$= (0.303)^2 \times 484$

$= 44.44 W$

Hence ~~bulb B will~~ lamp B will be brighter than lamp A

b) When connected ~~parallely~~ in parallel with 220V supply :-



Since both the bulbs have the same potential difference across them, hence

$P_A = \frac{V^2}{242} = \frac{(220)^2}{242} = 200 W$

$P_B = \frac{V^2}{484} = \frac{(220)^2}{484} = 100 W$

Hence lamp A will be brighter than lamp B

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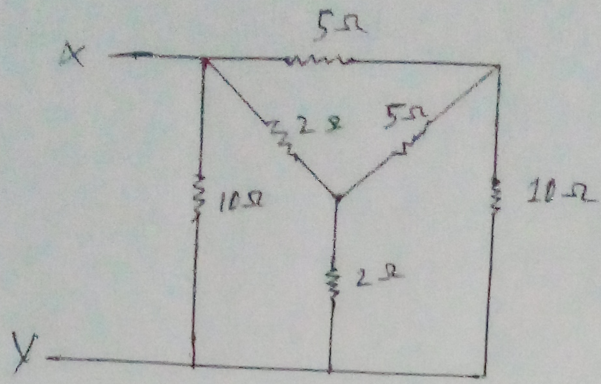
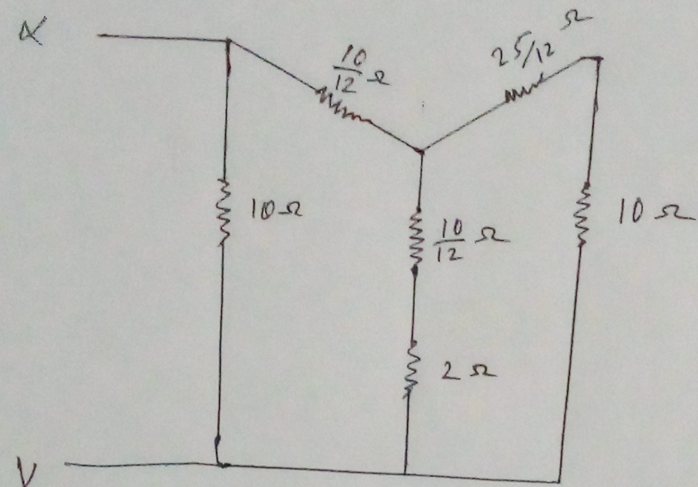
2) a)

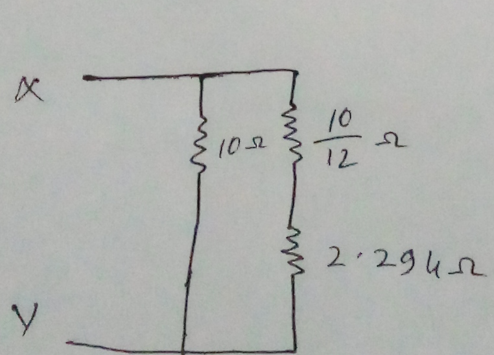


we can convert this circuit using star-~~dets~~ delta conversion as:-



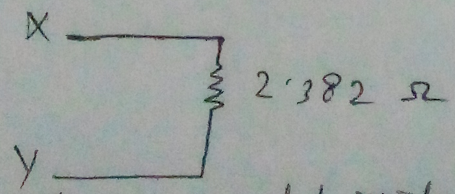
Now, $\left(\frac{25}{12} + 10\right) \parallel \left(\frac{10}{12} + 2\right)$

$\therefore$ We get



Now, $\left(\frac{10}{12} + 2{\cdot}294\right) \parallel 10$

$\therefore$ We get,



$\therefore$ The ~~required res~~ Equivalent resistance is 2·382 Ω

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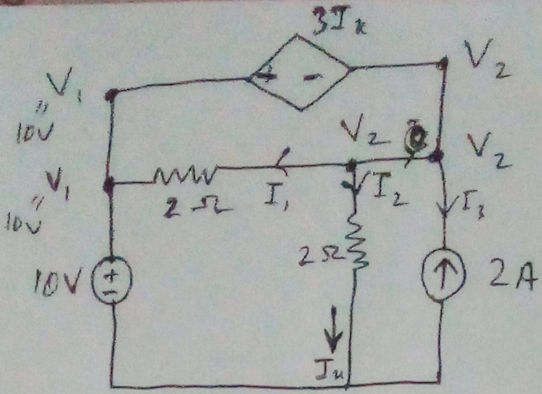
2) b)



Applying KCL at V_2

$$I_1 + I_2 + I_3 = 0$$

$$\Rightarrow I_3 = -2A$$

$$I_1 = \frac{V_2 - 10}{2}$$

$$I_2 = I_x = \frac{V_2}{2}$$

Also, $V_1 = 10V$

$$\therefore \frac{V_2 - 10}{2} + \frac{V_2}{2} - 2 = 0$$

$$\Rightarrow 2V_2 - 10 = 4$$

$$\Rightarrow V_2 = \frac{14}{2} = 7V$$

$$\therefore 3I_x = 10 - 7$$

$$\Rightarrow I_x = \frac{3}{3}$$

$$= 1A$$

$$\therefore I_x = 1A$$

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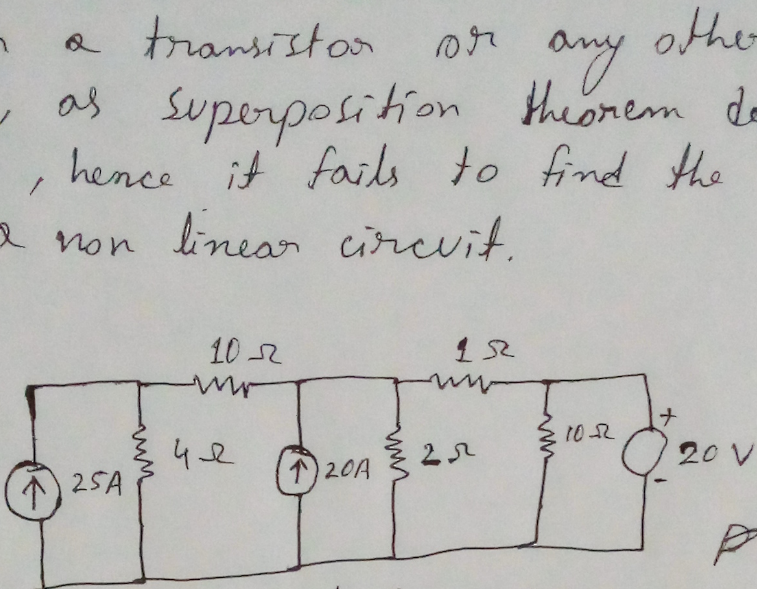
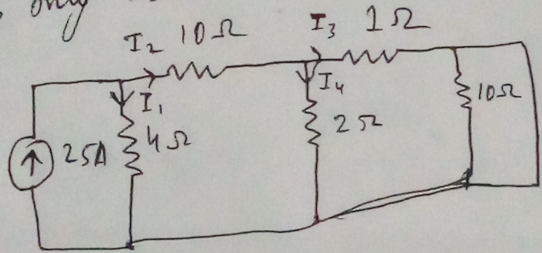
3) a) Superposition theorem is not applicable to non-linear networks as ~~superposition theorem depends on~~ there is not a linear relationship between current and voltage in a non linear circuit consisting of a diode or a transistor or any other unilateral element, as superposition theorem depends on this linearity, hence it fails to find the current flowing through a non linear circuit.

b)



To find the current in the 1 Ω resistor by superposition method:-

When keeping only 25A current source :-



From circuit anylysis we can see

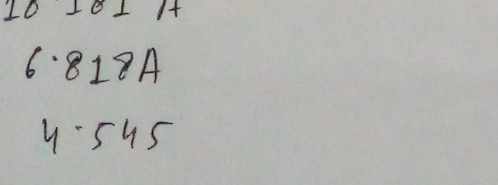
$I_1 = 18.181\ A$

$I_2 = 6.818A$

$I_3 = 4.545$

$I_4 = 2.272$

When keeping only 20 A current source



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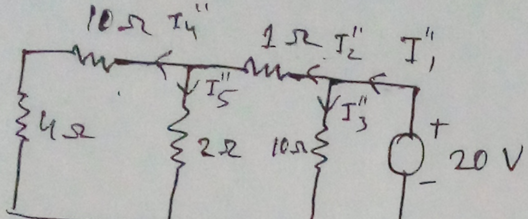
Now, from circuit analysis we can see

$I_2' = 19.090 A$

$I_3' = 12.726 A$

When only keeping 20 V voltage source



Now from circuit ~~an~~ analysis we can see

$I_1'' = 2.156 A$

$I_2'' = 1.690 A$

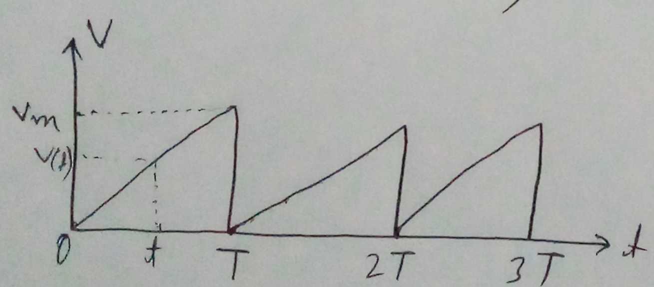
Now, current through 1 Ω resistor

$= I_3 + I_3' - I_2''$

$= 4.545 + 12.726 - 1.690$

$= 15.581 A$ (Answer)

5) a)



To find the (I) Average value and (II) RMS value

Now, $\frac{V(t)}{t} = \frac{V_m}{T}$

$\therefore V(t) = \frac{V_m}{T}(t)$

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I) Average value

$$V_{avg} = \frac{1}{T}\int_0^T v(t)\,dt$$

$$= \frac{1}{T}\int_0^T \frac{V_m}{T} t\,dt$$

$$= \frac{V_m}{T^2}\left[\frac{t^2}{2}\right]_0^T$$

$$= \frac{V_m}{T^2} \times \frac{T^2}{2}$$

$$= 0.5\,V_m$$

II) RMS Value

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

$$= \sqrt{\frac{1}{T}\int_0^T \frac{V_m^2}{T^2} \times t^2\,dt}$$

$$= \sqrt{\frac{V_m^2}{T^3}\left[\frac{t^3}{3}\right]_0^T}$$

$$= \sqrt{\frac{V_m^2}{T^3}\left[\frac{T^3}{3}\right]}$$

$$= 0.577\,V_m$$

5> b> $V = 120\,V$

~~**~~ $i(t) = 28.3 \sin(314t - \phi)\,A$

$P = 1200\,W$

$I = \frac{28.3}{\sqrt{2}} = 20.01\,A$

$P = I\cancel{V} \; VI\cos\phi$

$\Rightarrow 1200 = 120 \times 20.01 \times \cos\phi$

$\Rightarrow \cos\phi = 0.499$

$\Rightarrow \phi = \cancel{60.020}\; 60.066°$

$Z = \frac{V}{I} = \frac{120}{20.01} = 6\,\Omega$

$\bar{Z} = Z\angle\theta$

$= 6\angle 60.06°$

$= 3 + j5.2\,\Omega$

$\therefore$ Resistance $R = 3\,\Omega$

Reactance $X_L = 5.2\,\Omega$

$\therefore X_L = \omega L$

$\Rightarrow 5.2 = 314 \times L$

$\therefore$ Inductance $L = 0.0165\,H$

6> a> I> $V = 80 + 60j$ $\quad Z = \frac{|V|}{|I|} = \frac{100}{2\sqrt{5}}$

$I = 4 - 2j$

$= 10\sqrt{5}\,\Omega$

$\Rightarrow \boxed{Z = 22.360\,\Omega}$

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a) I) $\vec{V}\cdot\vec{I} = |V|\,|I|\cos\phi$

$$\frac{320-120}{(100)\,2\sqrt{5}} = \cos\phi$$

$$\cos\phi = \frac{1}{\sqrt{5}}$$

$$\boxed{\text{Power factor} = \cos\phi = \frac{1}{\sqrt{5}}}$$

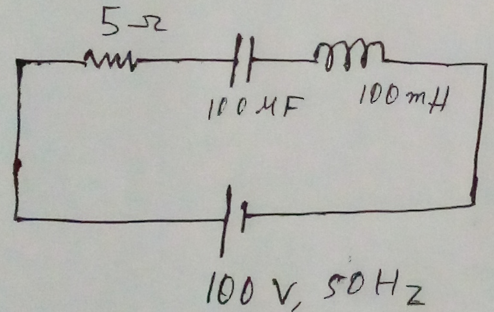
a) III) Active power $= \vec{V}\cdot\vec{I}$

$= 200\ W$

Reactive power $= |\vec{V} \times \vec{I}_x|$

$= 400\ W$

6) b)



$\omega = 2\pi f = 100\pi$

$X_L = 100 \times 10^{-3} \times 100\pi$

$= 10\pi$

$\therefore X_L = 31.415\ \Omega$

$$X_C = \frac{1}{100 \times 10^{-6} \times 100\pi}$$

$$= \frac{100}{\pi}$$

$\therefore X_C = 31.830\ \Omega$ (Answer)

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