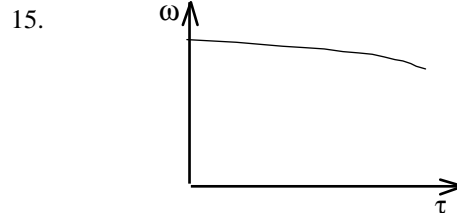
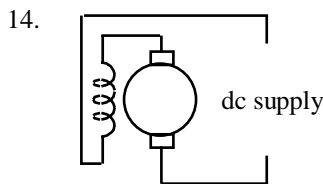


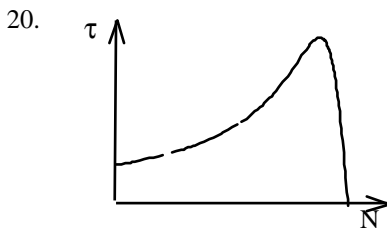
EE 101 – Electrical Engineering - Model Answers to Specimen Questions 1

1. 230 V
2. 50 Hz
3. 11 kV (or 33 kV)
4. $V_Y(t) = 326 \sin(100\pi t + \pi/6 - 2\pi/3)$ or $326 \sin(100\pi t - \pi/2)$
5. $V_R(t) = 326 \sin(100\pi t + \pi/6)$
Effective value $V_R = 326/\sqrt{2} = 230.5 \text{ V}$
6. $V_L = \sqrt{3} \times 230.5 = 399.3 \cong 400 \text{ V}$
7. Less power loss caused by the lower transmission current necessary to transmit the same amount of power.
8. Hydroelectric power, Conventional thermal power (coal or oil), (also Nuclear power).
9. Electric drives, electrical heating, (also electric lighting, electric welding).
10. (a) ampere, A (b) farad, F [note: unit names do not start with a capital letter]
11. (a) electric flux density (or electric charge density) (b) angular frequency (or angular velocity)
12. energy losses and change in energy stored
13. Armature winding and Field winding



16. $s = \frac{N_s - N}{N_s}$, where N_s is the synchronous speed and N is the rotor speed

17. (c) 1500 rpm
18. True
19. (a) Single phase induction motors



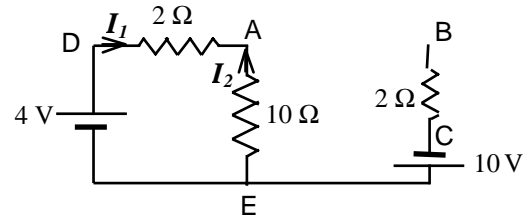
21. (a) $v(t) = L \frac{di(t)}{dt}$ or $v = L \frac{di}{dt}$ (b) $v(t) = \frac{1}{C} \int i(t) \cdot dt$ or $v = \frac{1}{C} \int i \cdot dt$
22. (a) $\frac{1}{2} L \cdot i^2$ (b) $\frac{1}{2} C \cdot v^2$
23. $I_3 = I_1 + I_2$ (or $I_1 + I_2 - I_3 = 0$)
24. $4 + 10 = 2 I_1 + (3 + 2) \cdot I_3$ (or $14 = 2 I_1 + 5 I_3$)
25. with only 4 V supply (10 V supply short-circuited), $I_1 = 0.75 \text{ A}$, so that $I_3 = I_1 \cdot \frac{10}{15} = 0.5 \text{ A}$
with only 10 V supply (4 V supply short-circuited), $I_3 = 1.5 \text{ A}$
 $\therefore I_3 = (0.5 + 1.5) \text{ A} = 2 \text{ A}$
26. $V_{AB} = \frac{3}{5} \times 10 = 6 \text{ V}$

27. With AB open, $I_1 = 4/(2+10) = 1/3$ A

$\therefore V_{AE} = 10 \times 1/3 = 10/3$ V

$\therefore V_{AB} = 10/3 + 10 = 13.33$ V

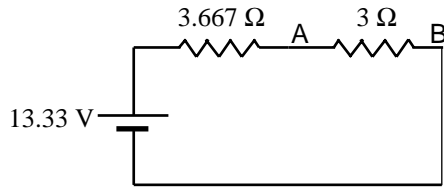
i.e. Thevenin's voltage source across AB = 13.33 V



28. With the voltage sources short-circuited,

Thevenin's impedance across AB = $2\Omega // 10\Omega + 2\Omega = \frac{2 \times 10}{2 + 10} + 2 = 3.667 \Omega$

29.



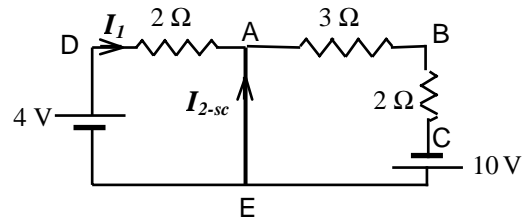
30. I_{2-sc} is supplied from the two sources

$I_{2-sc} = -4/2 + 10/(3+2) = -2 + 2 = 0$ A.

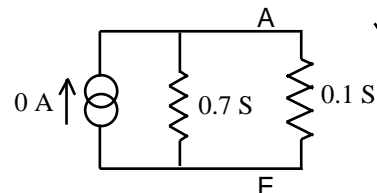
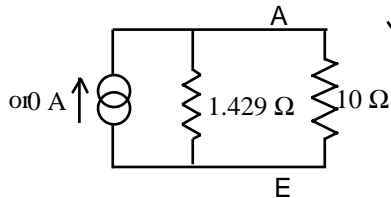
\therefore Norton's current source across AE = 0 V

31. Norton's impedance across AE corresponds to

$2 // (3+2) \Omega = \frac{2 \times 5}{2 + 5} = 10/7 = 1.429 \Omega$ or admittance = $7/10 = 0.7$ S

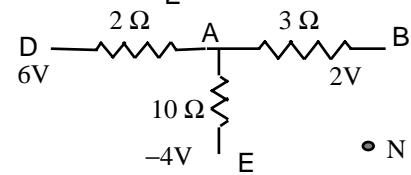


32.

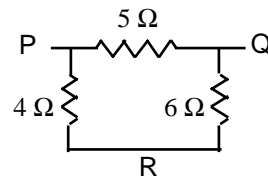


33. Using Millmann's theorem

$V_{AN} = \frac{\frac{1}{2} * 6 + \frac{1}{10} * (-4) + \frac{1}{3} * 2}{\frac{1}{2} + \frac{1}{10} + \frac{1}{3}} = \frac{90 - 12 + 20}{15 + 3 + 10} = \frac{98}{28} = 3.5$ V



34. $Y_{DB} = \frac{\frac{1}{2} * \frac{1}{3}}{\frac{1}{2} + \frac{1}{10} + \frac{1}{3}} = \frac{5}{15 + 3 + 10} = \frac{5}{28}$, $\therefore R_{DB} = \frac{28}{5} = 5.6 \Omega$



35. $Z_{PS} = \frac{5 \times 4}{5 + 4 + 6} = \frac{20}{15} = 1.33 \Omega$

36. Maximum power to load = 100 W

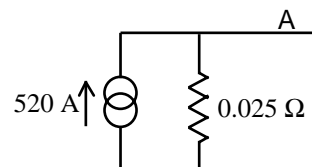
Load voltage = 25 V = E/2 for maximum power transfer. Also, $P_{max} = E^2/4R$

\therefore supply voltage E = $25 \times 2 = 50$ V, Internal resistance $R = E^2/4P_{max} = 50^2/400 = 6.25 \Omega$

37. E = 13 V, r = 0.025 Ω.

\therefore short circuit current = $13/0.025 = 520$ A

Therefore the Thevenin's equivalent circuit is



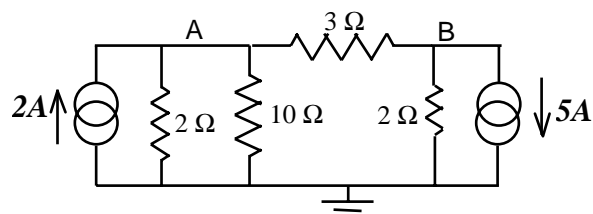
38. Maximum power that can be delivered = $E^2/4R = 13^2/(4 \times 0.025) = 1690$ W = 1.69 kW

Terminal voltage = $E/2 = 13/2 = 6.5$ V

39. at node A

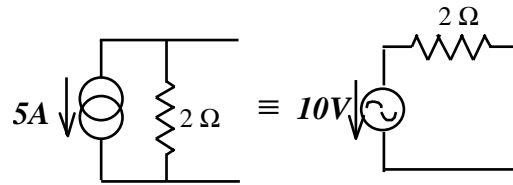
$2 = V_A/2 + V_A/10 + (V_A - V_B)/3$

$-5 = V_B/2 + (V_B - V_A)/3$



40. Thevenin's voltage source = $5 \times 2 = 10 \text{ V}$

Thevenin's impedance = 2Ω



41. Peak = 4 V

42. Since the waveform is made out of straight lines, the mean value of the waveform corresponds to the mean of the positive peak value and the negative peak value. [This can also be shown by either integration or considering the areas]

$$\text{mean value} = (4 + (-2))/2 = 1 \text{ V}$$

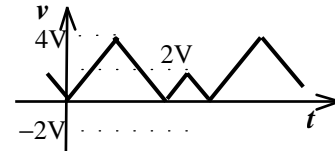
43. Average value of the waveform is obtained from rectification.

The values of times could be obtained from similar triangles as

$$\text{duration of positive half cycle} = T \times 4/(4+2) = 2T/3$$

$$\text{duration of negative half cycle} = T \times 2/(4+2) = T/3$$

$$\therefore \text{Average value} = (1/T) \times [0.5 \times 4 \times 2T/3 + 0.5 \times 2 \times T/3] = 5/3 = 1.667 \text{ V}$$



$$44. \frac{100 \times 10^{-6} \times 3.5 \times 8.854 \times 10^{-12}}{1 \times 10^{-3}} = 3.0989 \times 10^{-12} = 3.099 \text{ pF}$$

$$45. F = \frac{1 \times 5}{4\pi \times 8.854 \times 10^{-12} \times (150 \times 10^{-3})^2} = 1.997 \times 10^{12} \text{ N}$$

$$46. 10 \times 10 \times 10^6 = 10^8 \text{ N} = 100 \text{ MN}$$

$$47. 500 \times 10^{-6} / 10 \times 10^{-6} = 50 \text{ V}$$

$$48. (1/2) \times 10 \times 10^{-6} \times 100^2 = 0.05 \text{ J}$$

$$49. 200 \times 4 = 800 \text{ A}$$

$$50. H = \frac{200 \times 4}{100 \times 10^{-3}} = 8 \times 10^3 \text{ A/m}$$

$$51. B = \mu_0 \mu_r H, \quad 1.2 = 2000 \times 4\pi \times 10^{-7} H, \quad H = 1500/\pi = 477.5 \text{ A}$$

$$52. \phi = B A, \quad 15 \times 10^{-6} = B \times 25 \times 10^{-6}, \quad B = 0.6 \text{ T}$$

$$53. 1000/2 \times 10^{-3} = 0.5 \times 10^{-6} \text{ H}^{-1}$$

$$54. S = l/\mu A = \frac{0.5}{1200 \times 4\pi \times 10^{-7} \times 0.01} = 33157 = 33.16 \times 10^3 \text{ H}^{-1}$$

$$55. L = \frac{N^2 \mu A}{l} = \frac{N^2}{S} = \frac{200^2}{33.16 \times 10^3} = 1.206 \text{ H}$$

$$56. 100^2/10^6 = 10^{-2} \text{ H} = 10 \text{ mH}$$

$$57. \frac{0.9 \times 200 \times 100 \times 1200 \times 4\pi \times 10^{-7} \times 0.01}{0.5} = 0.543 \text{ H}$$

$$58. \frac{0.85 \times 100 \times 200}{10^6} = 0.017 \text{ H}$$

$$59. \frac{1}{2} \times 10 \times 10^{-3} \times 10^2 = 0.5 \text{ J}$$

$$60. \frac{1}{2} \times \frac{0.8^2}{4\pi \times 10^{-7}} \times 10^4 \times 10^{-6} = 2546 = 2.546 \text{ kJ}$$