Electrical and Electronic Measurements Test 1

Number of Questions: 35 **Section Marks: 90**

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. In a two wattmeter method used for measuring 3 phase power each wattmeter reads 200 kw ± 2 % and 160 kw ± 5%. The maximum percentage error in the measurement of total 3 ϕ power would be
(A) ± 3.33 % (B) ± 2 %
(C) ± 5 % (D) ± 7 %

2. Which among the following statements is false regarding sensitivity of a PMMC voltmeter
(A) Sensitivity is defined as the ratio of change in output response to the input response
(B) It is usually expressed in (Ω/v)
(C) Sensitivity is direct proportional to the current required for full scale deflection
(D) Lesser the current required for full scale deflection, higher the sensitivity

3. When the torque/weight ratio of the moving system of an instrument is low it means.
(A) Lesser accuracy owing to high frictional losses
(B) Higher accuracy owing to low frictional losses
(C) Torque / weight ratio does not effect accuracy
(D) High precision readings owing to high frictional losses

4. Moving iron instruments do not use eddy current damping because
(A) of weak operating magnetic field and permanent magnet required for eddy current damping would distort the operating field
(B) They are used in horizontal positions
(C) of large damping by eddy current damping
(D) They have a strong operating magnetic field.

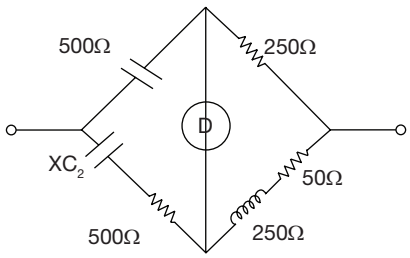
5. A 50 Hz bar primary *C.T* has a secondary with 1000 turns. The secondary supplies a current of 5 A into a purely resistive burden of 2Ω. The phase angle between primary and secondary, if the magnetizing ampere turns are 400 is
(A) 90° (B) 46°
(C) 85.4° (D) 4.6°

6. A PMMC instrument is designed with following specifications
(i) coil diameter = 2 cm
(ii) coil length = 3 cm
No of turns = 200
Air gap flux density (magnetic) = 0.4 Wb/m^2 when the above instrument was tested to produced a torque of 96 μNm, the current supplied to the coil must be
(A) 1 mA (B) 2 mA
(C) 1.5 mA (D) 2.75 mA

7. The input power to a 3 phase synchronous motor is measured by a two wattmeter method and the readings are 460 W and 150 W. The power factor at which the motor operates is
(A) 0.36 (B) 0.56
(C) 0.75 (D) 0.88

8. In an ammeter – voltmeter method of measurement of resistance (ammeter connected to the load side). If the internal resistances of ammeter and voltmeter are 0.02Ω and 4000Ω respectively and if the readings taken were 4 A and 360 V. The true reading of voltmeter is
(A) 359.92 V (B) 360 V
(C) 360.08 V (D) None of the above

9. The value of capacitive reactance is



(A) 50Ω (B) 100Ω
(C) 150Ω (D) 200Ω

10. The *x* deflection plates of a CRT are 40 mm long and 10 mm apart. The screen is 50 cm away from the centre of the plates. For the CRO to have a deflection sensitivity of 0.33 mm the voltage to be applied to anode is
(A) 3000 V (B) 3003 V
(C) 3030 V (D) 3300 V

11. A rectangular wave when passes through a P.M.M. C reads R_1.
A sinusoidal ac [through a full wave rectifier] when passes through a P. M. M. C reads R_2. A square wave when passes through a moving iron instrument reads R_3
A sinusoidal ac when passes through a moving iron instrument reads R_4
If all input waveforms had equal peak values then the correct magnitudes of measurements arranged in the ascending order will be
(A) R_1, R_2, R_3, R_4 (B) $R_2, R_4, R_3 = R_1$
(C) R_4, R_3, R_2, R_1 (D) $R_4, R_3 = R_1, R_2$

12. In the process of measurement of low resistance using Kelvins Double bridge method more than one set of readings are taken, for one direction of current and with the direction of current reversed. Doing so

(A) Corrects variations in source voltage
(B) Eliminates the effect of thermo – electric emf
(C) Eliminates the effect of resistance of the leads
(D) Eliminates the effect of contact resistance

13. A potentiometer is a
(A) Deflecting type instrument
(B) Digital instrument
(C) Null type instrument
(D) Null type as well as deflecting type instrument

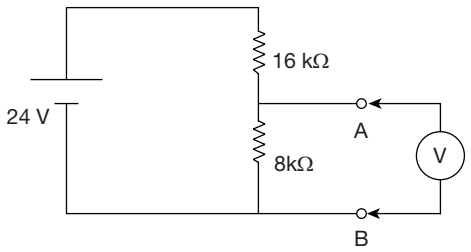
14. The largest readout that can be obtained in a $2\frac{1}{2}$ digit voltmeter is
(A) 999 (B) 499
(C) 199 (D) 099

15. The effect of an external field on an indicating instrument would be minimum when the external field and the operating field are
(A) Parallel (B) Inclined at 30°
(C) Inclined at 60° (D) perpendicular

16. A moving coil of meter with 150 turns and a length and width of 20 mm × 10 mm respectively. It is placed in a uniform radial flux density of 0.25 Wb/m^2. If this configuration of a deflecting system produces a torque of 338 μ Nm then the magnitude of current which is measured is
(A) 40 mA (B) 50 mA
(C) 45 mA (D) 55 mA

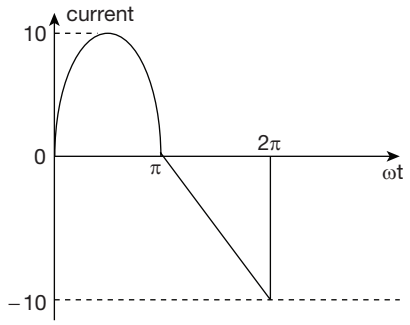
17. A peak to peak reading ac voltmeter and an rms reading ac voltmeter are used to determine whether the signals are sinusoidal or not and the following readings were obtained.
Signal 1→ Peak to peak reading: 10.81V
rms reading : 12V
Signal 2→ Peak to peak reading: 7.5V
rms reading : 8.33V
Signal 3→ Peak to peak reading: 22.62V
rms reading : 8V
Which of the above signals is sinusoidal in nature
(A) signal 3 only (B) signal 2 only
(C) signal 1 only (D) signal 1 & 2

18. The voltage across terminals *AB* of the network shown is measured using two different voltmeters, *X* with sensitivity of
10 KΩ/volts and *Y* with a sensitivity of 1KΩ/volt. Which of the following statement is true regarding the error in measurement.



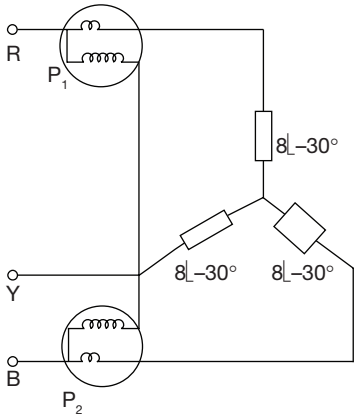
(A) Voltmeter *X* has 3.24% and *Y* has 40%
(B) Voltmeter *X* has 3.24% and *Y* has 50%
(C) Voltmeter *X* has 6.25% and *Y* has 40%
(D) Voltmeter *X* has 6.25% and *Y* has 60%

19. A current waveform shown in the figure is fed to a moving coil ammeter and moving iron ammeter. The ratio of readings of moving iron ammeter to moving coil ammeter respectively would be



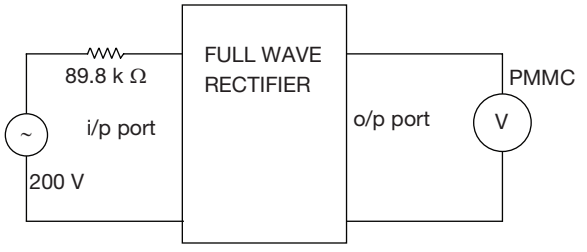
(A) 0.68 A (B) 1 A
(C) 13.84 A (D) 20 A

20. A star connected, 3ϕ balanced load is connected to a 230*V* (*L* –*L*) r.m.s, 50 Hz, ac supply as shown below



If the phase sequence was *RYB* the readings of the wattmeters P_1 and P_2 would respectively be.
(A) 600 W, 300 W (B) 0 W, 900 W
(C) 300 W, 600 W (D) 250 W, 650 W

21. A 200V (rms) ac source with an internal resistance of 89.8KΩ is connected across the input terminals of a full wave rectifier. The output terminals to a P.M.M.C voltmeter as shown.



If the dc current required for full scale deflection of PMMC is 2mA (assuming that the diodes are ideal) a

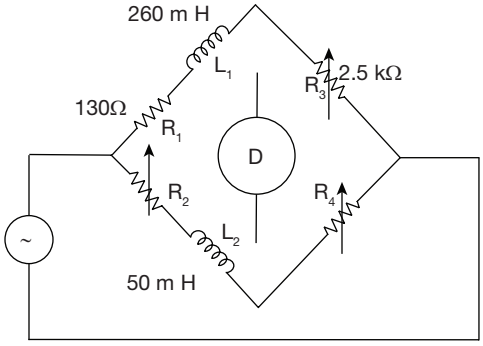
PMMC with what value of internal resistance has to be used to obtain a full scale deflection.

(A) 200Ω (B) 150Ω
(C) 100Ω (D) 50Ω

22. In a carey fosters bridge, the value of unknown resistance is determined by comparing it with a standard resistance of 2Ω. The slide wire employed is 2m long and has a resistance of 0.50Ω in 100 divisions. The ratio arms, if nominally are 25Ω each and if the balance was obtained at 50cm. The nominal value of resistance which is being measured is

(A) 2Ω (B) 2.25Ω
(C) 1.75Ω (D) 2.5Ω

23. The value of unknown inductance is measured by bridge shown below. If the bridge is at balance the variable resistances R_2 and R_4 are to be set at



(A) 0.48Ω, 62.4Ω (B) 0.48 kΩ, 62.4 kΩ
(C) 0.48Ω, 62.4 kΩ (D) 0.48 kΩ, 24.96Ω

24. A 380 V, 6 A single phase energy meter, at 0.8 pf half load, rated voltage makes 240 revolutions. The meter constant is 1800 rev/kwh. If the guaranteed percentage error in the reading of the instrument given by the manufacturer is (12% faster). Then the time taken by the meter to indicate the actual reading amounts to

(A) 7.6 mins (B) 10 mins
(C) 7.6 hours (D) 10 hours

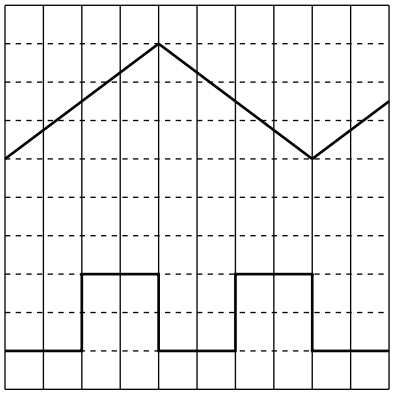
25. A current transformer operated at 50 Hz has a secondary with 250 turns. The secondary supplies a current of 5 A into a purely resistive burden of 2Ω. The magnetizing ampere turns is 400. If the phase angle between primary and secondary current had to be 18.33°, the number of primary turns to be employed is

(A) bar primary (B) 5 turns
(C) 10 turns (D) 20 turns

26. A sinusoidal signal being observed in a CRO has a frequency of 5 KHz. The number of cycles of input signal appeared on the screen for a sweep frequency of 2.5 KHz and 10 KHz will respectively be.

(A) 0.5, 2 (B) 4, 1
(C) 1, 4 (D) 2, 0.5

27.



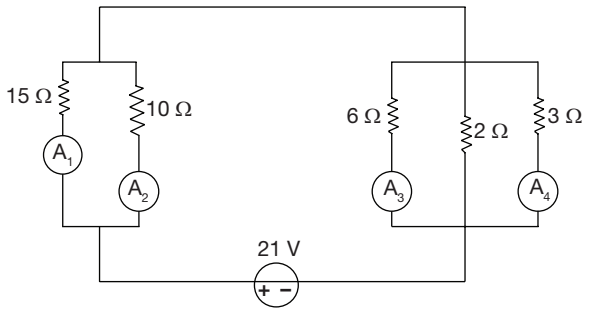
The time /div and volts/div axes of an oscilloscope have been erased. A student connects a 0.25 KHz, 15 V($p-p$) triangular wave calibration pulse to channel 1 of scope and observes the screen to be as shown in the upper trace of the figure. The unknown signal is connected to channel 2 and the waveform is as seen in the lower trace. The amplitude ($p-p$) and period of the unknown signal respectively are.

(A) 7.5 V, 2 S (B) 7.5 V, 4 S
(C) 7.5 V, 2 ms (D) 15 V, 4 ms

28. A slide wire potentiometer has 10 wires of 4 m each with the help of a standard voltage source of 2.468 V and the resistance of the potentiometer wire is 200Ω. If the potentiometer is standardized when the working current is 20 mA. The length where the jockey should be placed to standardize the potentiometer is

(A) 246.8 m (B) 246.8 cm
(C) 2.468 cm (D) 24.68 m

29. Which among the following ammeters (P.M.M.C) would measure 1A.



(A) A_1 (B) A_2
(C) A_3 (D) A_4

30. A passive, non linear resistor R whose characteristics are given by $V_R = I^2 R$ is connected across a 6 V dc supply with an internal resistance of 5Ω. The power dissipated in the non linear resistor is

(A) 0.5 W (B) 1 W
(C) 1.5 W (D) 2 W

31. An input voltage of 2V and a reference voltage of 4 V at a supply frequency of 50 Hz are used for a dual

slope integrating type DVM. If the total conversion time is of 0.4 S then the first integration is carried out for

(A) 10 periods (B) 20 periods
(C) 30 periods (D) 40 periods

Common Data Questions 32 and 33:

The primary winding exciting current of a *C.T* with bar primary has a nominal ratio of 500:1, operating on an external burden of 3.2Ω (non inductive) the secondary voltage reversed there being 500 secondary turns. With 2 A flowing in the secondary winding, and angle between no load current and secondary emf is and 40.6° and no load current is 3.8A.

32. The actual transformation ratio of primary winding current to secondary winding current is

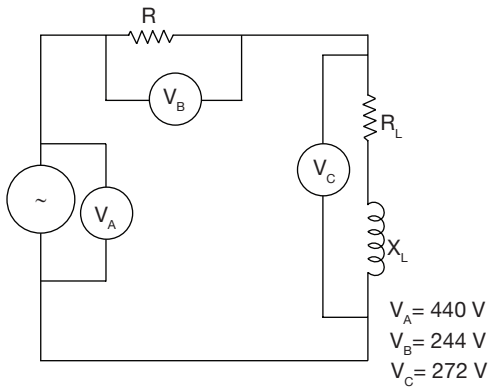
(A) 500 (B) 501.44
(C) 498.56 (D) 505.55

33. The phase angle between the primary winding current and secondary winding current is

(A) 0.708° (B) 1.108°
(C) 0.142° (D) 1.42°

Linked Answer Questions 34 and 35:

The voltmeter readings across the elements of a network are as shown



34. The power factor of the load is

(A) 0.85 (B) 0.65
(C) 0.45 (D) 1

35. The approximate power consumption in the load if R_L = 10Ω would be

(A) 750 W (B) 1000 W
(C) 1.25 KW (D) 1.5 KW

Answers Keys

1. A	**2.** C	**3.** A	**4.** A	**5.** D	**6.** B	**7.** C	**8.** C	**9.** B	**10.** C
11. B	**12.** B	**13.** C	**14.** C	**15.** D	**16.** C	**17.** C	**18.** C	**19.** D	**20.** C
21. A	**22.** B	**23.** D	**24.** A	**25.** A	**26.** D	**27.** C	**28.** B	**29.** D	**30.** B
31. D	**32.** B	**33.** C	**34.** C	**35.** D					

Hints and Explanations

1. Total 3 ϕ power

$P = P_1 + P_2$

$$\% \text{ Error} = \frac{\%P_1}{P} \times P_1 + \frac{\%P_2}{P} \times P_2$$

$$= \frac{2}{360} \times 200 + \frac{5}{360} \times 160$$

= 3.33 % (or)

200 kw ± 2% error → 4 kw

160 kw ± 5% error → 8 kw

360 kw → ?? → Total error 12 kw

$$\frac{12}{360} \times 100 = 3.33\ \%.$$ Choice (A)

2. Choices (A), (B) & (D) are true

$$\text{sensitivity} = \left(\frac{1}{I_{f.s.d}}\right)$$

choice (C) is false. Choice (C)

3. Choice (A)

4. Choice (A)

5. For purely resistive burden δ = 0

cos δ = 1, sin δ = 0

$$\theta = \frac{180}{\pi}\left[\frac{I_m \cos\delta - I_e \sin\delta}{nI_s}\right] = \frac{180}{\pi}\left[\frac{I_m}{nI_s}\right]$$

$$I_m = \frac{400}{1} = 400,\ I_s = 5$$

$$n = \frac{1000}{1} = 1000$$

θ = 4.58°. Choice (D)

6. $T_d = NBI\,A$

where $A = \ell \times d$

$96 \times 10^{-6} = 200 \times 0.4 \times I \times 2 \times 10^{-2} \times 3 \times 10^{-2}$

I = 2 mA. Choice (B)

7. For 2 wattmeter method of measurement of power

$$\phi = \tan^{-1}\left(\frac{\sqrt{3}(P_1 - P_2)}{P_1 + P_2}\right)$$

$$= \tan^{-1}\left[\frac{\sqrt{3}(460 - 150)}{460 + 150}\right] = 41.35^\circ$$

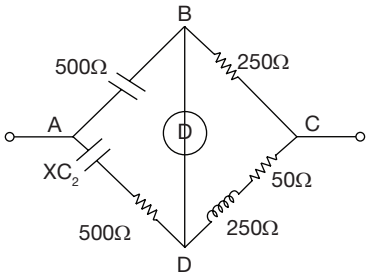
cos ϕ = 0.75. Choice (C)

8. Voltage reading indicated = voltage across the resistance (true value) + voltage dissipated across ammeter

$V = V_a + V_r$, $R = \dfrac{V}{I} = 90$

$= I R_a + I R = 4\,(0.02 + 90) = 360.08$ V. Choice (C)

9.



@condition of balance $Z_{AD}\,Z_{BC} = Z_{AB}\,Z_{CD}$

$Z_{AD} = \dfrac{Z_{AB} Z_{CD}}{Z_{BC}}$

$500 - j\,X\,C_2 = \dfrac{-j\,500 \times (50 + j\,250)}{250\,\Omega} = -j\,100 + 500$

$500 - j\,X\,C_2 = 500 - j\,100$

$XC_2 = 100\ \Omega$. Choice (B)

10. Deflection sensitivity $= \dfrac{L\ell_d}{2dV_a}$

$L \rightarrow$ Length from the centre of the plates to the screen

$\ell_d \rightarrow$ length of the deflecting plates

$d \rightarrow$ distance between two deflecting plates

$V_a \rightarrow$ anode voltage

$V_a = \dfrac{L\ell_d}{2ds} = \dfrac{50 \times 10^{-2} \times 40 \times 10^{-3}}{2 \times 10 \times 10^{-3} \times 0.33 \times 10^{-3}}$

$= 3030$ V. Choice (C)

11. If peak value $= V_p$

R_1 = average value $= V_p$ (for a rectangular wave)

R_2 = Average value $= \dfrac{2V_p}{\pi}$ [for a full wave rectified sine wave]

R_3 = r.m.s value $= V_p$ [for a square wave]

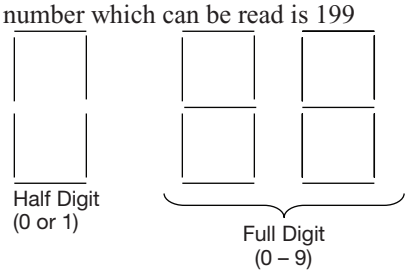
R_4 = r.m.s value $= \dfrac{V_p}{\sqrt{2}}$

$R_2 < R_4 < R_1 = R_3$. Choice (B)

12. Choice (B)

13. Choice (C)

14. Largest number which can be read is 199



Choice (C)

15. The effect of stray magnetic field would be minimum when both fields are perpendicular to each other. Choice (D)

16. $T_d = N\,B\,I\,A$

$I = \dfrac{T_d}{N\ B\ A}$

$= \dfrac{338 \times 10^{-6}}{150 \times 0.25 \times 20 \times 10^{-3} \times 10 \times 10^{-3}}$

$= 0.045$ (or) 45 mA. Choice (C)

17. For a sine wave form factor = 1.11

$F.F = \dfrac{\text{r.m.s value}}{\text{avg value}} = \dfrac{\text{r.m.s value}}{\left(\dfrac{2Vp}{\pi}\right)} = \dfrac{\text{Vr.m.s}}{\left(\dfrac{Vpp}{\pi}\right)}$

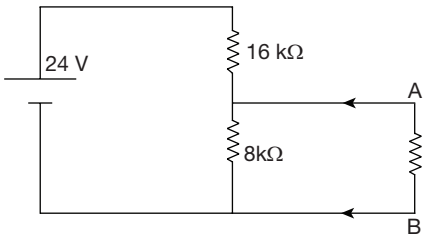
Signal 1 $F.F = \dfrac{12}{\left(\dfrac{10.81}{\pi}\right)} \neq 1.11$

Signal 2 $F.F = \dfrac{8.33}{\left(\dfrac{7.5}{\pi}\right)} \neq 1.11$

Signal 3 $F.F = \dfrac{8}{\left(\dfrac{22.62}{\pi}\right)} = 1.11$. Choice (C)

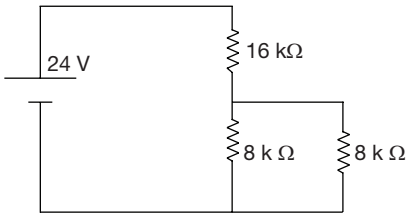
18. True $V_{AB} = 24 \times \dfrac{8}{8+16} = 8$ V

Resistance offered by $X = 10$ k Ω/v × 8 = 80 k Ω



$V_{AB} = 24 \times \dfrac{(80k\,//\,8k)}{(80k\,//\,8k) + 16k} = 7.5$ V

% Error $= \dfrac{8 - 7.5}{8} = 6.25$ %



Resistance offered by $y = 1$ k Ω/v × 8 = 8 k Ω

$V_{AB} = \dfrac{24 \times (8k\,//\,8k)}{(8k\,//\,8k) + 16} = 4.8$ v

$$\% \text{ Error} = \frac{8-4.8}{8} = 40\%.$$

Choice (C)

19. Moving coil measures average values

$$I_{avg} = \frac{1}{2\pi}\left[\int_0^{\pi} 10\sin\omega t\, d\,\omega t + \int_{\pi}^{2\pi}\left(\frac{-10\omega t}{\pi}+10\right)d\omega t\right]$$

$= 0.68$ A

$$I^2_{rms} = \frac{1}{2\pi}\left[\int_0^{\pi}(10\sin\omega t)^2\, d\omega t + \int_{\pi}^{2\pi}\left[\frac{-10\,\omega t}{\pi}+10\right]^2 d\omega t\right]$$

$I_{rms} = 13.84$

$$\frac{I_{rms}}{I_{avg}} = \frac{13.84}{0.68} = 20.35 \text{ A}.$$

Choice (D)

20. ϕ from the diagram is $-30°$

For two wattmeter method

$$\phi = \tan^{-1}\left[\sqrt{3}\left(\frac{W_1-W_2}{W_1+W_2}\right)\right] = -30°$$

$$\frac{W_1-W_2}{W_1+W_2} = \frac{-\tan 30}{\sqrt{3}} = -0.33$$

$W_2 = 2W_1$

The only option which satisfies this is. Choice (C)

21. Full wave rectifies converts ac to dc values and the average values of a full wave rectified wave is given by $\frac{2V_m}{\pi}$

Where V_m is the peak value

$$V_{dc} = \frac{2V_m}{\pi} = \frac{2\times 200\sqrt{2}}{\pi} = 180 \text{ V}$$

$$\text{Total resistance}(R_T) = \frac{V_{dc}}{2\text{mA}} = \frac{180}{2\text{mA}} = 90 \text{ K}\Omega$$

$R_s = 89.8$ K Ω

$R_T = R_s + (R_i)$ PMMC

$(R_i)\text{PMMC} = R_T - R_s = 200\ \Omega$. Choice (A)

22. Let ℓ_1 be the distance of balance point on slide wire from the unknown resistance end (in cm) of slide wire. Let r be the resistance per cm length of slide wire

$$r = \frac{0.5}{200} = 2.5 \times 10^{-3}\ \Omega/\text{cm}$$

$p = Q = 25\ \Omega$, $S = 2\ \Omega$

under balance

$$\frac{P}{Q} = \frac{R+\ell_1 r}{S+(200-\ell_1)|r|}$$

$$\frac{25}{25} = \frac{R+50\times 2.5\times 10^{-3}}{2+(200-50)\times 2.5\times 10^{-3}}$$

$R + 0.125 = 2 + 0.375$

$R = 2.25\ \Omega$. Choice (B)

23. $(R_1 + j\,\omega\, L_1)\, R_4 = (R_2 + j\,\omega\, L_2)\, R_3$

Equating imaginary terms

$L_1 R_4 = L_2 R_3$

$$R_4 = \frac{50\times 10^{-3}\times 2.5\times 10^3}{260\times 10^{-3}} = 0.48 \text{ k}\Omega$$

Equating real part $R_1 R_4 = R_2 R_3$

$$R_2 = \frac{130\times 0.48\times 10^3}{2.5\times 10^3} = 24.96\ \Omega.$$

Choice (D)

24. Measured energy $= \frac{240 \text{ rev}}{1800 \text{ rev/kwh}} = 0.13$ kwh

$$\% \text{ Error} = \frac{\text{Measured value-Actual value}}{\text{Actual value}} \times 100$$

$= 12\ \%$ (Given)

$$\frac{M.V - A.V}{A.V} = 0.12$$

$$A.V = \frac{M.V}{[1+0.12]} = \frac{0.13}{1.12} = 0.116 \text{ kwh}$$

$$380 \times \left(\frac{6}{2}\right) \times 0.8 \times t = 0.116 \text{ kwh}$$

$t = 0.127$ hrs

$= 0.127 \times 60 = 7.6$ mins. Choice (A)

25. $\theta = \frac{180}{\pi}\left[\frac{I_m}{nI_s}\right] = 18.33$

$$n = \frac{180\times I_m}{\pi\times 18.33\times I_s} = \frac{180\times 400}{\pi\times 18.33\times 5} = 250$$

$\frac{n_2}{n_1} = 250 \Rightarrow n_1 = 1$ ($\because n_2 = 250$). Choice (A)

26. Duration of one cycle of input

$$T = \frac{1}{5k} = 0.2 \text{ ms}$$

When sweep frequency is 2.5 KHz

Duration of one cycle of sweep

$$T_s = \frac{1}{2.5k} = 0.4 \text{ ms}$$

$$\text{No of cycles appeared} = \frac{0.4 \text{ ms}}{0.2 \text{ ms}} = 2$$

When sweep frequency is = 10 KHz

Duration of one cycle of sweep

$$T_s = \frac{1}{10k} = 0.1 \text{ ms}$$

$$\text{No of cycles appeared} = \frac{0.1 \text{ ms}}{0.2 \text{ ms}} = 0.5.$$

Choice (D)

27. From calibration pulse

$$\frac{\text{Voltage}}{\text{Division}} = (\Delta V) = \frac{15}{4} = 3.75 \text{ V}$$

$$\frac{\text{Time}}{\text{Division}} = (\Delta T) = \frac{\left(\frac{1}{0.25\,\text{KHz}}\right)}{8} = \frac{4\,\text{ms}}{8} = 0.5\ \text{ms}$$

Amplitude of unknown signal $(P - P)$
$= \Delta V \times 2 = 3.75 \times 2 = 7.5$ V
Time period $= \Delta T \times 4 = 0.5 \times 4 = 2$ ms. Choice (C)

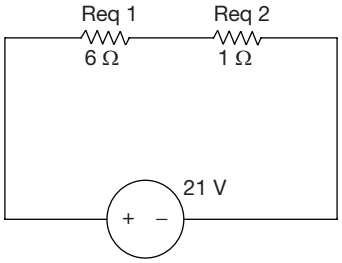
28. Total length of solid wire
$= 10 \times 4 = 40$ m $= 4000$ cm
Total resistance $= 2000\ \Omega$
Resistance/cm $= 2000/4000 = 0.5\ \Omega$/cm
Resistance corresponding to standardization

$$= \frac{2.468\,\text{V}}{20\,\text{mA}} = 123.4\ \Omega$$

Length at which jockey is placed

$$= \frac{123.4\,\Omega}{0.5\Omega/\text{cm}} = 246.8\ \text{cm}.$$ Choice (B)

29. Re drawing the figure after calculating R_{eq} of the parallel pair
$R_{eq}\ 1 = 15\ //\ 10 = 6\ \Omega$
$R_{eq}\ 2 = 6\ //\ 3\ //\ 2 = 1\ \Omega$



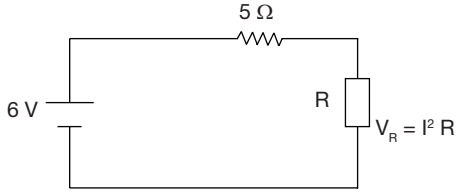
Voltage across $R_{eq}\ 1 = 21 \times \frac{6}{6+1} = 18$ V

Voltage across $R_{eq}\ 2 = 21 \times \frac{1}{6+1} = 3$ V

Current through $3\ \Omega = \frac{3V}{3} = 1$ A

A_4 measures (1A). Choice (D)

30.



Applying *K.V.L* to the loop $6 = 5I + I^2_R$
(since all are in series same current flows)
$I_R = 1$ satisfies above equation $V_R = I^2_R = 1$
Power $= V_R I_R = 1$ W. Choice (B)

31. In a dual slope integrating type *DVM* $\left(\frac{T_1}{T_2}\right) = \left(\frac{V_{ref}}{V_{in}}\right)$

Where T_1 is the first integration time

T_2 is the total conversion time

$$T_1 = \left[\frac{4}{2}\right] \times 0.4 = 0.8\ \text{secs}$$

$= 0.8$ sec $\times$ 50 cycles/sec
$= 40$ cycles (or) periods. Choice (D)

32. $R_{02} = 3.2$
$X_{02} = 0$
Since $X_{02} = 0 \cos\delta = 0 \Rightarrow \delta = 0$
α = angle between I_0 and ϕ
$= 90 -$ (angle between I_0 and $E_{s\,rev}$)
$\alpha = 90 - 40.6° = 49.4°$
$\cos\alpha = 0.65$ $\sin\alpha = 0.76$

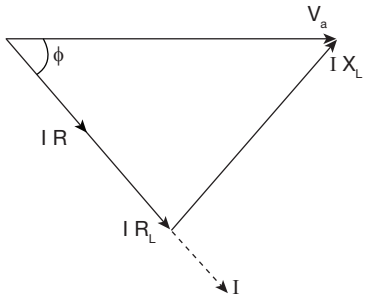
$$R = n + \frac{I_o}{I_s}\sin(\delta + \alpha)$$

$$= 500 + \frac{3.8}{2}\sin(0 + 49.4) = 501.44.$$ Choice (B)

33. $$\theta = \frac{180}{\pi}\left[\frac{I_o \cos(\delta + d)}{nI_s}\right]$$

$$= \frac{180}{\pi}\left[\frac{3.8 \times \cos(0 + 49.4)}{500 \times 2}\right] = 0.142°.$$ Choice (C)

34. Due to inductance the net current flowing through the circuit lags the applied voltage by an angle ϕ. The phasor diagram is as below



$I R_L = V_c \cos\phi$
$I X_L = V_c \sin\phi$
From the phasor diagram
$440^2 = (244 + 272\cos\phi)^2 + (272\sin\phi)^2$
$440^2 - 244^2 - 272^2 = 2 \times 244 \times 272 \cos\phi$

$$\cos\phi = \frac{60080}{2 \times 244 \times 272} = 0.45.$$ Choice (C)

35. Approximate power dissipated $= V_{RL} I_{RL} \cos\phi$
Considering R_L alone $\cos\phi = 1$
Power $= V_{RL} I_{RL}$

$$= V_c \cos\phi \times \frac{V_c \cos\varphi}{R}$$

$$= 272 \times 0.45 \times \frac{272 \times 0.45}{10\,\Omega}$$

$= 1498\ \text{W} \simeq 1.5$ kW. Choice (D)