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CONTENTS

ELECTRICAL ENGINEERING

Objective Practice Sets

Electrical & Electronic Measurements

1 CHAPTER

Introduction

MCQ and NAT Questions

Q.1 Consider the following statements regarding "precision" of an instrument:

1. Precision is a measure of the degree of agreement within a group of measurements.
2. Precision is necessary, but not sufficient condition for accuracy.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

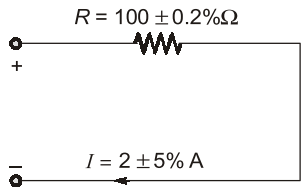
Q.2 A 0 to 200 V voltmeter has a guaranteed accuracy of 1% of full scale reading. The voltage measured by this instrument is 50 V. What is the limiting error?

(a) 4% (b) 2%
(c) 1% (d) 0.25%

Q.3 Two meters *X* and *Y* require 40 mA and 50 mA, respectively, to give full-scale deflection, then

(a) sensitivity can not be judged with given information.
(b) both are equally sensitive.
(c) *X* is more sensitive.
(d) *Y* is more sensitive.

Q.4 In the circuit given in the figure, the limiting error in the power dissipation 'I^2R' across the resistor *R* is



(a) 1.2% (b) 5.2%
(c) 10.2% (d) 25.2%

Q.5 The dead zone in a pyrometer is 0.125% of span. The instrument is calibrated from 500°C to 2000°C. What temperature range must occur before it can be detected in degree centigrade _____.

Q.6 A voltmeter reading 70 V on its 100 V range and an ammeter reading of 80 mA on its 150 mA range are used to determine power dissipation in a resistor. Both these instruments are guaranteed to be accurate within ±2% at full scale deflection. The limiting error (in percentage) in power measurement is _____ .
(Answer upto one decimal place)

Q.7 A first order instrument is characterized by

(a) Time constant only
(b) Static sensitivity and time constant
(c) Static sensitivity and damping coefficient
(d) Static sensitivity and time constant and natural frequency of oscillations

Q.8 A resistance of 108 Ω is specified using significant figures as indicated below:

1. 108 Ω
2. 108.0 Ω
3. 0.000108 MΩ

Among these:

(a) 1 represents greater precision than 2 and 3
(b) 2 represents greater precision but 1 and 3 represents same precision
(c) 2 and 3 represent greater precision than 1
(d) 1, 2 and 3 represent the same precision

Q.9 **Assertion (A):** Random errors can be minimized by statistical methods.
Reason (R): These are caused by arithmetic error while taking readings.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Q.10 The following is not essential for the working of an indicating instrument

Answers Introduction

1. (c)	2. (a)	3. (c)	4. (c)	5. (1.875)	6. (6.6)	7. (b)	8. (b)
9. (c)	10. (b)	11. (c)	12. (b)	13. (b)	14. (c)	15. (b)	16. (5)
17. (b)	18. (a)	19. (b)	20. (a)	21. (1)	22. (b)	23. (1.956)	24. (b)
25. (b)	26. (a)	27. (c)	28. (b)	29. (c)	30. (a,b)	31. (c,d)	

Explanations Introduction

1. (c)

- Precision is a measure of reproducibility of measurements i.e. for a fixed value of variable, it is the measure of the degree to which successive measurements differ from one another.
- Precision is not sufficient condition for accuracy since precision of an instrument does not guarantee of the accuracy of the instrument.
- Precision is not the guarantee of accuracy.

2. (a)

Given, full scale reading = 200 V

Magnitude of limiting error of instrument is

$$= \frac{1}{100} \times 200 = 2 \text{ V}$$

$$\therefore \text{Relative limiting error} = \frac{2}{50} \times 100 = 4\%$$

3. (c)

- Sensitivity α $\dfrac{1}{\text{Deflection factor}}$
- Static sensitivity = $\dfrac{1}{I_{FSD}}$

Here X have lower I_{FSD} and hence X is more sensitive meter.

4. (c)

$$P = I^2R$$

Limiting error is given as,

$$\frac{dP}{P}\% = 2\frac{dI}{I}\% + \frac{dR}{R}\%$$

$$= 2 \times 5\% + 0.2\% = 10.2\%$$

5. Sol.

$$\text{Span} = 2000\,^\circ\text{C} - 500\,^\circ\text{C}$$

$$= 1500\,^\circ\text{C}$$

$\therefore$ Temperature change

$$= \frac{0.125}{100} \times 1500$$

$$= 1.875\,^\circ\text{C}$$

6. Sol.

The magnitude of limiting error of the voltmeter = $0.02 \times 100 = 2$ V

Percentage limiting error at 70 V

$$= \frac{2}{70} \times 100 = 2.857\%$$

The magnitude of limiting error of the ammeter

$$= 0.02 \times 150 \text{ mA} = 3 \text{ mA}$$

Percentage limiting error at 80 mA

$$= \frac{3}{80} \times 100 = 3.75\%$$

$$P = VI$$

Percentage limiting error in power measurement

$$= 2.857\% + 3.75\%$$

$$= 6.607\% \approx 6.6\%$$

7. (b)

For first order instruments, transfer function is,

$$\text{T.F.} = \frac{K}{1+sT}$$

where, K = static sensitivity

T = time constant

8. (b)

1. 108 Ω has 3 significant figures.
2. 108.0 Ω has 4 significant figures.
3. 0.000108 MΩ can be written has 108 Ω.

So, it has 3 significant figures.

The more the significant figures, the greater the precision of measurement.

Hence, option (b) is correct.

2 CHAPTER

Measurement of Resistance

MCQ and NAT Questions

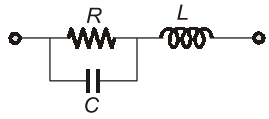
Q.1 As per classification of resistance, medium resistance falls in the category of
(a) 1 Ω to 10 kΩ (b) 1 kΩ to 10 kΩ
(c) 1 Ω to 0.1 MΩ (b) above 0.1 MΩ

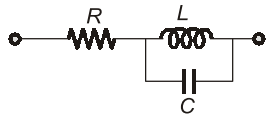
Q.2 For the measurement of medium resistance values which of the following is NOT used.
(a) Kelvin's Double bridge method
(b) Substitution method
(c) Wheatstone bridge
(d) Ohmmeter method

Q.3 Which one of the following is measured by the loss of charge method?
(a) Low *R* (b) Low *L*
(c) High *R* (d) High *L*

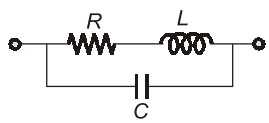
Q.4 A standard resistance is made 'Bifilar' type to eliminate
(a) Stray capacitance
(b) Inductive effect
(c) Skin effect
(d) Temperature effect

Q.5 The equivalent circuit of a wire-wound resistor can be represented as

(a) 

(b) 

(c) 

(d) 

Q.6 A resistance is measured by the voltmeter-ammeter method. The voltmeter reading is 50 V on 100 V scale and ammeter reading is 50 mA on 100 mA scale. If both the meters are guaranteed for accuracy within 2% of full scale, what is the limit within which resistance can be measured?
(a) 10 Ω (b) 20 Ω
(c) 40 Ω (d) 80 Ω

Q.7 **Statement (I) :** Ammeter and voltmeter method is used for measurement of low as well as medium resistances.
Statement (II) : Carey-Foster slide wire bridge is a modification of the Wheatstone bridge.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.8 An ammeter of resistance 0.05 Ω and a voltmeter of 500 Ω are employed for measurement of resistance. The value of resistance to be measured for which the two different circuit measurements give equal error is _____ Ω.

Q.9 Consider the following statements regarding megger:
1. It is working on principle of ratio meter.
2. Spring is used in megger to bring the pointer to the zero initial position.
3. Air friction damping is used.
Which of the above statement(s) are **not** correct?
(a) 1 and 3 only (b) 2 only
(c) 1 and 2 only (d) None of the above

Q.10 A length of cable is tested for insulation resistance by the loss of charge method. The cable capacitance is 600 pF. It is observed that the

(b) The deflection of the galvanometer is 58.4 mm.
(c) The sensitivity of the bridge is 11.68 mm/Ω.
(d) The sensitivity of the bridge is 5.84 mm/Ω.

Q.25 The various method(s) employed for measuring high resistance is/are:
(a) Megohm bridge method
(b) Meggar
(c) Ammeter voltmeter method
(d) Carrey Foster slide wire bridge method.

■■■■

Answers Measurement of Resistance

1. (c)	**2.** (a)	**3.** (c)	**4.** (b)	**5.** (d)	**6.** (d)	**7.** (b)	**8.** (5)	**9.** (d)
10. (100)	**11.** (d)	**12.** (d)	**13.** (a)	**14.** (10)	**15.** (b)	**16.** (a)	**17.** (d)	**18.** (a)
19. (c)	**20.** (b)	**21.** (20)	**22.** (19.7)	**23.** (a,c)	**24.** (b,c)	**25.** (a,b)		

Explanations Measurement of Resistance

1. (c)

Low resistance : below 1 Ω
Medium resistance : 1 Ω to 100 kΩ (or 0.1 MΩ)
High resistance : above 0.1 MΩ

2. (a)

Kelvin's double bridge method is used for very low resistance measurements i.e. ($R < 1\ \Omega$) while other methods for medium resistance measurements.

3. (c)

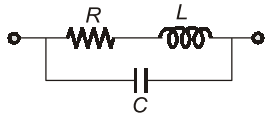
Loss of charge method is employed for the measurement of high resistance. In this method, the resistance R to be measured is connected in parallel with a capacitor C and an electrostatic voltmeter.

4. (b)

Resistance are 'Bifilar' type to reduce net magnetic field to zero and make self inductance of coil, thus reducing/eliminating inductive effect.

5. (d)

Equivalent circuit of wire wound resistance,



6. (d)

$$R = \frac{V_m}{I_m} = \frac{50}{50\times10^{-3}} = 10^3\ \Omega$$

$V = 50 \pm (2\%\ \text{of}\ 100\ \text{V})$
$I_m = 50 \times 10^{-3} \pm (2\%\ \text{of}\ 100\ \text{mA})$
$R_m = 10^3 \pm 4\% = 1000 \pm 40$
$= 960\ \Omega$ to $1040\ \Omega$
Hence, limit $= 1040 - 960 = 80\ \Omega$

7. (b)

- Ammeter and voltmeter can be employed for measurement of low as well as medium resistance but not measurement of high resistance because leakage current can't be neglected.
- Carry Foster bridge method is used for medium resistance measurement and is modification of Wheastone bridge.

Both are correct statements but not explanation.

8. Sol.

For the errors to be same in two different connections of ammeter-voltmeter method, we have

$$\left|\frac{R_a}{R_T}\right| = \left|\frac{R_T}{R_v}\right|$$

i.e., $R_T = \sqrt{R_a \cdot R_v}$

$= \sqrt{0.05\times500} = 5\ \Omega$

9. (d)

- Megger is an instrument used to measure the insulation resistance.
- It works on principle of ratiometer i.e. basically on comparison.
- Air friction damping is used.
- Spring is there which bring pointer to zero position.

Hence, all statements given are correct.