

POSTAL Book Package

2023

Electrical Engineering Objective Practice Sets

Electrical & Electronic Measurements

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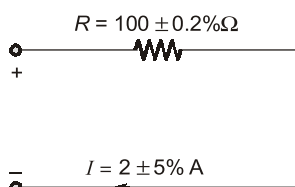
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Introduction

MCQ and NAT Questions

- Q.1** The difference between the indicated value and the true value of a quantity is
 (a) Gross error (b) Absolute error
 (c) Dynamic error (d) Relative error
- Q.2** 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.3** 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.4** 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.5** 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.6** Two resistors with nominal resistance values R_1 and R_2 have additive uncertainties ΔR_1 and ΔR_2 respectively. When these resistances are connected in parallel, the standard deviation of the error in the equivalent resistance R is

$$(a) \pm \sqrt{\left\{ \frac{\partial R}{\partial R_1} \Delta R_1 \right\}^2 + \left\{ \frac{\partial R}{\partial R_2} \Delta R_2 \right\}^2}$$

$$(b) \pm \sqrt{\left\{ \frac{\partial R}{\partial R_2} \Delta R_1 \right\}^2 + \left\{ \frac{\partial R}{\partial R_1} \Delta R_2 \right\}^2}$$

$$(c) \pm \sqrt{\left\{ \frac{\partial R}{\partial R_1} \right\}^2 \Delta R_2 + \left\{ \frac{\partial R}{\partial R_2} \right\}^2 \Delta R_1}$$

$$(d) \pm \sqrt{\left\{ \frac{\partial R}{\partial R_1} \right\}^2 \Delta R_1 + \left\{ \frac{\partial R}{\partial R_2} \right\}^2 \Delta R_2}$$

- Q.7** 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.8** 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 $\pm 2\%$ at full scale deflection. The limiting error (in percentage) in power measurement is _____.
 (Answer upto one decimal place)
- Q.9** 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.10** A resistance of 108 Ω is specified using significant figures as indicated below:

A voltage of 10 V is to be measured. To obtain minimum error in the reading, one should select the meter

- (a) M1 (b) M2
(c) M3 (d) M4

Q.32 Match **List-I** (Error parameters) with **List-II** (Values) and select the correct answer : (σ is the standard deviation of Gaussian error) :

List-I	List-II
A. Precision index	1. 0.67σ
B. Probable error	2. 3σ
C. Error limit	3. $0.39/\sigma$
D. Peak probability density of error	4. $0.71/\sigma$

Codes:

	A	B	C	D
(a)	4	2	1	3
(b)	4	1	2	3
(c)	3	1	2	4
(d)	3	2	1	4

Q.33 Certain observations are done using normal or Gaussian curve of errors. It was found that precision index is 3.5. Then the value of standard deviation and probable error are respectively.

- (a) 0.202, 0.14 (b) 0.14, 0.202
(c) 4.95, 3.33 (d) 3.33, 4.95

Q.34 Which one of the following statements is not correct?

- (a) Correctness in measurement requires both accuracy and precision.
(b) Reproducibility and consistency are expressions that best describe precision in measurements.
(c) It is not possible to have precise measurements which are not accurate.
(d) An instrument with 2% accuracy is better than another with 5% accuracy.

Q.35 Consider the following properties of any measurement system:

1. Fidelity 2. Reproducibility
3. Lag 4. Dead zone

Which of these are both dynamic and undesirable characteristics of a measurement system?

- (a) 1 and 3 both (b) 3 only
(c) 3 and 4 both (d) 2, 3 and 4

Q.36 A 4 dial decade box has

- Decade a of $10 \times 1000 \Omega \pm 0.2\%$
Decade b of $10 \times 100 \Omega \pm 0.1\%$
Decade c of $10 \times 10 \Omega \pm 0.5\%$
Decade d of $10 \times 1 \Omega \pm 2\%$

If the setting is at 8172Ω . Then range of resistance value is

- (a) (8165.5 to 8178.5) Ω
(b) (8159.5 to 8184.5) Ω
(c) (8155.5 to 8188.5) Ω
(d) None of these

Multiple Select Questions (MSQ)

Q.37 A set of independent voltage measurements were taken by five observers and were recorded as 15.5 V, 15.8 V, 16 V, 16.5 V, 15 V. Which of the following inferences is/are correct?

- (a) The arithmetic mean is 15.76 V.
(b) The average deviation is zero.
(c) The variance obtained is 0.559 V
(d) The variance obtained is $0.313 V^2$

Q.38 The total current, $I = I_1 + I_2$ in a circuit is measured as $I_1 = 125 \pm 2A$, $I_2 = 200 \pm 3A$.

- (a) If limits of error are given as standard deviations, I is measured as $325 \pm 3.61A$.
(b) If the errors in I_1 and I_2 are limiting errors, then I is measured as $325 \pm 5A$.
(c) If limits of error are given as standard deviations, I is measured as $325 \pm 2.24A$.
(d) If the errors in I_1 and I_2 are considered as limiting errors, then I is measured as $325 \pm \frac{1}{65} A$.

Q.39 The undesirable static characteristics of a measuring system is/are:

- (a) Accuracy (b) Sensitivity
(c) Dead zone (d) Hysteresis



Answers		Introduction					
1. (b)	2. (c)	3. (a)	4. (c)	5. (c)	6. (a)	7. (1.875)	8. (6.6)
9. (b)	10. (b)	11. (b)	12. (c)	13. (c)	14. (b)	15. (c)	16. (b)
17. (b)	18. (c)	19. (b)	20. (d)	21. (5)	22. (b)	23. (a)	24. (b)
25. (a)	26. (1)	27. (b)	28. (1.956)	29. (b)	30. (b)	31. (d)	32. (b)
33. (a)	34. (c)	35. (b)	36. (c)	37. (a,d)	38. (a,b)	39. (c,d)	

Explanations		Introduction					
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1. (b)

- Absolute error = Measured/Indicating value – True value
- Relative error = $\frac{\text{Measured value} - \text{True value}}{\text{True value}}$

$$\begin{aligned} \frac{dP}{P}\% &= 2\frac{dI}{I}\% + \frac{dR}{R}\% \\ &= 2 \times 5\% + 0.2\% = 10.2\% \end{aligned}$$

2. (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.

$$\begin{aligned} \sigma_{\text{res}} &= \sqrt{\left(\frac{\partial R}{\partial R_1}\right)^2 \sigma_1^2 + \left(\frac{\partial R}{\partial R_2}\right)^2 \sigma_2^2} \\ &= \sqrt{\left(\frac{\partial R}{\partial R_1}\right)^2 \Delta R_1^2 + \left(\frac{\partial R}{\partial R_2}\right)^2 \Delta R_2^2} \end{aligned}$$

3. (a)

Given, full scale reading = 200 V
Magnitude of limiting error of instrument is

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

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

4. (c)

- Sensitivity $\propto \frac{1}{\text{Deflection factor}}$
- Static sensitivity = $\frac{1}{I_{\text{FSD}}}$

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

5. (c)

$$P = I^2 R$$

Limiting error is given as,

6. (a)**7. Sol.**

$$\begin{aligned} \text{Span} &= 2000^\circ\text{C} - 500^\circ\text{C} \\ &= 1500^\circ\text{C} \end{aligned}$$

\therefore Temperature change

$$\begin{aligned} &= \frac{0.125}{100} \times 1500 \\ &= 1.875^\circ\text{C} \end{aligned}$$

8. Sol.

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

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

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

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