POSTAL Book Package 2023

ESE

Electronics Engineering

Objective Practice Sets

Electronic Measurements & Instrumentation

Contents

MADE EASY Publications

1 CHAPTER

Introduction

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

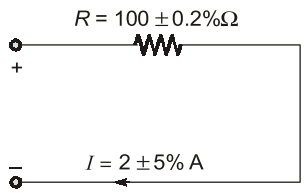
Q.2 Consider the following statements regarding "precision" of an instrument:
1. Precision is a measure of the degree of agreement within a group of measurements.
2. Precision is necessary, but not sufficient condition for accuracy.

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 ±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:

1. 108 Ω
2. 108.0 Ω
3. 0.00108 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.11 The total current $I = I_1 + I_2$ in a circuit is measured as I_1 = 150 ± 1 A, I_2 = 250 ± 2 A, where the limits of error are given as standard deviations. I is measured as

(a) (400 ± 3) A (b) (400 ± 2.24) A
(c) (400 ± 1/5) A (d) (400 ± 1) A

Q.12 Match **List-I** (Accuracy) with **List-II** (Type of the standard) and select the correct answer:

List-I	List-II
A. Least accurate	1. Primary
B. More accurate	2. Secondary
C. Much more accurate	3. Working
D. Highest possible accurate	4. International

Codes:

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

Q.13 **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.14 The following is not essential for the working of an indicating instrument

(a) deflecting torque (b) braking torque
(c) damping torque (d) controlling torques

Q.15 **Assertion (A):** Damping torque is used to bring the pointer to the zero initial position if there is not deflecting torque.

Reason (R): Eddy current damping is preferred for the applications requiring high magnetic field.

(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.16 Which one of the following is the definition of the dead zone of an instrument?

(a) The time required by an instrument to warm up initially.
(b) The largest change of input quantity for which there is no output of the instrument.
(c) The time required by the instrument to begin to respond to a change in the measurement.
(d) The unmeasured quantity which exceeds the maximum range of the instrument.

Q.17 Five observers have taken a set of independent voltage measurements and recorded as 110.10 V, 110.20 V, 110.15 V, 110.30 V and 110.25 V. Under the situation mentioned above, the range of error is

(a) ±0.3 V (b) ±0.1 V
(c) ±0.2 V (d) ±1.0 V

Q.18 During measurement in a college laboratory, nine different set of readings were observed. The standard deviation and variance can be calculated respectively using:

(a) $\sqrt{\frac{\Sigma d^2}{9}}, \frac{\Sigma d^2}{9}$ (b) $\sqrt{\frac{\Sigma d^2}{8}}, \frac{\Sigma d^2}{9}$

(c) $\sqrt{\frac{\Sigma d^2}{8}}, \frac{\Sigma d^2}{8}$ (d) $\sqrt{\frac{\Sigma d^2}{9}}, \frac{\Sigma |d|}{9}$

Q.19 Consider the following:

1. Human errors
2. Improper application of instruments
3. Error due to worn parts of an instrument
4. Errors due to effects of environment

Which of the above come under the type of systematic errors?

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

Q.20 Four ammeters M1, M2, M3 and M4 with following specifications are available (Full scale accuracy values as a percent of full scale). M_1 = 20 ± 0.1,

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)

Explanations Introduction

1. (b)

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

2. (c)

- Precision is a measure of reproductibility 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.

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

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

5. (c)

$$P = I^2R$$

Limiting error is given as,

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

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

6. (a)

$$\sigma_{res} = \sqrt{\left(\frac{\partial R}{\partial R_1}\right)^2 \sigma_1^2 + \left(\frac{\partial R}{\partial R_2}\right)^2 \sigma_2^2}$$

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

7. Sol.

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

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

$\therefore$ Temperature change

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

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

8. Sol.

The magnitude of limiting error of the voltmeter = 0.02 × 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

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

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

9. (b)

For first order instruments, transfer function is,

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

where, K = static sensitivity

T = time constant