POSTAL Book Package 2021

Instrumentation Engineering

Objective Practice Sets

Measurements

Contents

MADE EASY Publications

2 CHAPTER
Galvanometers, Voltmeters and Ammeters

Q.1 Match **List-I (Instrument)** with **List-II (Property/ use)** and select the correct answer using the codes. Given below the lists :

List-I

A. PMMC
B. Moving Iron
C. Thermocouple
D. Electrostatic type

List-II

1. Square law type scale
2. Very good high frequency response
3. Linear scale over the entire range
4. Voltmeter

Codes:

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

Q.2 The voltage of a circuit in measured by a voltmeter having a finite resistance which is half of the output resistance of the circuit. The voltmeter will measure

(a) higher value of voltage
(b) lower value of voltage
(c) exact value of voltage
(d) it will measure zero

Q.3 An ac voltmeter has a range of 0-600 mV and its accuracy is 0.5% of the f.s.d. (full scale deflection). If the input voltage to the instrument is 200 mV, the output of the instrument would be

(a) 201 mV
(b) 199 mV
(c) Between 199 and 201 mV
(d) Between 197 and 203 mV

Q.4 The deflection angle of the pointer of an ideal moving iron ammeter is 25° for 2 A dc current. If a current of 2 sin(314)t A is passed through the ammeter then the deflection angle is _____ degree.

Q.5 Which one of the following measuring instruments would consume the LOWEST power from the source during measurement?

(a) Permanent magnet moving coil
(b) Electronic multimeter
(c) Electrostatic instrument
(d) Moving iron instrument

Q.6 In a moving-iron meter, the deflecting torque is proportional to

(a) square of the current through the coil
(b) current through the coil
(c) sine of the current through the coil
(d) square-root of the current through the coil

Q.7 Which of the following statements is true?

(a) Deflection type instruments are more sensitive as compared with null type of instruments.
(b) Deflection type instruments are less sensitive as compared to the null type of instruments.
(c) Null type of instruments are more suited for measurement in dynamic conditions as compared with the deflection type of instruments.
(d) All of the above.

Q.8 A voltmeter of 0-1 volt range is desired to measure 0-100 volt. The value of series resistance R_s required, if the sensitivity of the voltmeter is 1kΩ/V is _____ kΩ.

Q.9 If a current of $3\sin(\pi t)$ amperes is passed through a moving iron ammeter, the ammeter deflection angle is 135°. The applied dc current if the deflection of the pointer is 30° is _____ A dc.

Q.10 A moving iron voltmeter is connected across the voltage source whose instantaneous value is $v(t) = 5 + 10\cos(314\,t + 30°)$. The reading of the meter is

(a) 15 V (b) 5 V

(c) $\sqrt{125}$ V (d) $\sqrt{75}$ V

Q.11 The inductance of MI type of instrument is given by

$L = 10 - 5\theta - 2\theta^2$ μH

Where, θ is deflection in radians. The spring constant for the instrument, k is 24×10^{-6} Nm/rad. The magnitude of deflection for an input current of 5 amperes is _____ rad.

Q.12 The current in a circuit consist of a dc component of 10 A superimposed on a 50 Hz. Sinusoidal component of rms value of 10 A. The reading shown by a PMMC ammeter will be

(a) $10\sqrt{2}$ A (b) 0 A

(c) 10 A (d) $\left(10 + \frac{10}{\pi}\right)$ A

Q.13 An ammeter of range 0 to 1 A is used to measure current in the range of 0 to 100 A. If internal resistance of the ammeter is 1000 Ω. The value of shunt resistance required is _____ Ω

Q.14 The deflection angle of the pointer of an ideal moving iron ammeter is 30° for 1.5 ampere dc current. If a current of 2 sin(314t) amperes is passed through the ammeter then the deflection angle is _____ degree.

Q.15 The sensitivity of a PMMC instrument is 10 kΩ/V. If this instrument is used in a rectifier type voltmeter with half waves rectification. What would be the sensitivity ?

(a) 10 kΩ/V (b) 9 kΩ/V

(c) 4.5 kΩ/V (d) 22.2 kΩ/V

Q.16 A voltmeter of 0 - 1 volt range is desired to measure 0 - 20 volt. The value of resistance required to be connected with the voltmeter if the sensitivity of the voltmeter is 1.5 kΩ/V, is

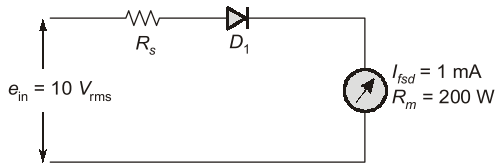
(a) 28.5 kΩ in parallel

(b) 28.5 kΩ in series

(c) 12.5 kΩ in parallel

(d) 12.5 kΩ in series

Q.17 Calculate the value of the multiplier resistor for a 10 V_{rms} range on the voltmeter as shown in the figure given below. Assuming forward resistance of the diode is zero and the reverse resistance is infinite.



(a) 2.3 kΩ (b) 3.3 kΩ

(c) 4.3 kΩ (d) 5.3 kΩ

Q.18 A 10 V Full-scale voltmeter having 100 kΩ/V sensitivity is used to measure the output of a photovoltaic cell having an internal resistance of 1 MΩ. The voltmeter reads 5 V. The voltage generated by the photovoltaic cell is.

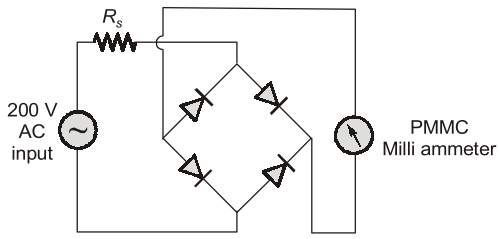
(a) 5 V

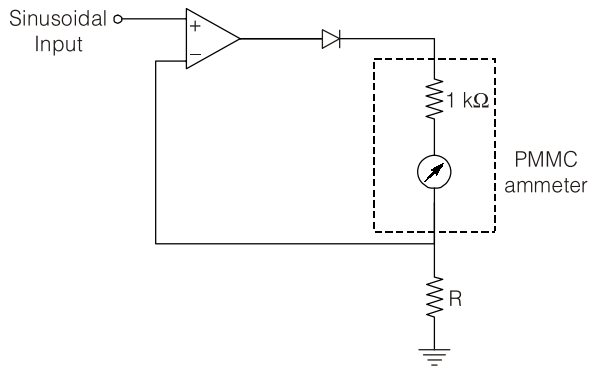
(b) 10 V

(c) Greater than 5 V but less than 10 V

(d) Greater than 10 V

Q.19 A rectifier type ac voltmeter consists of a series resistance R_s, an ideal full-wave rectifier bridge and a PMMC instrument as shown in the figure. The internal resistance of the instrument is 200 Ω and a full scale deflection is produced by a dc current of 1 mA. The value of R_s required to obtain full scale deflection with an ac voltage of 200 V (rms) applied to the input terminal, is





Q.41 An ac voltmeter using full-wave rectification and having a sinusoidal input has an ac sensitivity equal to

(a) 1.414 times dc sensitivity
(b) dc sensitivity
(c) 0.90 times dc sensitivity
(d) 0.707 times dc sensitivity

Q.42 Match **List-I (Parameter to be measured)** with **List-II (Instrument to be used)** and select the correct answer using the code given below the lists:

List-I

A. Average value of current
B. RMS value of current
C. Frequency of a wave
D. Strain gauge resistance

List-II

1. Self-balancing bridge
2. Wien bridge
3. PMMC ammeter
4. Moving-iron ammeter

Codes:

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

Q.43 What is the series resistance required to extend the 0-100 V range of a 20000 Ω/V meter to 0-1000 V?

(a) 10 MΩ (b) 16 MΩ
(c) 18 MΩ (d) 20 MΩ

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Answers Galvanometers, Voltmeters and Ammeters

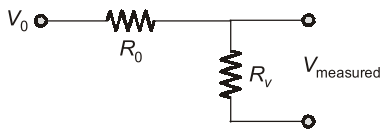
1. (d)	2. (b)	3. (d)	5. (d)	6. (a)	7. (b)	10. (d)	12. (c)	15. (c)
16. (b)	17. (c)	18. (b)	19. (a)	20. (a)	21. (a)	22. (b)	23. (b)	24. (b)
25. (c)	26. (d)	27. (c)	28. (a)	29. (b)	30. (b)	31. (d)	32. (d)	34. (c)
36. (d)	38. (c)	39. (a)	41. (c)	42. (a)	43. (c)			

Explanations Galvanometers, Voltmeters and Ammeters

1. (d)

PMMC → linear scale
Moving iron → square law scale
Thermocouple → good high frequency response
Electrostatic → voltmeter

2. (b)



$$V_{measured} = \frac{R_v}{R_v + R_0} \cdot V_0$$

since $(R_v + R_0)$ is more compared to R_v

$\therefore V_{measured}$ is lower then V_0

3. (d)

$$\text{Deviation} = 600 \times \frac{0.5}{100} = 3$$

Thus, for an input of 200 mV, the output of the instrument will lie in the range 200 ± 3 = between 197 and 203 mV.

36. (d)

Moving-iron meter and thermocouple meter have square-law response so do not have linear scale.

37. (0.002)

$$I_m = 10 \text{ mA}$$

$$R_m = \frac{100}{10} = 10\ \Omega$$

$$\text{Shunt multiplying factor} = \frac{50}{10 \times 10^{-3}} = 5000$$

$$\text{Shunt resistance} = \frac{10}{5000 - 1} = 0.002\ \Omega$$

38. (c)

Reading of ac ammeter = rms valve

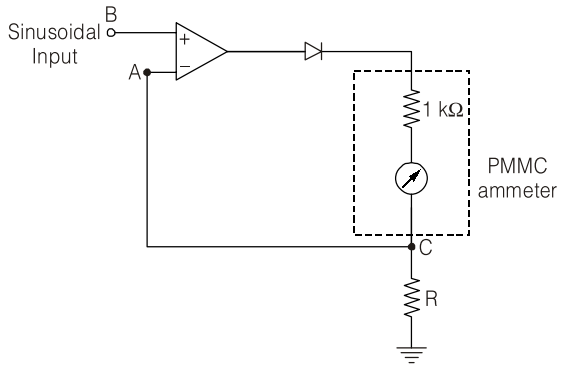
$$\text{rms valve} = I_{max}\sqrt{\alpha}$$

where, α = duty cycle

$$\alpha = \frac{1}{2}$$

$$\text{rms valve} = 100 \text{ mA}\sqrt{\frac{1}{2}} \cong 71 \text{ mA}$$

40. (22.5)



$$V_B = V_{avg} = \frac{200\sqrt{2}}{\pi} = 90 \text{ mV}$$

$$V_A = V_B$$

(By the concept of virtual ground)

$$\therefore \quad V_A = 90 \text{ mV}$$

Also, it can be observed that $V_C = V_B$ at point 'C'

$$V_C = I_R$$

$$90 \times 10^{-3} = 4 \times 10^{-3} \times R$$

$$R = \frac{90}{4} = 22.5\ \Omega$$

41. (c)

For full-wave rectifier type of instruments,

$$V_{avg} = 0.9 \text{ V where } V = V_m / \sqrt{2}$$

43. (c)

Initial resistance = 20000 × 100 = 2 MΩ

Final resistance = 20000 × 1000 = 20 MΩ

∴ Series resistance = 20 – 2 = 18 MΩ

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