

EXERCISE - O

SINGLE CORRECT TYPE QUESTIONS

Significant Digits

1. Round off the following number within three significant figures $-4.735 \times 10^{-6} \text{ kg}$
 (A) $4.74 \times 10^{-6} \text{ kg}$ (B) $5.00 \times 10^{-6} \text{ kg}$ (C) $4.70 \times 10^{-6} \text{ kg}$ (D) $4.73 \times 10^{-6} \text{ kg}$

PER055

2. $4.338 + 4.835 \times 3.88 \div 3.0$ is equal to:
 (A) 10.6 (B) 10.59 (C) 10.5912 (D) 10.591267

PER057

3. The length, breadth and thickness of a block are given by $l = 12 \text{ cm}$, $b = 6 \text{ cm}$ and $t = 2.45 \text{ cm}$. The volume of the block according to the idea of significant figures should be
 (A) $1 \times 10^2 \text{ cm}^3$ (B) $2 \times 10^2 \text{ cm}^3$ (C) $1.763 \times 10^2 \text{ cm}^3$ (D) None of these

PER058

Vernier Callipers and Screw Gauge

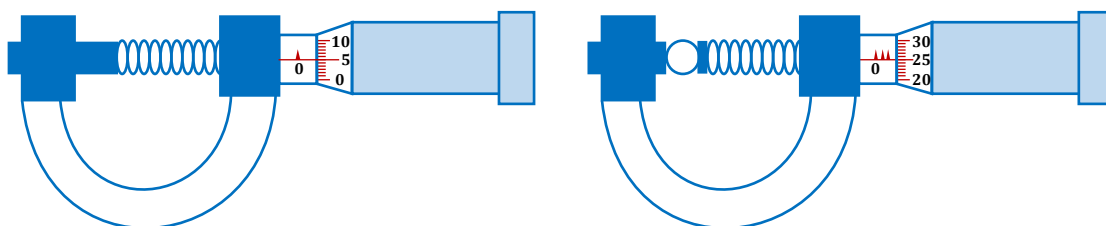
4. The vernier of a circular scale is divided into 30 divisions, which coincides with 29 main scale divisions. If each main scale division is $(1/2)^\circ$, the least count of the instrument is
 (A) $0.1'$ (B) $1'$ (C) $10'$ (D) $30'$

PER070

5. The pitch of a screw gauge is 0.5 mm and there are 100 divisions on its circular scale. The instrument reads $+2$ circular scale divisions when nothing is put in-between its jaws. In measuring the diameter of a wire, there are 8 divisions on the main scale and 83^{rd} circular scale division coincides with the reference line. Then the diameter of the wire is
 (A) 4.05 mm (B) 4.405 mm (C) 3.05 mm (D) 1.25 mm

PER072

6. The circular divisions of shown screw gauge are 50. It moves 0.5 mm on main scale in one rotation. The diameter of the ball is



- (A) 2.25 mm (B) 2.20 mm (C) 1.20 mm (D) 1.25 mm

PER074

7. The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge, whose pitch is 0.5 mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5 mm and that on the circular scale is 20 divisions. If the measured mass of the ball has a relative error of 2%, the relative percentage error in the density is
 (A) 0.9% (B) 2.4% (C) 3.1% (D) 4.2%

PER075

Error Analysis in Experiments

8. A body travels uniformly a distance of $(13.8 \pm 0.2) \text{ m}$ in a time $(4.0 \pm 0.3) \text{ s}$. The velocity of the body within error limits is
- (A) $(3.45 \pm 0.2) \text{ ms}^{-1}$ (B) $(3.45 \pm 0.3) \text{ ms}^{-1}$
 (C) $(3.45 \pm 0.4) \text{ ms}^{-1}$ (D) $(3.45 \pm 0.5) \text{ ms}^{-1}$

PER061

9. An experiment measures quantities x, y, z and then t is calculated from the data as $t = \frac{xy^2}{z^3}$. If percentage errors in x, y and z are respectively 1%, 3%, 2%, then percentage error in t is :
- (A) 10 % (B) 4 % (C) 7 % (D) 13 %

PER062

10. Two resistance are measured in ohm and is given as:-

$$R_1 = 3\Omega \pm 1\%$$

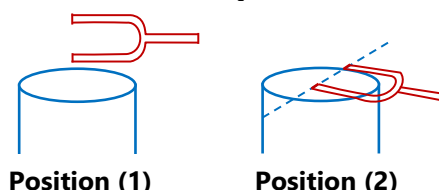
$$R_2 = 6\Omega \pm 2\%$$

When they are connected in parallel, the percentage error in equivalent resistance is

- (A) 3% (B) 4.5% (C) 0.67% (D) 1.33%

PER066

11. In a resonance-column experiment, the tuning fork is held above the open end of the glass tube. This can be done in two ways position (1) one prong below the other, and position (2) the two prongs at the same horizontal level. The correct position is –



- (A) (1) in all cases
 (B) (2) in all cases
 (C) (1) for first resonance and (2) for second resonance
 (D) (2) for first resonance and (1) for second resonance

PER077

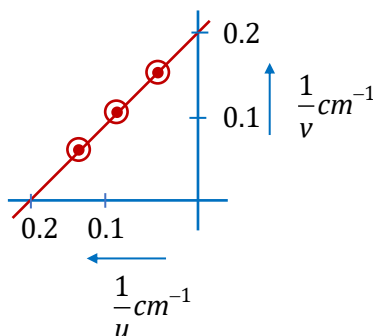
12. A student is performing the experiment of Resonance Column. The diameter of the column tube is 4 cm. The distance frequency of the tuning fork is 512 Hz. The air temperature is 38°C in which the speed of sound is 336 m/s. The zero of the meter scale coincides with the top end of the Resonance column. When first resonance occurs, the reading of the water level in the column is
- (A) 14.0 (B) 15.2 (C) 16.4 (D) 17.6

PER079

13. Following observation are taken from a travelling microscope to determine the refractive index of a liquid. Reading for the bottom of an empty beaker = 12.324 cm. Reading for the bottom of the beaker when partially filled with the liquid = 12.802 cm. Reading for the liquid surface = 13.895 cm. What is the refractive index of the liquid?
- (A) 1.232 (B) 1.389 (C) 1.437 (D) 1.208

PER081

14. An experiment with convex lens gives certain result which is represented by a student in the shown graph. What would be the power of the lens used.



- (A) 0.2D (B) 1D (C) 0.1D (D) 20D

PER082

15. In an optics experiment, with the position of the object fixed, a student varies the position of the convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and the image distance v , from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 45° with the x -axis meets the experimental curve at P . The coordinates of P will be:

- (A) $\left(\frac{f}{2}, \frac{f}{2}\right)$ (B) (f, f) (C) $(4f, 4f)$ (D) $(2f, 2f)$

PER083

16. In Searle's apparatus, when experimental wire is loaded and unloaded, the air bubble in spirit level gets shifted.

- (A) towards reference wire while loading and towards experimental wire while unloading
(B) towards experimental wire while loading and towards reference wire while unloading
(C) towards experimental wire, both the times, during loading and unloading
(D) towards reference wire, both the times during loading and unloading

PER087

17. A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.80 mm with an uncertainty of ± 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01 mm. Take $g = 9.8 \text{ m/s}^2$ (exact). The Young's modulus obtained from the reading is

- (A) $(2.0 \pm 0.3) \times 10^{11} \text{ N/m}^2$ (B) $(2.0 \pm 0.2) \times 10^{11} \text{ N/m}^2$
(C) $(2.0 \pm 0.1) \times 10^{11} \text{ N/m}^2$ (D) $(2.0 \pm 0.05) \times 10^{11} \text{ N/m}^2$

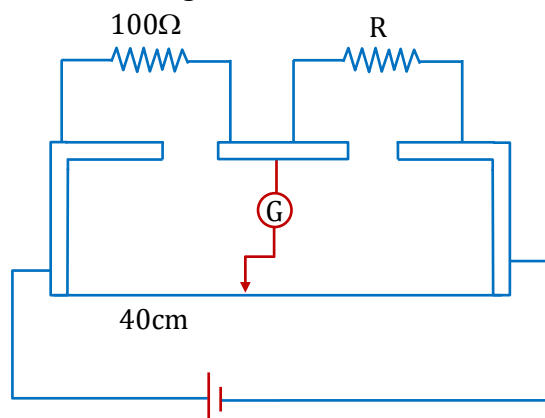
PER088

18. The period of oscillation of a simple pendulum is $T = 2\pi \sqrt{\frac{L}{g}}$. Measured value of L is 20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90s using a wrist watch of 1s resolution. The accuracy in the determination of g is :

- (A) 1% (B) 5% (C) 2% (D) 3%

PER092

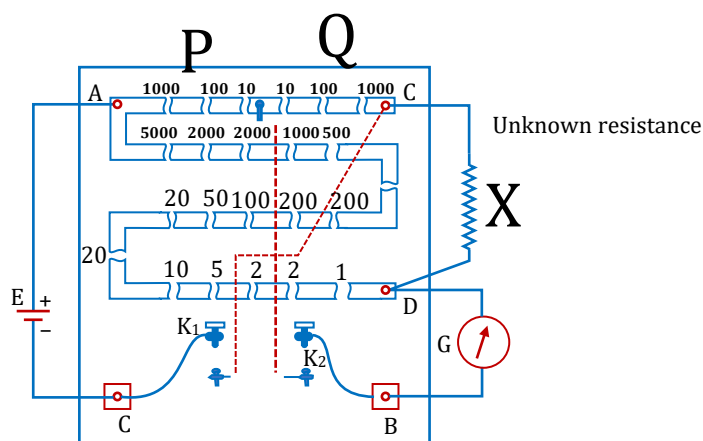
19. In a meter bridge circuit, the known resistance used in resistance box is $100\ \Omega$ (without any error, and the unknown resistor is put in right arm). The null point is found to be 40 cm from left end. If mm scale is used in the meter bridge then resistance of the unknown resistor is:



- (A) $150\ \Omega \pm \frac{3}{8}\ \Omega$ (B) $150\ \Omega \pm \frac{1}{8}\ \Omega$ (C) $150\ \Omega \pm \frac{5}{8}\ \Omega$ (D) $150\ \Omega \pm \frac{7}{16}\ \Omega$

PER094

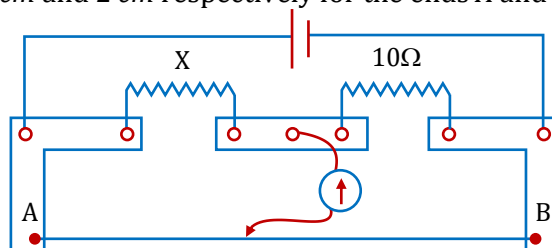
20. In the post office box circuit, $10\ \Omega$ plug is taken out in arm AB and $100\ \Omega$ plug is taken out in arm BC . If the unknown resistor is kept in melting ice chamber, $600\ \Omega$ resistance is required in arm AD for zero deflection in galvanometer. Now if the unknown resistor is kept at 100°C (steam chamber), $630\ \Omega$ resistance is required in arm AD for zero deflection. Temperature coefficient of resistance of the unknown wire is:



- (A) $2.5 \times 10^{-4}/^\circ\text{C}$ (B) $5 \times 10^{-4}/^\circ\text{C}$ (C) $7.5 \times 10^{-4}/^\circ\text{C}$ (D) $8 \times 10^{-4}/^\circ\text{C}$

PER095

21. A meter bridge is set-up as shown, to determine an unknown resistance 'X' using a standard 10-ohm resistor. The galvanometer shows null point when tapping-key is at 52 cm mark. The end-corrections are 1 cm and 2 cm respectively for the ends A and B . The determined value of x is



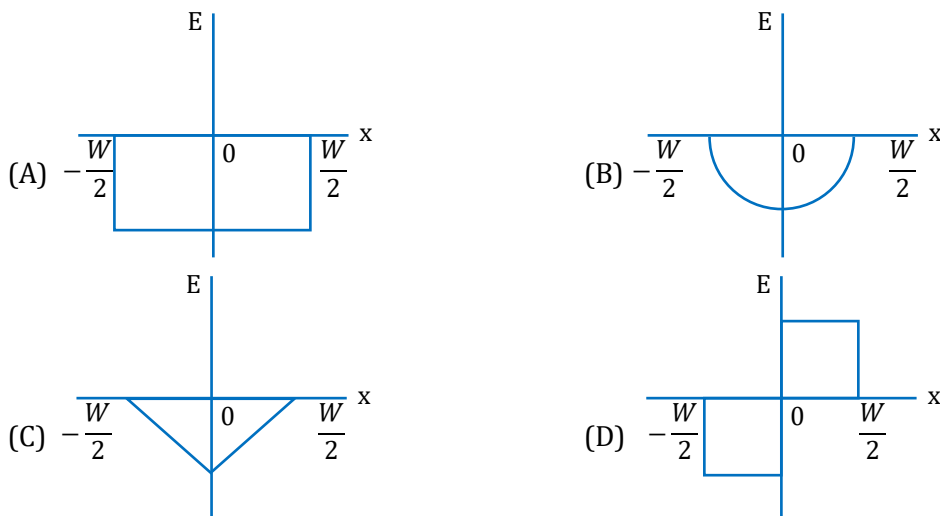
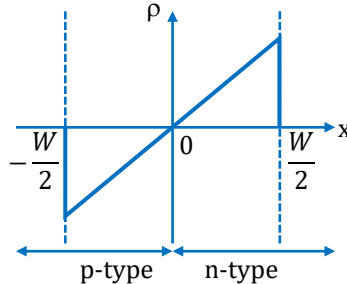
- (A) $10.2\ \Omega$ (B) $10.6\ \Omega$ (C) $10.8\ \Omega$ (D) $11.1\ \Omega$

PER096

Semiconductor

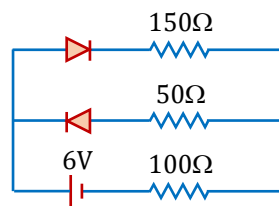
22. The manifestation of band structure in solids is due to -
(A) Bohr's correspondence principle. (B) Pauli's exclusion principle.
(C) Heisenberg's uncertainty principle. (D) Boltzmann's law.
PSC028
23. In a P - N junction diode not connected to any circuit -
(A) the potential in the same everywhere.
(B) the P -type side is at a higher potential than the N -type side.
(C) there is an electric field at the junction directed from the N -type side to the P -type side.
(D) there is an electric field at the junction directed from the P -type to the N -type side.
PSC030
24. If the ratio of the concentration of electrons to that of holes in a semiconductor is $\frac{7}{5}$ and the ratio of currents is $\frac{7}{4}$ then what is the ratio of their drift velocities -
(A) $\frac{5}{4}$ (B) $\frac{4}{7}$ (C) $\frac{5}{6}$ (D) $\frac{4}{5}$
PSC032
25. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an n -type semiconductor, the density of electrons is $10^{19} m^{-3}$ and their mobility is $1.6 m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n -type semiconductor contribution of holes is ignored) is close to:
(A) $2\Omega m$ (B) $0.4\Omega m$ (C) $4\Omega m$ (D) $0.2\Omega m$
PSC035
26. For extrinsic semiconductors; when doping level is increased;
(A) Fermi-level of p -type semiconductor will go upward, and Fermi-level of n -type semiconductors will go downward.
(B) Fermi-level of p -type semiconductors will go downward, and Fermi-level of n -type semiconductor will go upward.
(C) Fermi-level of both p -type and n -type semiconductors will go upward for $T > T_F$ K and downward for $T < T_F$ K, where T_F is Fermi temperature.
(D) Fermi-level of p and n -type semiconductors will not be affected.
PSC036
27. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an n -type semiconductor, the density of electrons is $10^{19} m^{-3}$ and their mobility is $1.6 m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n -type semiconductor contribution of holes is ignored) is close to :-
(A) $2\Omega m$ (B) $0.4\Omega m$ (C) $4\Omega m$ (D) $0.2\Omega m$
PSC095

28. A semiconductor pn junction at thermal equilibrium has the space charge density $\rho(x)$ profile as shown in the figure. The figure that best depicts the variation of the electric field E with x is :- (W denotes the width of the depletion layer)



PSC096

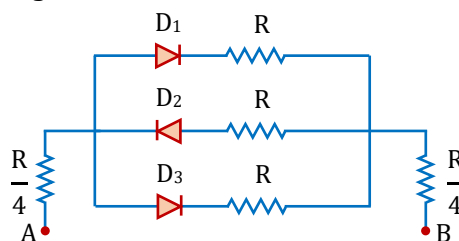
29. In the below given arrangement determine the ammeter reading, if each diodes have a forward resistance of 50Ω and infinite backward resistance -



- (A) zero (B) 0.02 (C) 0.03 (D) 0.036

PSC040

30. In the following circuits PN -junction diodes D_1 , D_2 and D_3 are ideal for the following potential of A and B , the correct increasing order of resistance between A and B will be -



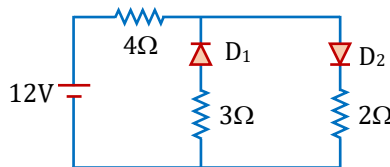
- (i) $-10V, -5V$ (ii) $-5V, -10V$ (iii) $-4V, -12V$
 (A) (i) < (ii) < (iii) (B) (iii) < (ii) < (i) (C) (ii) = (iii) < (i) (D) (i) = (iii) < (ii)

PSC042

31. Most important use of Zener diode is to have –
 (A) constant voltage across applied load.
 (B) any desired current at constant voltage.
 (C) a $p-n$ junction working under constant regulated voltage conditions.
 (D) a $p-n$ junction to operate at high voltages.

PSC044

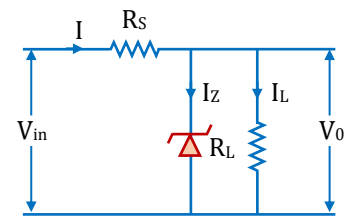
32. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit ?



- (A) 2.31 A (B) 1.33 A (C) 1.71 A (D) 2.00 A

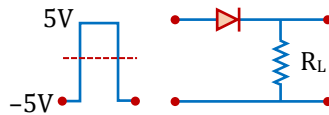
PSC047

33. In given figure when input voltage increases,
 (A) the current through R_S , R_L and Zener increases.
 (B) the current through R_S increases, Zener increases but through R_L remains constant.
 (C) the current through R_S increases, through Zener decreases, R_L increases.
 (D) the current through R_S increases, through Zener remains constant but R_L increases.



PSC048

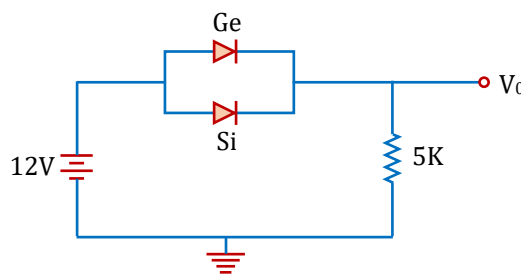
34. If in a $p-n$ junction diode, a square input signal of 10V is applied as shown. Then the output signal across R_L will be :-



- (A) (B) (C) (D)

PSC049

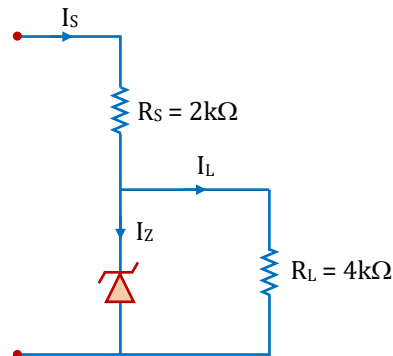
35. Ge and Si diodes start conducting at 0.3V and 0.7V respectively. In the following figure if Ge diode connection are reversed, the value of V_0 changes by:
 (Assume that the Ge diode has large breakdown voltage)



- (A) 0.6 V (B) 0.8 V (C) 0.4 V (D) 0.2 V

PSC050

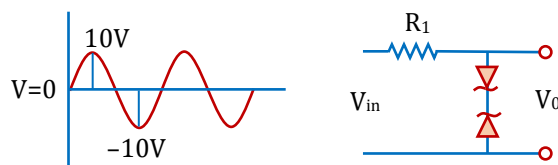
36. Figure shown a DC voltage regulator circuit, with a Zener diode of breakdown voltage = 6V. If the unregulated input voltage varies between 10 V to 16 V, then what is the maximum Zener current?



- (A) 2.5 mA (B) 3.5 mA (C) 7.5 mA (D) 1.5 mA

PSC052

37. Take the breakdown voltage of the Zener diode used in the given circuit as 6V. For the input voltage shown in figure below, the time variation of the output voltage is : (Graphs drawn are schematic and not to scale)



- (A) (B)
- (C) (D)

PSC053

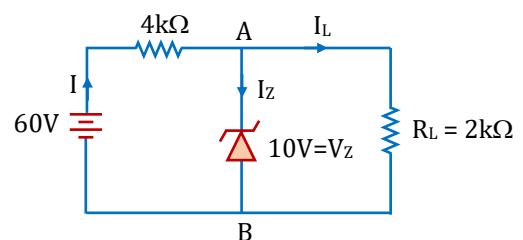
38. Zener breakdown occurs in a p - n junction having p and n both:

- (A) lightly doped and have wide depletion layer.
(B) heavily doped and have narrow depletion layer.
(C) lightly doped and have narrow depletion layer.
(D) heavily doped and have wide depletion layer.

PSC054

39. A Zener diode is connected to a battery and a load as shown below. The currents I , I_Z and I_L are respectively.

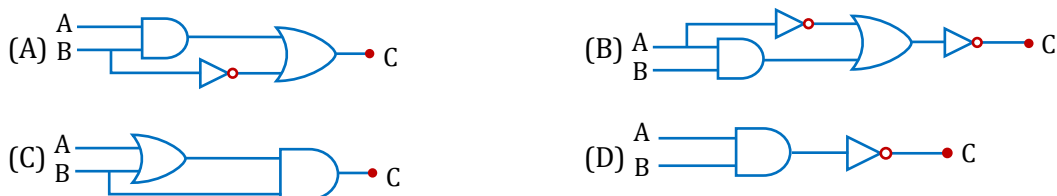
- (A) 12.5 mA, 5 mA, 7.5 mA
(B) 15 mA, 7.5 mA, 7.5 mA
(C) 12.5 mA, 7.5 mA, 5 mA
(D) 15 mA, 5 mA, 10 mA



PSC055

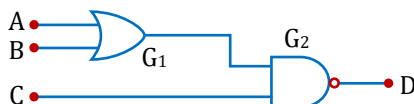
40. Which of the following circuits correctly represents the following truth table?

A	B	C
0	0	0
0	1	0
1	0	1
1	1	0



PSC085

41. For the given combination of gates, if the logic states of inputs A, B, C are as follows $A = B = C = 0$ and $A = B = 1, C = 0$ then the logic states of output D are –



- (A) 0, 0 (B) 0, 1 (C) 1, 0 (D) 1, 1

PSC086

42. This symbol represents



- (A) NOT gate (B) OR (C) AND gate (D) NOR gate

PSC087

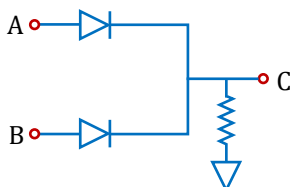
43. In which of the following cases, we would obtain an output of one.



- (A) $x = 1, y = 1, z = 1$ (B) $x = 1, y = 1, z = 0$ (C) $x = 0, y = 1, z = 1$ (D) $x = 0, y = 0, z = 1$

PSC089

44. In the circuit below, A and B represent two inputs and C represents the output.

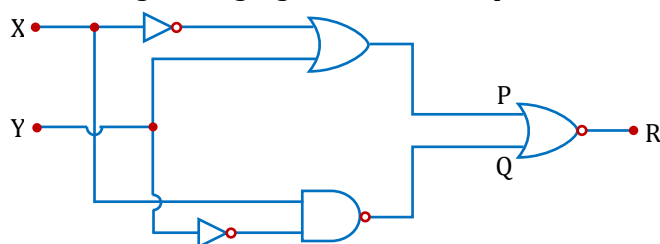


The circuit represents.

- (A) AND gate (B) NAND gate (C) OR gate (D) NOR gate

PSC090

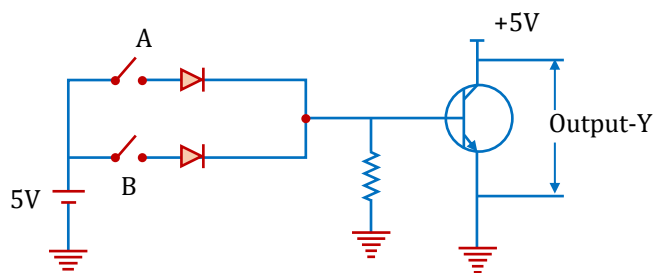
45. To get output '1' at R, for the given logic gate circuit the input values must be:



- (A) $X = 0, Y = 1$ (B) $X = 1, Y = 1$ (C) $X = 0, Y = 0$ (D) $X = 1, Y = 0$

PSC092

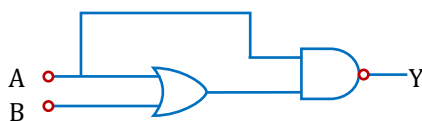
46. Boolean relation at the output stage-Y for the following circuit is:



- (A) $A + B$ (B) $\bar{A} + \bar{B}$ (C) $\bar{A} \cdot \bar{B}$ (D) $A \cdot B$

PSC094

47. The truth table for the circuit given in the fig. is:



(A)	A	B	Y
	0	0	1
	0	1	1
	1	0	0

(B)	A	B	Y
	0	0	0
	0	1	0
	1	0	1

(C)	A	B	Y
	0	0	1
	0	1	0
	1	0	0

(D)	A	B	Y
	0	0	1
	0	1	1
	1	0	1

PSC097

MULTIPLE CORRECT TYPE QUESTIONS

Significant Digits

48. A cuboid has sides of 10.4 cm, 3.8 cm and 1.02 cm. Choose the correct statement(s) about the area of the faces and its volume with due regard to significant digits.
- (A) The largest face area is 39.52 cm^2 .
 (B) The smallest face area is 3.9 cm^2 .
 (C) The volume of the cuboid is $4.0 \times 10^1 \text{ cm}^3$.
 (D) The perimeter of the smallest face is 9.64 cm.

PER097

Vernier Callipers and Screw Gauge

49. In ordinary Vernier callipers, 10th division of the Vernier scale coincides with 9th division of the main scale. In a specially designed Vernier callipers the Vernier scale is so constructed that 10th division on it coincides with 11th division on the main scale. Each division on the main scale equals to 1 mm. The callipers have a zero error as shown in the figure-I. When the Vernier calliper is used to measure a length, the concerned portion of its scale is shown in figure-II.

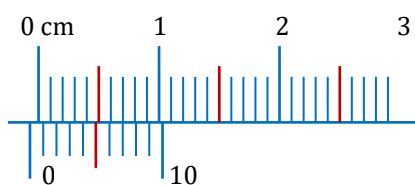


Figure-I

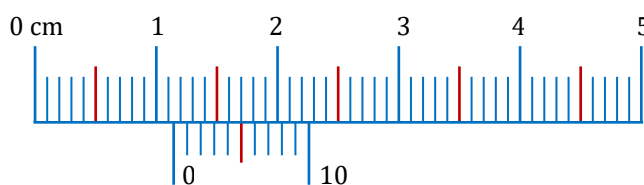


Figure-II

- (A) Zero error in the callipers has magnitude 0.7 mm.
 (B) The length being measured is 1.08 cm.
 (C) The length being measured is 1.22 cm.
 (D) Zero error in the callipers has magnitude 0.3 mm

PER076

50. In a screw gauge, there are 100 divisions in circular scale and each main scale division is of 1 mm. When there is no gap between the jaws, 98th division coincides with the main scale zero and zero of main scale is not visible. While measuring the diameter of a ball, the circular scale is between 2 mm mark and 3 mm mark such that the 23rd division of circular scale coincides with the reference line. Select the incorrect alternative.

- (A) the least count of the screw gauge is 0.01 cm
 (B) the zero error is -0.04 mm
 (C) the diameter of the ball is 2.25 mm
 (D) the zero error is positive zero error

PER098

51. We want to design a carbon resistor in shape of a cylinder. Its resistivity is known precisely. The diameter is measured by a screw gauge whose main scale has a least count of 1 mm and circular scale has 100 divisions. The length is measured by a vernier callipers whose main scale is 1 mm and 9 main scale divisions coincide with 10 vernier scale divisions. We wish that the fourth band in the colour code be painted gold. In which of the following screw gauge readings and vernier callipers readings will our goal be achieved?

- (A) Screw gauge: msr 2 divisions, 50th csd coinciding, Vernier scale: msr: 1.2 cm, 5th vernier division coinciding.
 (B) Screw gauge: msr 1 divisions, 0th csd coinciding, Vernier scale: msr: 0.3 cm, 3rd vernier division coinciding.
 (C) Screw gauge: msr 0 divisions, 40th csd coinciding, Vernier scale: msr: 5 cm, 0th vernier division coinciding.
 (D) Screw gauge: msr 1 divisions, 10th csd coinciding, Vernier scale: msr: 8 cm, 8th vernier division coinciding.

PER099

Error Analysis in Experiments

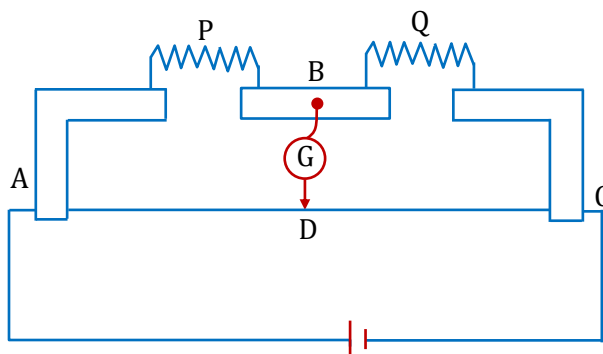
52. In resonance air-column method, two resonances in the air-column were obtained by lowering the water level. The resonance with the shorter air-column is the first resonance and that with the longer air-column is the second resonance. Then,
- (A) the intensity of the sound heard at the first resonance was more than that at the second resonance.
 - (B) the prongs of the tuning fork were kept in a horizontal plane above the resonance tube.
 - (C) the amplitude of vibration of the ends of the prongs is typically around 1 cm .
 - (D) the length of the air-column at the first resonance was somewhat shorter than $1/4$ th of the wavelength of the sound in air.

PER080

53. In an experiment to measure surface tension of completely wetting liquid, the capillary was dipped in liquid. The level of water in beaker was measured using travelling microscope to be 1.43 cm . The level of water in capillary was measured to be 6.23 cm . The readings for inner diameter were 0.00 cm and 0.32 cm respectively. Neglect the expansion of capillary and water on heating.
- (A) % error in measurement of h is 0.4%
 - (B) % error in measurement of surface tension is 6.46%
 - (C) if temperature increases, level of water in capillary will be less than 6.23 cm .
 - (D) $s = 0.38 \pm 0.04\text{ N/m}$

PER086

54. In the meter bridge circuit, the point D is the balance point.



- (A) If the jockey is shifted to the left of D , current will flow from the meter bridge wire to the point B .
- (B) If jockey is shifted to the right of D , current will flow from point B to the meter bridge wire.
- (C) If the jockey is at point D , but now the resistance P is heated, then the current will flow from point B to the meter bridge wire.
- (D) If the jockey is at point D , but now the resistance P is heated, then the current will flow from the meter bridge wire to the point B .

PER091

55. Two resistors R_1 and R_2 have measured values as $R_1 = 3.0\ \Omega \pm 0.1\ \Omega$; $R_2 = 6.0\ \Omega \pm 0.2\ \Omega$. Then
- (A) Least count of device used to measure R_2 is $0.2\ \Omega$
 - (B) When connected in series the error will be 3.34%
 - (C) When connected in parallel the error will be $0.1\ \Omega$ (approx.)
 - (D) When connected in parallel the error will be $0.2\ \Omega$ (approx.)

PER100

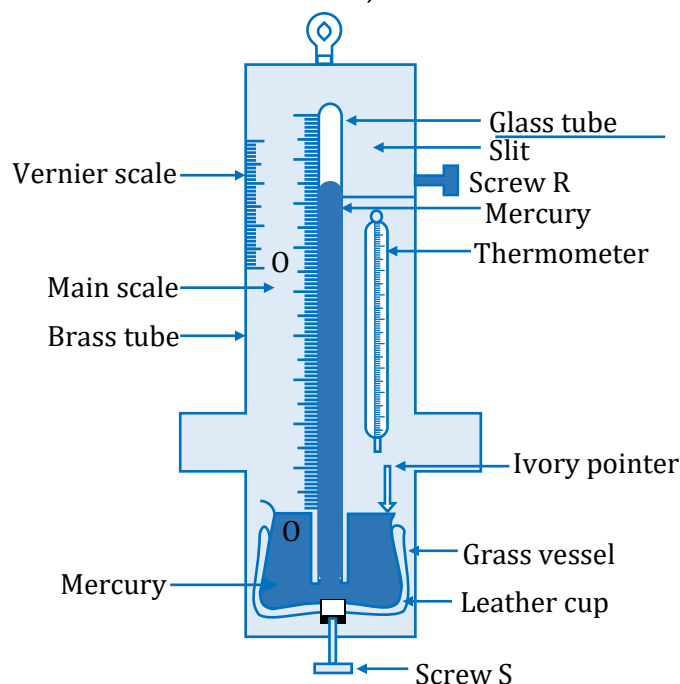
56. In the Searle's experiment, after every step of loading, why should we wait for two minutes before taking the readings?
- (A) So that the wire can have its desired change in length.
 (B) So that the wire can attain room temperature.
 (C) So that vertical oscillations can get subsided.
 (D) So that the wire has no change in its radius.

PER101

MISCELLANEOUS QUESTION

Paragraph for Question No. 57 and 58

Fortin's barometer is an improved form of mercury barometer. It is used for accurate measurement of atmospheric pressure. It consists of a thick walled glass tube of length $1m$. The glass tube contains a cistern of mercury. The bottom of the vessel is made of leather which can be raised or lowered by means of a screw provided below. The whole barometer is enclosed in a brass tube and glass windows are provided to take the readings. An ivory pointer is fixed to the lid of the vessel containing mercury. The tip of this index coincides with zero of the vertical scale on the glass tube. At the upper end of the glass tube a vernier scale is fixed which slides up and down with help of a screw. The height of the mercury column in the barometer is found using the vernier scale. This is done by making the zero of vernier coincide with the convex meniscus of mercury column in the tube by adjusting the screw R given. However, the instrument has two possible sources of systematic errors. (1) The scale is calibrated at 20° celcius. If the temperature is higher or lower, expansion of mercury will change the reading. The expansion of glass tube and scale can be neglected. (2) The fortin barometer has to be exactly vertical. If it is not vertical, reading will not reflect the true pressure. Since the tube is wide, effect of surface tension can be neglected.



Assume that the vernier scale has 20 divisions which coincide with 19 divisions of main scale. Each main scale division is 1 mm .

57. Select the **CORRECT** statement:

- (A) If the scale is tilted slightly, the reading of fortin barometer will be more than the true value and if the temperature of the mercury is more than 20°C , then also the reading of the barometer will be more than the true value.
- (B) If the scale is tilted slightly, the reading of fortin barometer will be less than the true value and if the temperature of the mercury is more than 20°C , then the reading of the barometer will be more than the true value.
- (C) If the scale is tilted slightly, the reading of fortin barometer will be less than the true value and if the temperature of the mercury is more than 20°C , then also the reading of the barometer will be less than the true value.
- (D) If the scale is tilted slightly, the reading of fortin barometer will be more than the true value and if the temperature of the mercury is more than 20°C , then the reading of the barometer will be less than the true value.

PER102

58. If the reading of vernier scale is such that 18th division is coinciding with a main scale, zero of vernier reads 752 mm and there is no zero error, what is the percentage uncertainty in the pressure (approx) ?

- (A) 0.013% (B) 0.04% (C) 0.007% (D) 0.003%

PER103

EXERCISE - S

Significant Digits

1. Significant figures are given in the following quantities are p, q, r, s, t, u, v and w respectively.

(A) 343 g (B) 2.20 (C) 1.103 N (D) 0.4142 s
 (E) 0.0145 m (F) 1.0080 V (G) 9.1×10^4 km (H) 1.124×10^{-3} V

Value of $\frac{(p+q+r+s+t+u+v+w)}{4}$ is _____

PER056

Vernier Callipers and Screw Gauge

2. In a vernier callipers, 19 divisions of its main scale match with (20) divisions on its vernier scale. Each division of the main scale is ' a ' units. Using the vernier principle, if least count is $\frac{a}{4x}$ then find the value of x _____.

PER067

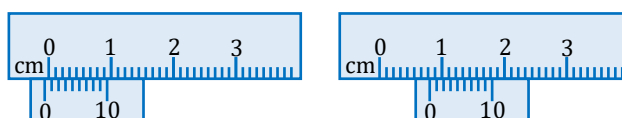
3. The pitch of a screw gauge is 1 mm and there are 50 divisions on its cap. When nothing is put in between the studs, 44th division of the circular scale coincides with the reference line zero of the main scale is not visible. When a glass plate is placed between the studs, the main scale reads three divisions and the circular scale reads 26 divisions. Calculate the thickness of the plate.

PER073

4. Using screw gauge, the observation of the diameter of a wire are 1.324, 1.326, 1.334, 1.336 cm respectively. Find the average diameter, the mean error, the relative error and % error.

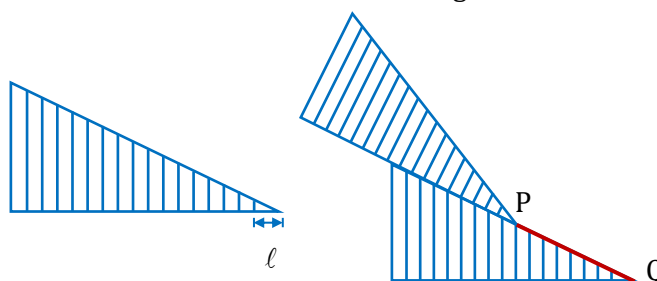
PER104

5. The main scale of a vernier callipers reads in millimeter and its vernier is divided into 10 divisions which coincides with 9 divisions of the main scale. The reading for shown situation is found to be $\frac{23x}{10}$ mm. Find the value of x .



PER105

6. Consider a home made vernier scale as shown in the figure.



In this diagram, we are interested in measuring the length of the line PQ. If both the inclines are identical and their angles are equal to q then what is the least count of the instrument.

PER106

Error Analysis in Experiments

7. In a given optical bench, a needle of length 10 cm is used to estimate bench error. The object needle, image needle and lens holder have their reading as shown.

$$x_0 = 1.1 \text{ cm} \quad x_l = 21.0 \text{ cm} \quad x_i = 10.9 \text{ cm}$$

Estimate the bench errors which are present in image needle holder and object needle holder. Also find the focal length of the convex lens when.

$$x_0 = 0.6 \text{ cm} \quad x_l = 22.5 \text{ cm} \quad x_i = 11.4 \text{ cm}$$

PER085

8. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2 \text{ s}^{-1}$. The measurement of A has an error of 1.25%. If the error in the measurement of time is 1.50%, the percentage error in the value of $E(t)$ at $t = 5 \text{ s}$ is

PER107

9. A travelling microscope is used to measure the refractive index of a glass slab. The microscope is focused on a spot on the table and the reading of microscope is 10.08 cm. Now the glass slab is put on the spot and microscope is raised to focus on the apparent position of spot. The reading is 12.48 cm. Now the microscope is raised further to focus on the top of the slab. The reading is 14.88 cm. If the least count of scale is 0.01 cm, what is the % error in refractive index?

PER108

10. Work done on the system as a function of time t is given as $W(t) = A^3 \ln(at^2)$, where $a = 3 \text{ s}^{-2}$. The measurement of A has an error of 0.5%. If the error in the measurement of time is 1.25%, the percentage error in the $W(t)$ at $t = 2 \text{ sec}$ is. [Take $\ln(12) = 2.5$]

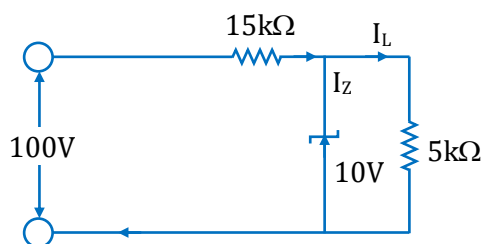
PER109

11. In surveying, sometimes a value can be found for an inaccessible length ℓ (such as the height of a tall tree) by measuring other three lengths ℓ_1, ℓ_2, ℓ_3 in terms of which $\ell = \frac{\ell_1 \ell_2}{\ell_3}$. Suppose we perform such an experiment and obtain the following results (in feet) $\ell_1 = 200 \pm 2$, $\ell_2 = 5.5 \pm 0.1$, $\ell_3 = 10.0 \pm 0.4$. If in this experiment value of ℓ is expressed as $\ell = 110 \pm x$, find value of x (in feet)

PER110

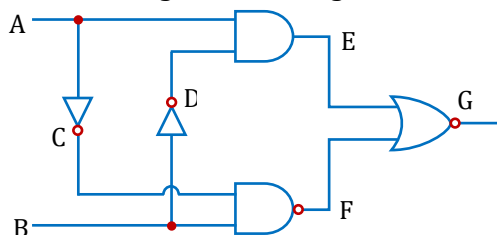
Semiconductor

12. For the circuit shown in figure, find:
(i) the output voltage
(ii) the voltage drop across series resistance
(iii) the current through zener diode.



PSC098

13. Write a truth table for the circuit in figure, including the states at C, D, E, F and G.



PSC099

EXERCISE - JEE (Main) PYQ

1. The current voltage relation of diode is given by $I = (e^{1000V/T} - 1) \text{ mA}$, where the applied voltage V is in volts and the temperature T is in degree Kelvin. If a student makes an error measuring $\pm 0.01 \text{ V}$ while measuring the current of 5 mA at 300 K , what will be error in the value of current in mA ? [JEE (Main) 2014]
- (1) 0.5 mA (2) 0.05 mA (3) 0.2 mA (4) 0.02 mA

PER008

2. A student measured the length of a rod and wrote it as 3.50 cm . Which instrument did he use to measure it? [JEE (Main) 2014]
- (1) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm .
 (2) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm .
 (3) A meter scale.
 (4) A vernier calliper where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm .

PER009

3. The forward biased diode connection is: [JEE (Main) 2014]
- (1) -3V —  -3V (2) 2V —  4V
 (3) -2V —  $+2\text{V}$ (4) $+2\text{V}$ —  -2V

PSC019

4. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45^{th} division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25^{th} division coincides with the main scale line? [JEE (Main) 2016]
- (1) 0.50 mm (2) 0.75 mm (3) 0.80 mm (4) 0.70 mm

PER010

5. A student measures the time period of 100 oscillations of a simple pendulum four times. The data set is 90 s , 91 s , 95 s and 92 s . If the minimum division in the measuring clock is 1 s , then the reported mean time should be: [JEE (Main) 2016]
- (1) $92 \pm 3 \text{ s}$ (2) $92 \pm 2 \text{ s}$ (3) $92 \pm 5.0 \text{ s}$ (4) $92 \pm 1.8 \text{ s}$

PER011

6. If a, b, c, d are inputs to a gate and x is its output, then as per the following time graph, the gate is [JEE (Main) 2016]



(1) NAND

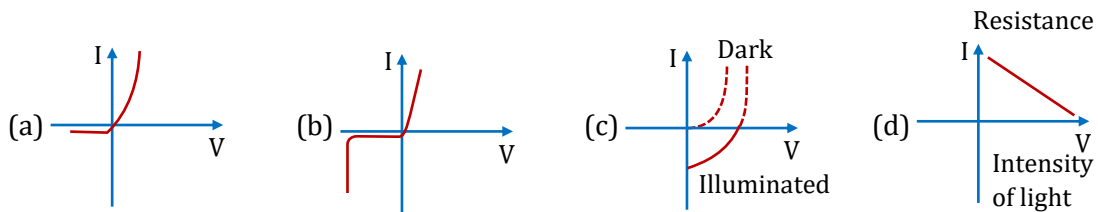
(2) NOT

(3) AND

(4) OR

PSC020

7. Identify the semiconductor devices whose characteristics are given below, in the order (a), (b), (c), (d):
[JEE (Main) 2016]



- (1) Zener diode, Solar cell, Simple diode, Light dependent resistance
(2) Simple diode, Zener diode, Solar cell, Light dependent resistance
(3) Zener diode, Simple diode, Light dependent resistance, Solar cell
(4) Solar cell, Light dependent resistance, Zener diode, Simple diode

PSC021

8. The following observations were taken for determining surface tension T of water by capillary method:

Diameter of capillary, $D = 1.25 \times 10^{-2} m$

Rise of water, $h = 1.45 \times 10^{-2} m$

Using $g = 9.80 m/s^2$ and the simplified relation $T = \frac{r h g}{2} \times 10^3 N/m$, the possible error in surface tension is closest to:

[JEE (Main) 2017]

- (1) 2.4% (2) 10% (3) 0.15% (4) 1.5%

PER012

9. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is:

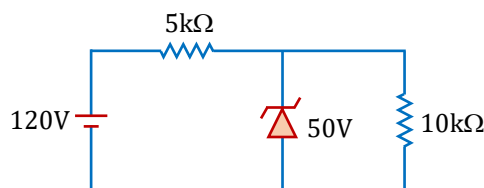
[JEE (Main) 2018]

- (1) 3.5% (2) 4.5% (3) 6% (4) 2.5%

PER013

10. For the circuit shown below, the current through the Zener diode is:

[JEE (Main) 2019]



- (1) 5 mA (2) Zero (3) 14 mA (4) 9 mA

PSC022

11. A simple pendulum is being used to determine the value of gravitational acceleration g at a certain place. The length of the pendulum is 25.0 cm and a stop watch with 1s resolution measures the time taken for 40 oscillations to be 50 s. The accuracy in g is:

[JEE (Main) 2020]

- (1) 3.40% (2) 5.40% (3) 4.40% (4) 2.40%

PER014

12. The least count of the main scale of a vernier calipers is 1 mm. Its vernier scale is divided into 10 divisions and coincide with 9 divisions of the main scale. When jaws are touching each other, the 7th division of vernier scale coincides with a division of main scale and the zero of vernier scale is lying right side of the zero of main scale. When this vernier is used to measure length of a cylinder the zero of the vernier scale between 3.1 cm and 3.2 cm and 4th VSD coincides with a main scale division. The length of the cylinder is : (VSD is vernier scale division) [JEE (Main) 2020]

(1) 3.21 cm (2) 2.99 cm (3) 3.2 cm (4) 3.07 cm

PER015

13. Using screw gauge of pitch 0.1 cm and 50 divisions on its circular scale, the thickness of an object is measured. It should correctly be recorded as : [JEE (Main) 2020]

(1) 2.123 cm (2) 2.125 cm (3) 2.121 cm (4) 2.124 cm

PER016

14. A physical quantity z depends on four observables a, b, c and d , as $z = \frac{a^2 b^{\frac{2}{3}}}{\sqrt{c} d^3}$. The percentage of error in the measurement of a, b, c and d are 2%, 1.5%, 4% and 2.5% respectively. The percentage of error in z is: [JEE (Main) 2020]

(1) 12.25% (2) 14.5% (3) 16.5% (4) 13.5%

PER017

15. A student measuring the diameter of a pencil of circular cross-section with the help of a vernier scale records the following four readings 5.50 mm, 5.55 mm, 5.45 mm; 5.65 mm. The average of these four readings is 5.5375 mm and the standard deviation of the data is 0.07395 mm. The average diameter of the pencil should therefore be recorded as: [JEE (Main) 2020]

(1) $(5.5375 \pm 0.0739) \text{ mm}$ (2) $(5.538 \pm 0.074) \text{ mm}$
(3) $(5.54 \pm 0.07) \text{ mm}$ (4) $(5.5375 \pm 0.0740) \text{ mm}$

PER018

16. If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is: [JEE (Main) 2021]

(1) 86.4 s (2) 4.32 s (3) 43.2 s (4) 8.64 s

PER019

17. In the experiment of Ohm's law, a potential difference of 5.0 V is applied across the end of a conductor of length 10.0 cm and diameter of 5.00 mm. The measured current in the conductor is 2.00 A. The maximum permissible percentage error in the resistivity of the conductor is :- [JEE (Main) 2021]

(1) 3.9 (2) 8.4 (3) 7.5 (4) 3.0

PER020

18. A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s^2 , without any significant error, his observation are as following.

Physical Quantity	Least Count of the Equipment used for measurement	Observed value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is:

[JEE (Main) 2021]

- (1) 0.0083 (2) 0.0155 (3) 0.155 (4) 0.083

PER021

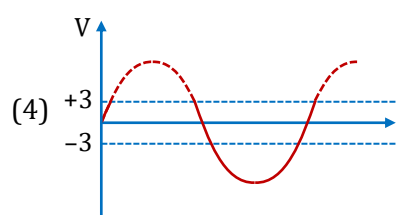
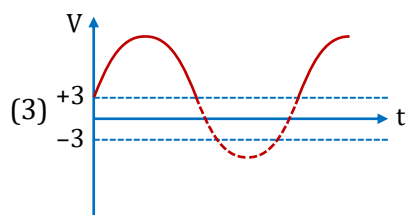
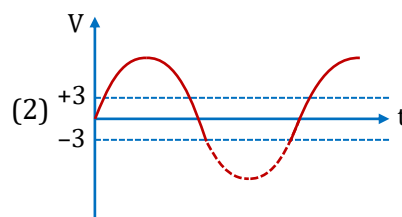
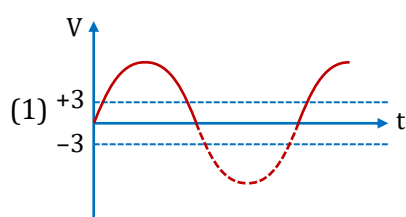
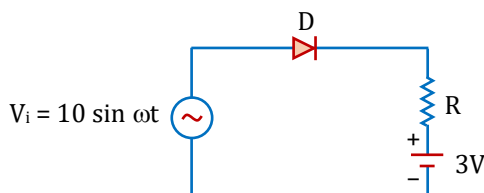
19. In a semiconductor, the number density of intrinsic charge carriers at 27°C is $1.5 \times 10^{16}/\text{m}^3$. If the semiconductor is doped with impurity atom, the hole density increases to $4.5 \times 10^{22}/\text{m}^3$. The electron density in the doped semiconductor is $\text{_____} \times 10^9/\text{m}^3$.

[JEE (Main) 2021]

PSC023

20. Choose the correct waveform that can represent the voltage across R of the following circuit, assuming the diode is ideal one:

[JEE (Main) 2021]



PSC024

21. Statement-I:

To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect a capacitor across the output parallel to the load R_L . [JEE (Main) 2021]

Statement-II :

To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect an inductor in series with R_L .

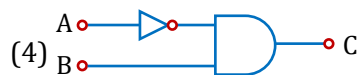
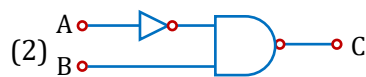
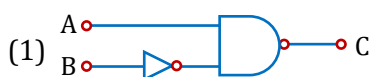
In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Statement I is true, but Statement II is false.
- (2) Statement I is false, but Statement II is true.
- (3) Both Statement I and Statement II are false.
- (4) Both Statement I and Statement II are true.

PSC025

22. The logic circuit shown above is equivalent to:

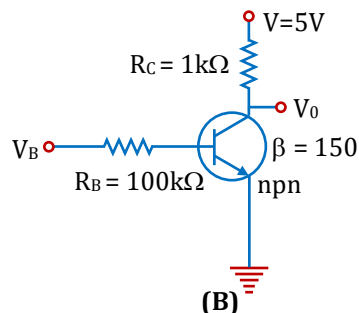
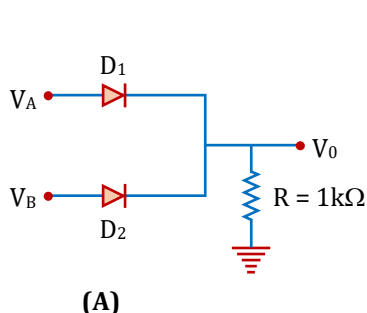
[JEE (Main) 2021]



PSC026

23. If V_A and V_B are the input voltages (either 5V or V_0) and V_0 is the output voltage then the two gates represented in the following circuit (A) and (B) are:-

[JEE (Main) 2021]



- (1) AND and OR Gate
- (3) NAND and NOR Gate

- (2) OR and NOT Gate
- (4) AND and NOT Gate

PSC027

24. A cylindrical wire of mass $(0.4 \pm 0.01)g$ has length $(8 \pm 0.04)cm$ and radius $(6 \pm 0.03)mm$. The maximum error in its density will be

[JEE (Main) 2023]

- (1) 1%
- (2) 3.5 %
- (3) 4%
- (4) 5%

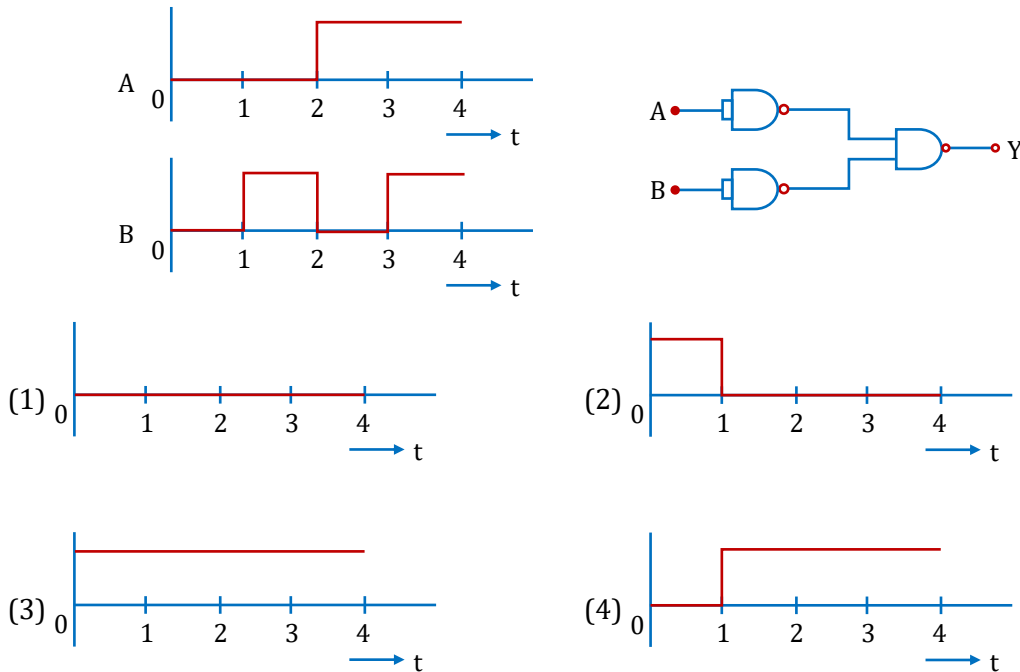
PER111

25. In an experiment with Vernier callipers of least count 0.1 mm , when two jaws are joined together the zero of Vernier scale lies right to the zero of the main scale and 6th division of Vernier scale coincides with the main scale division. While measuring the diameter of a spherical bob, the zero of vernier scale lies in between 3.2 cm and 3.3 cm marks, and 4th division of vernier scale coincides with the main scale division. The diameter of bob is measured as : [JEE (Main) 2023]

(1) 3.18 cm (2) 3.25 cm (3) 3.26 cm (4) 3.22 cm

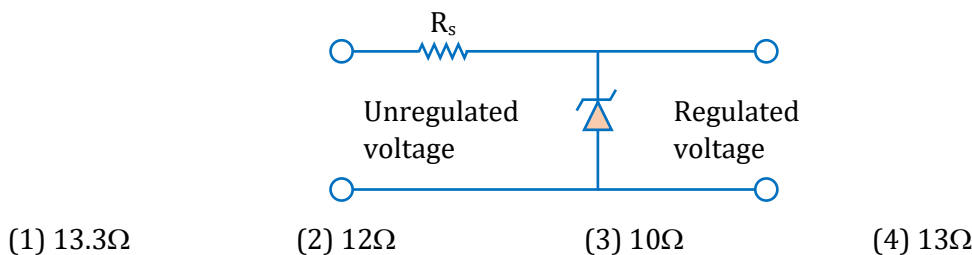
PER112

26. For the logic circuit shown, the output waveform at Y is: [JEE (Main) 2023]



PSC100

27. A zener diode of power rating 1.6 W is to be used as voltage regulator. If the zener diode has a breakdown of 8 V and it has to regulate voltage fluctuating between 3 V and 10 V . The value of resistance R_s for safe operation of diode will be : [JEE (Main) 2023]



PSC101

EXERCISE - JEE (Advanced) PYQ

1. Using the expression $2d \sin \theta = \lambda$, one calculates the values of d by measuring the corresponding angles θ in the range 0 to 90° . The wavelength λ is exactly known and the error in θ is constant for all values of θ . As θ increases from 0° :-
[JEE (Advanced) 2013]

(A) the absolute error in d remains constant
(B) the absolute error in d increases
(C) the fractional error in d remains constant
(D) the fractional error in d decreases

PER041

2. During Searle's experiment, zero of the Vernier scale lies between $3.20 \times 10^{-2} m$ and $3.25 \times 10^{-2} m$ of the main scale. The 20^{th} division of the Vernier scale exactly coincides with one of the main scale divisions. When an additional load of $2 kg$ is applied to the wire, the zero of the Vernier scale still lies between $3.20 \times 10^{-2} m$ and $3.25 \times 10^{-2} m$ of the main scale but now the 45^{th} division of Vernier scale coincides with one of the main scale divisions. The length of the thin metallic wire is $2 m$ and its cross-sectional area is $8 \times 10^{-7} m^2$. The least count of the Vernier scale is $1.0 \times 10^{-5} m$. The maximum percentage error in the Young's modulus of the wire is
[JEE (Advanced) 2014]

PER042

3. Consider a Vernier callipers in which each $1 cm$ on the main scale is divided into 8 equal divisions and a screw gauge with 100 divisions on its circular scale. In the Vernier callipers, 5 divisions of the Vernier scale coincide with 4 divisions on the main scale and in the screw gauge, one complete rotation of the circular scale moves it by two divisions on the linear scale. Then :

[JEE (Advanced) 2015]

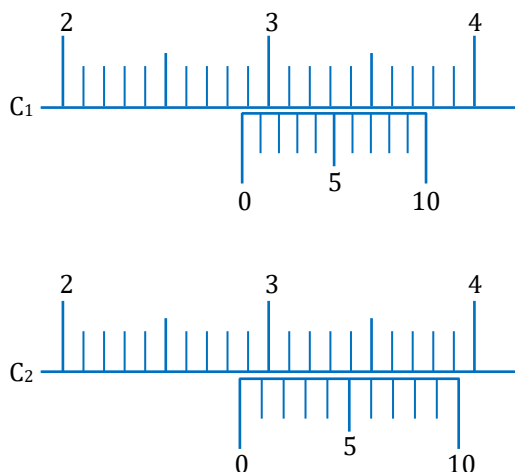
- (A) If the pitch of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is $0.01 mm$.
(B) If the pitch of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is $0.005 mm$.
(C) If the least count of the linear scale of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is $0.01 mm$.
(D) If the least count of the linear scale of the screw gauge is twice the least count of the Vernier callipers, the least count of the screw gauge is $0.005 mm$.

PER043

4. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2 s^{-1}$. The measurement of A has an error of 1.25% . If the error in the measurement of time is 1.50% , the percentage error in the value of $E(t)$ at $t = 5 s$ is.
[JEE (Advanced) 2015]

PER044

5. There are two vernier calipers both of which have 1 cm divided into 10 equal divisions on the main scale. The Vernier scale of one of the calipers (C_1) has 10 equal divisions that correspond to 9 main scale divisions. The Vernier scale of the other caliper (C_2) has 10 equal divisions that correspond to 11 main scale divisions. The readings of the two calipers are shown in the figure. The measured values (in cm) by calipers C_1 and C_2 respectively, are [JEE (Advanced) 2016]



- (A) 2.87 and 2.86 (B) 2.87 and 2.87 (C) 2.87 and 2.83 (D) 2.85 and 2.82

PER045

6. In an experiment to determine the acceleration due to gravity g , the formula used for the time period of a periodic motion is $T = 2\pi \sqrt{\frac{7(R-r)}{5g}}$. The values of R and r are measured to be $(60 \pm 1) \text{ mm}$ and $(10 \pm 1) \text{ mm}$, respectively. In five successive measurements, the time period is found to be 0.52 s, 0.56 s, 0.57 s, 0.54 s and 0.59 s. The least count of the watch used for the measurement of time period is 0.01 s. Which of the following statement(s) is(are) true ? [JEE (Advanced) 2016]

- (A) The error in the measurement of r is 10%.
 (B) The error in the measurement of T is 3.57%.
 (C) The error in the measurement of T is 2%.
 (D) The error in the determined value of g is 11%.

PER046

7. A person measures the depth of a well by measuring the time interval between dropping a stone and receiving the sound of impact with the bottom of the well. The error in his measurement of time is $\delta T = 0.01$ second and he measures the depth of the well to be $L = 20$ meters. Take the acceleration due to gravity $g = 10 \text{ ms}^{-2}$ and the velocity of sound is 300 ms^{-1} . Then the fractional error in the measurement, $\delta L / L$, is closest to [JEE (Advanced) 2017]

- (A) 0.2 % (B) 5 % (C) 3 % (D) 1 %

PER047

PARAGRAPH FOR QUESTION NO. 8 and 9

If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation $z = x/y$. If the errors in x, y and z are $\Delta x, \Delta y$ and Δz , respectively, then

[JEE (Advanced) 2018]

$$z \pm \Delta z = \frac{x \pm \Delta x}{y \pm \Delta y} = \frac{x}{y} \left(1 \pm \frac{\Delta x}{x}\right) \left(1 \pm \frac{\Delta y}{y}\right)^{-1}$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$, to first power in $\Delta y/y$, is $1 \mp (\Delta y/y)$. The relative errors in independent variables are always added. So the error in z will be

$$\Delta z = z \left(\frac{\Delta x}{x} + \frac{\Delta y}{y}\right)$$

The above derivation makes the assumption that $\frac{\Delta x}{x} \ll 1$, $\frac{\Delta y}{y} \ll 1$. Therefore, the higher powers of these quantities are neglected.

8. Consider the ratio $r = \frac{(1-a)}{(1+a)}$ to be determined by measuring a dimensionless quantity a . If the error in the measurement of a is Δa ($\Delta a/a \ll 1$), then what is the error Δr in determining r ?

- (A) $\frac{\Delta a}{(1+a)^2}$ (B) $\frac{2\Delta a}{(1+a)^2}$ (C) $\frac{2\Delta a}{(1-a^2)}$ (D) $\frac{2a\Delta a}{(1-a^2)}$

PER048

9. In an experiment the initial number of radioactive nuclei is 3000. It is found that 1000 ± 40 nuclei decayed in the first 1.0 s. For $|x| \ll 1$, $\ln(1+x) = x$ up to first power in x . The error $\Delta \lambda$, in the determination of the decay constant λ , in s^{-1} , is :-

- (A) 0.04 (B) 0.03 (C) 0.02 (D) 0.01

PER049

10. A steel wire of diameter 0.5 mm and Young's modulus $2 \times 10^{11} \text{ Nm}^{-2}$ carries a load of mass M . The length of the wire with the load is 1.0 m. A vernier scale with 10 divisions is attached to the end of this wire. Next to the steel wire is a reference wire to which a main scale, of least count 1.0 mm, is attached. The 10 divisions of the vernier scale correspond to 9 divisions of the main scale. Initially, the zero of vernier scale coincides with the zero of main scale. If the load on the steel wire is increased by 1.2 kg, the vernier scale division which coincides with a main scale division is..... (Take $g = 10 \text{ ms}^{-2}$ and $\pi = 3.2$).

[JEE (Advanced) 2018]

PER050

11. An optical bench has 1.5 m long scale having four equal divisions in each cm. While measuring the focal length of a convex lens, the lens is kept at 75 cm mark of the scale and the object pin is kept at 45 cm mark. The image of the object pin on the other side of the lens overlaps with image pin that is kept at 135 cm mark. In this experiment, the percentage error in the measurement of the focal length of the lens is.

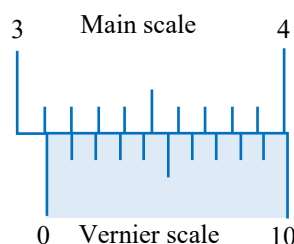
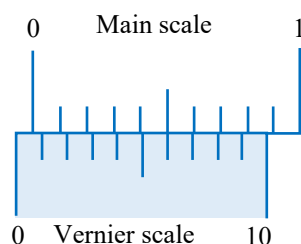
[JEE (Advanced) 2019]

PER051

12. Two capacitors with capacitance values $C_1 = 2000 \pm 10 \text{ pF}$ and $C_2 = 3000 \pm 15 \text{ pF}$ are connected in series. The voltage applied across this combination is $V = 5.00 \pm 0.02 \text{ V}$. The percentage error in the calculation of the energy stored in this combination of capacitors is _____. [JEE (Advanced) 2020]

PER052

13. The smallest division on the main scale of a Vernier calipers is 0.1 cm . Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this calipers with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is [JEE (Advanced) 2021]



- (A) 3.07 cm (B) 3.11 cm (C) 3.15 cm (D) 3.17 cm

PER053

14. Area of the cross-section of a wire is measured using a screw gauge. The pitch of the main scale is 0.5 mm . The circular scale has 100 divisions and for one full rotation of the circular scale, the main scale shifts by two divisions. The measured readings are listed below.

Measurement condition	Main scale reading	Circular scale reading
Two arms of gauge touching each other without wire	0 division	4 division
Attempt-1: With wire	4 divisions	20 divisions
Attempt-2: With wire	4 divisions	16 divisions

What are the diameter and cross-sectional area of the wire measured using the screw gauge?

[JEE (Advanced) 2022]

- (A) $2.22 \pm 0.02 \text{ mm}$, $\pi(1.23 \pm 0.02) \text{ mm}^2$ (B) $2.22 \pm 0.01 \text{ mm}$, $\pi(1.23 \pm 0.01) \text{ mm}^2$
 (C) $2.14 \pm 0.02 \text{ mm}$, $\pi(1.14 \pm 0.02) \text{ mm}^2$ (D) $2.14 \pm 0.01 \text{ mm}$, $\pi(1.14 \pm 0.01) \text{ mm}^2$

PER054

15. In an experiment for determination of the focal length of a thin convex lens, the distance of the object from the lens is $10 \pm 0.1 \text{ cm}$ and the distance of its real image from the lens is $20 \pm 0.2 \text{ cm}$. The error in the determination of focal length of the lens is $n\%$. The value of n is ____.

[JEE (Advanced) 2023]

PER113

JEE (Main) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

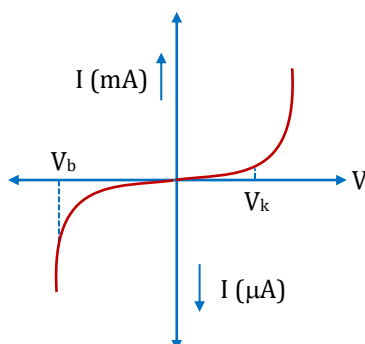
SECTION-A

- This section contains **SEVENTEEN** questions.
 - Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
 - For each question, darken the bubble corresponding to the correct option in the ORS.
 - For each question, marks will be awarded in one of the following categories:
Full Marks : +4, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : -1 in all other cases.
-
1. If $a = 8 \pm 0.08$ and $b = 6 \pm 0.06$. Let $x = a + b$, $y = a - b$, $z = a \times b$. The correct order of % error in x, y and z is :-
 (1) $x = y < z$ (2) $x = y > z$ (3) $x < z < y$ (4) $x > z < y$ PER001
2. The edge of a cube is $a = 1.2 \times 10^{-2} \text{ m}$. Then its volume will be recorded as :
 (1) $1.7 \times 10^{-6} \text{ m}^3$ (2) $1.70 \times 10^{-6} \text{ m}^3$ (3) $1.70 \times 10^{-7} \text{ m}^3$ (4) $1.78 \times 10^{-6} \text{ m}^3$ PER002
3. On the basis of detail given about two measuring instruments, select the correct statement.
 (i) Vernier callipers having main scale division = 0.05 cm and Vernier scale division = $\frac{2.45}{50} \text{ cm}$.
 (ii) Screw gauge having pitch 0.5 mm and its circular scale division measures 0.01 mm .
 (1) Both the instruments have same least count.
 (2) Least count of screw gauge is lesser than that of vernier callipers.
 (3) Both the instruments have same least count but screw gauge is more precise.
 (4) Both the instruments have different least count and screw gauge is more precise. PER003
4. In a Searle's experiment for determination of Young's Modulus, when a load of 50 kg is added to a 3 meter long wire micrometer screw having pitch 1 mm needs to be given a quarter turn in order to restore the horizontal position of spirit level. Young's modulus of the wire if its cross-sectional area is 10^{-5} m^2 is
 (1) $6 \times 10^{11} \text{ N/m}^2$ (2) $1.5 \times 10^{11} \text{ N/m}^2$ (3) $3 \times 10^{11} \text{ N/m}^2$ (4) None PER004
5. An electric field is applied to a semi-conductor. Let the number of charge carriers be n and the average drift speed be v . If the temperature is increased:
 (1) Both n and v will increase (2) n will increase but v will decrease
 (3) v will increase but n will decrease (4) Both n and v will decrease PSC001
6. P -type semiconductor is formed when
 A. As impurity is mixed in Si B. Al impurity is mixed in Si
 C. B impurity is mixed in Ge D. P impurity is mixed in Ge
 (1) A and C (2) A and D (3) B and C (4) B and D PSC002

7. A strip of copper and another of germanium are cooled from room temperature to 80K. The resistance of -
- (1) copper strip increases and that of germanium decreases
 - (2) copper strip decreases and that of germanium increases
 - (3) each of these increases
 - (4) each of these decreases

PSC003

8. The V - I characteristic for a p - n junction diode is plotted as shown in the figure. From the plot we can conclude that

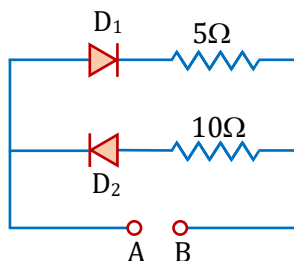


[$V_b \rightarrow$ breakdown voltage, $V_k \rightarrow$ knee voltage]

- (1) The forward bias resistance of diode is very high; almost infinity for small values of V and after a certain value it becomes very low.
- (2) The reverse bias resistance of diode is very high in the beginning up to breakdown voltage is not achieved.
- (3) Both forward and reverse bias resistances are same for all voltages.
- (4) Both (1) and (2) are correct.

PSC004

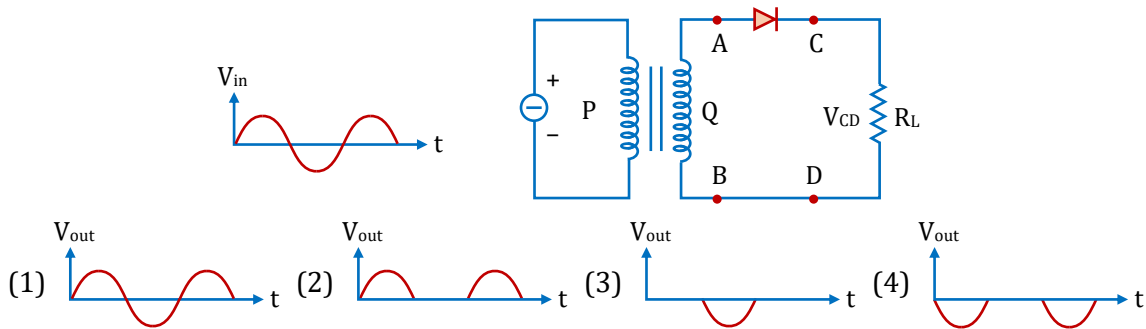
9. A 2V battery is connected across AB as shown in the figure. The value of the current supplied by the battery when in one case battery's positive terminal is connected to A and in other case when positive terminal of battery is connected to B will respectively be :-



- (1) 0.1 A and 0.2 A (2) 0.4 A and 0.2 A (3) 0.2 A and 0.4 A (4) 0.2 A and 0.1 A

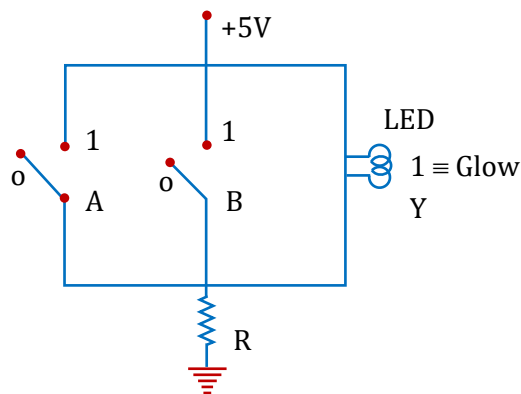
PSC005

10. In the half-wave rectifier circuit shown. Which one of the following wave forms is true for V_{CD} , if the input is as shown?



PSC006

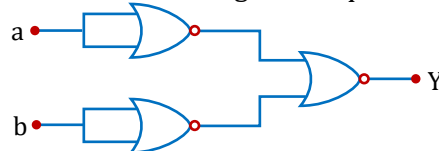
11. Name the logic gate equivalent to the diagram attached



- (1) OR (2) NOR (3) NAND (4) AND

PSC102

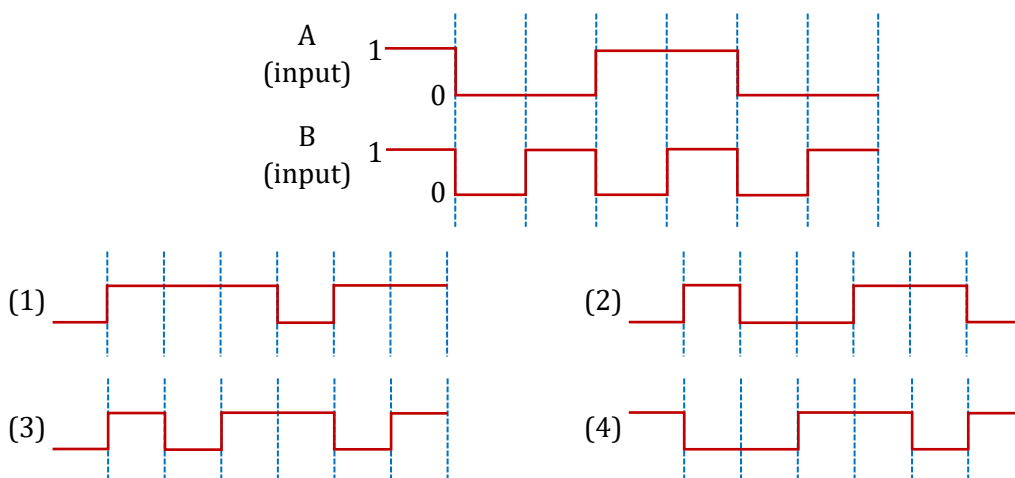
12. The logic performed by the circuit shown in figure is equivalent to :



- (1) AND (2) NAND (3) OR (4) NOR

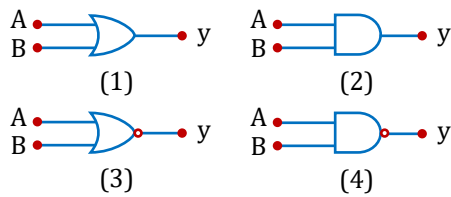
PSC103

13. The output from a NAND gate having inputs A and B given below will be.



PSC104

14. Given below are four logic gate symbols (figure). Those for OR, NOR and NAND are respectively.



- (1) 1, 4, 3 (2) 4, 1, 2 (3) 1, 3, 4 (4) 4, 2, 1

PSC010

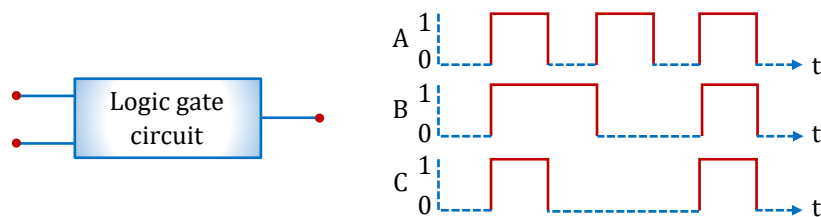
15. The following truth table corresponds to the logic gate –

A	0	0	1	1
B	0	1	0	1
X	0	1	1	1

- (1) NAND (2) OR (3) AND (4) XOR

PSC011

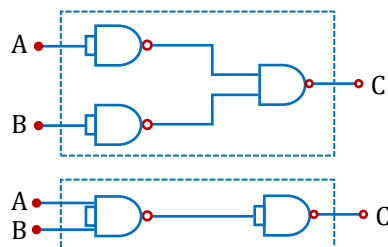
16. The following figure shows a logic gate circuit with two input A and B output C . The voltage waveforms of A , B and C are as shown in second figure below. The logic gate is:



- (1) OR gate (2) NAND gate (3) AND gate (4) NOR gate

PSC012

17. The combination of 'NAND' gates shown here under (figure) are equivalent to –



- (1) An OR gate and an AND gate respectively
 (2) An AND gate and a NOT gate respectively
 (3) An AND gate and an OR gate respectively
 (4) An OR gate and a NOT gate respectively

PSC013

SECTION-B

- This section will have **EIGHT questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:
 Full Marks : +4, if only correct answer is given.
 Zero Marks : 0, if no answer is given.
 Negative Marks : -1 for incorrect answer.

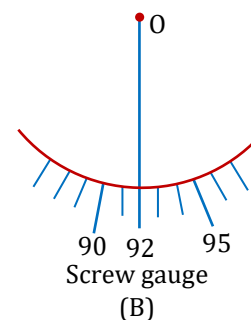
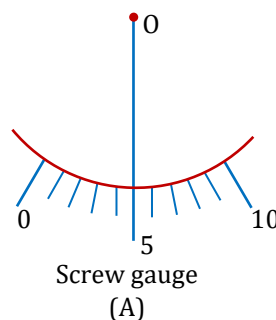
1. The least count of the main scale of a screw gauge is 1 mm . The minimum number of divisions on its circular scale required to measure $5 \mu\text{m}$ diameter of wire is:

PER005

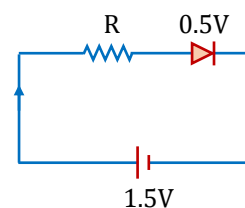
2. In a vernier callipers, each cm on the main scale is divided into 20 equal parts. If tenth vernier scale division coincides with ninth main scale division. Then the value of vernier constant will be $\times 10^{-2} \text{ mm}$.

PER006

3. Student A and Student B used two screw gauges of equal pitch and 100 equal circular divisions to measure the radius of a given wire. The actual value of the radius of the wire is 0.322 cm . The absolute value of the difference between the final circular scale readings observed by the students A and B is _____. [Figure shows position of reference 'O' when jaws of screw gauge are closed]
 Given pitch = 0.1 cm .

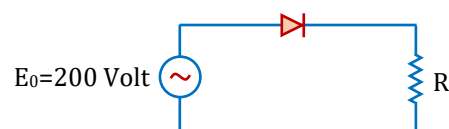


4. The diode used in the circuit shown in the figure has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milliwatts. What should be the value of the resistor R (in Ω) connected in series with the diode for obtaining maximum current –



PER007

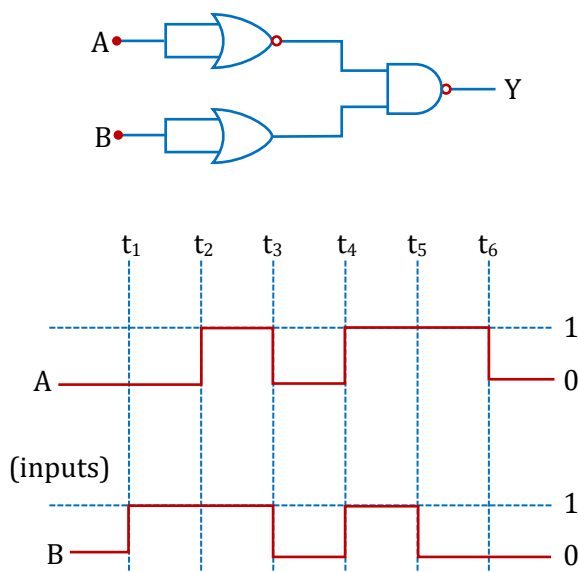
5. A sinusoidal voltage of peak value 200 volt is connected to a diode and resistor R in the circuit shown so that half wave rectification occurs. If the forward resistance of the diode is negligible compared to R then rms voltage (in volt) across R is approximately –



PSC014

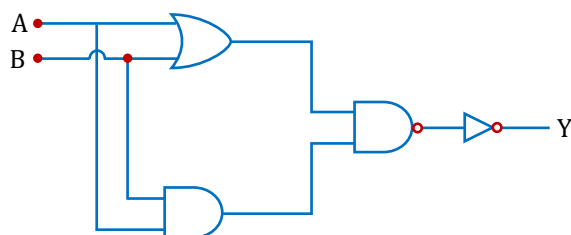
PSC015

6. For the following circuit and given inputs A and B , find output between t_5 to t_6 .



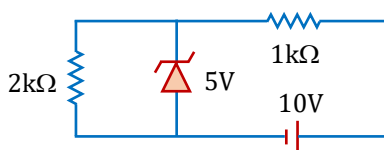
PSC105

7. The logic operations performed by the given digital circuit.
If $A = 1, B = 1$, find Y .



PSC106

8. In connection with the circuit drawn below, the value of current flowing through $2\text{ k}\Omega$ resistor is _____ $\times 10^{-4}\text{ A}$.



PSC018

JEE (Advanced) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION-I

- This section contains **EIGHT** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:
Full Marks : +3 if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 if none of the bubbles is darkened.
Negative Marks : -1 in all other cases.

1. A wire has a mass $0.3 \pm 0.003 \text{ g}$, radius $0.5 \pm 0.005 \text{ mm}$ and length $6 \pm 0.06 \text{ cm}$. The maximum percentage error in the measurement of its density is :-
 (A) 1 (B) 2 (C) 3 (D) 4

PER022

2. A vernier callipers having 1 main scale division = 0.1 cm is designed to have a least count of 0.02 cm . If n be the number of divisions on vernier scale and m be the length of vernier scale, then:
 (A) $n = 10, m = 0.5 \text{ cm}$ (B) $n = 9, m = 0.4 \text{ cm}$
 (C) $n = 10, m = 0.8 \text{ cm}$ (D) $n = 10, m = 0.2 \text{ cm}$

PER023

3. When the gap is closed without placing any object in the screw gauge whose least count is 0.005 mm , the 5th division on its circular scale coincides with the reference line on main scale, and when a small sphere is placed reading on main scale advances by 4 divisions, whereas circular scale reading advances to five times to the corresponding reading when no object was placed. There are 200 divisions on the circular scale. The radius of the sphere is
 (A) 4.10 mm (B) 4.05 mm (C) 2.10 mm (D) 2.05 mm

PER024

4. In a metre bridge experiment null point is obtained at 20 cm from one end of the wire when resistance X is balanced against another resistance Y . If $X < Y$, then where will be the new position of the null point from the same end, if one decide to balance a resistance of $4X$ against Y -
 (A) 50 cm (B) 80 cm (C) 40 cm (D) 70 cm

PER025

5. A student performs an experiment for determination of $g \left(= \frac{4\pi^2 l}{T^2} \right)$ $l \approx 1 \text{ m}$ and he commits an error of Δl . For the experiment takes the time of n oscillations with the stop watch of least count ΔT and he commits a human error of 0.1 sec . For which of the following data, the measurement of g will be most accurate?

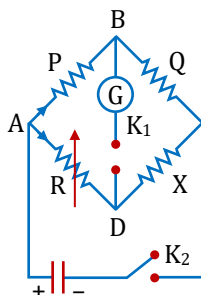
	Δl	ΔT	n	Amplitude of oscillation
(A)	5 mm	0.2 sec	10	5 mm
(B)	5 mm	0.2 sec	20	5 mm
(C)	5 mm	0.1 sec	20	1 mm
(D)	1 mm	0.1 sec	50	1 mm

PER026

6. In an experiment to determine the focal length (f) of a concave mirror by the u - v method, a student places the object pin A on the principal axis at a distance x from the pole P . The student looks at the pin and its inverted image from a distance keeping his/her eye in line with PA . When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then,
- (A) $x < f$ (B) $f < x < 2f$ (C) $x = 2f$ (D) $x > 2f$

PER027

7. In Wheatstone bridge experiment as shown in figure –



- (A) Key K_1 should be pressed first and then K_2 .
 (B) Key K_2 should be pressed first and then K_1 .
 (C) Any key can be pressed in any order.
 (D) Both keys should be pressed simultaneously.

PER028

8. In a resonance column method, resonance occurs at two successive level of $l_1 = 30.7 \text{ cm}$ and $l_2 = 63.2 \text{ cm}$ using a tuning fork of $f = 512 \text{ Hz}$. What is the maximum error in measuring speed of sound using relations $v = f\lambda$ and $\lambda = 2(l_2 - l_1)$
- (A) 256 cm/sec (B) 92 cm/sec (C) 128 cm/sec (D) 102.4 cm/sec

PER029

SECTION-II

- This section contains **FOUR** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 if only (all) the correct option(s) is (are) chosen.

Partial Marks : +3 if all the four options are correct but **ONLY** three options are chosen.

Partial Marks : +2 if three or more options are correct but **ONLY** two options are chosen, both of which are correct options.

Partial Marks : +1 if two or more options are correct but **ONLY** one option is chosen and it is a correct option.

Zero Marks : 0 if none of the options is chosen (i.e. the question is unanswered).

Negative Marks : -2 in all other cases.

For Example : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

9. In the Searle's experiment, after every step of loading, why should we wait for two minutes before taking the readings?
 (A) So that the wire can have its desired change in length.
 (B) So that the wire can attain room temperature.
 (C) So that vertical oscillations can get subsided.
 (D) So that the wire has no change in its radius.
PER030
10. Two resistance are $R_1 = 5.0 \pm 0.2 \Omega$ and $R_2 = 10.0 \pm 0.1 \Omega$. Equivalent resistance with limit of possible error is R_s and R_p when both resistances are connected in series and parallel respectively.
 (A) $R_s = 15.0 \Omega \pm 2\%$ (B) $R_p = 3.3 \Omega \pm 3\%$ (C) $R_s = 15.0 \Omega \pm 1\%$ (D) $R_p = 3.3 \Omega \pm 2\%$
PER031
11. A physical quantity P is related to four observables A, B, C and D as $P = 4\pi^2 A^3 B^2 / (\sqrt{C} D)$. The percentage error of the measurement in A, B, C and D are 1%, 3% and 2%, 4% respectively. Value of P is calculated 3.763.
 (A) Percentage error is 12% (B) Percentage error is 14%
 (C) Absolute error is 0.53 (D) Absolute error is 0.27
PER032
12. The period of oscillation of a simple pendulum in an experiment is recorded as 2.63 sec, 2.56 sec, 2.42 sec, 2.71 sec and 2.80 sec respectively:-
 (A) Time period is 2.62 sec (B) Average absolute error is 0.01 sec
 (C) Percentage error is 2.4% (D) Percentage error is 4.2%
PER033

SECTION-III

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows:

+										-									
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2				
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3				
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4				
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5				
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6				
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7				
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8				
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9				

- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 if ONLY the correct numerical value is entered as answer.
Zero Marks : 0 in all other cases.

13. The time period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\ell/g}$. The length of the pendulum is measured as $\ell = 10.0 \pm 0.1 \text{ cm}$ and the time period as $T = 0.50 \pm 0.02 \text{ s}$. Determine percentage error in the value of g .
PER034
14. The edge of a cube is measured using a vernier calliper. (9 division of the main scale is equal to 10 division of Vernier scale and 1 main scale division is 1 mm). The main scale division reading is 10 and 1 division of Vernier scale was found to be coinciding with the main scale. The mass of the cube is 2.736 g. The density is $\rho \text{ g/cm}^3$ upto correct significant figures. Find 100ρ .
PER035
15. The pitch of a screw gauge is 1 mm and there are 100 divisions on the circular scale. While measuring the diameter of a wire, the linear scale reads 1 mm and 47th division on the circular scale coincides with the reference line. The length of the wire is 5.6 cm. The curved surface area (in cm^2) of the wire in appropriate number of significant figures is A . Find $A \times 10$.
PER036
16. In a Searle's experiment, the diameter of the wire as measured by a screw gauge of least count 0.001 cm is 0.050 cm. The length, measured by a scale of least count 0.1 cm, is 110.0 cm. When a weight of 50 N is suspended from the wire, the extension is measured to be 0.125 cm by a micrometer of least count 0.001 cm. Maximum error in the measurement of Young's modulus of the material of the wire from these data is $P \times 10^9 \text{ N/m}^2$, then value of P is
PER037
17. A glass prism of angle $A = 60^\circ$ gives minimum angle of deviation $\theta = 30^\circ$ with the max. error of 1° when a beam of parallel light passed through the prism during an experiment. The permissible error in the measurement of refractive index μ of the material of the prism is $\frac{x\pi}{y}\%$ then value of $x + y$ is _____.
PER038
18. In a vernier calipers the main scale and the vernier scale are made up of different materials. When the room temperature increases by $\Delta T^\circ\text{C}$, it is found the reading of the instrument remains the same. Earlier it was observed that the front edge of the wooden rod placed for measurement crossed the N^{th} main scale division and $(N + 2)$ MSD coincided with the 2nd VSD. Initially, 10 VSD coincided with 9 MSD. If coefficient of linear expansion of the main scale is α_1 and that of the vernier scale is α_2 . If α_1/α_2 is $\frac{x+0.8}{(N+2)}$ then value of 'x' is (Ignore the expansion of the rod on heating)
PER039

ANSWER KEY

EXERCISE - O

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	A	B	B	B	C	C	B	D	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	A	B	C	D	D	A	B	D	C	B
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	B	B	C	A	B	B	B	B	B	C
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	A	D	B	D	C	B	B	B	C	B
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	D	A	D	C	D	C	A	BC	AC	ABD
Que.	51	52	53	54	55	56	57	58		
Ans.	BC	AD	ACD	ABD	ABC	ABC	A	C		

EXERCISE - S

- 7
- 5
- $R_t = 3.64 \text{ mm}$
- $\bar{D} = 1.330 \text{ cm}$, $\overline{\Delta D} = 0.005 \text{ cm}$, Relative error = + 0.004 %, error = 0.4%
- 3
- $L.C. = \ell \left[\frac{1 - \cos \theta}{\cos \theta} \right]$
- $5.5 \pm 0.1 \text{ cm}$
- 4
- 1.25
- 2.50
- 8
- (i) 10 V (ii) 90 V (iii) 4 mA
- 13.

A	B	C	D	E	F	G
0	0	1	1	0	0	1
0	1	1	0	0	1	0
1	0	0	1	1	0	0
1	1	0	0	0	0	1

EXERCISE - JEE (Main) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	3	4	4	3	2	4	2	4	2	4
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	3	4	4	2	3	3	1	2	5	3
Que.	21	22	23	24	25	26	27			
Ans.	4	4	2	3	1	4	3			

EXERCISE - JEE (Advanced) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	D	4	BC	4	C	ABD	D	B	C	3 [2.99, 3.01]
Que.	11	12	13	14	15					
Ans.	1.35 to 1.45	1.30	C	C	1					

JEE (Main) Practice Paper

Section-A	Q.	1	2	3	4	5	6	7	8	9	10
	A.	3	1	1	1	2	3	2	4	2	2
	Q.	11	12	13	14	15	16	17			
	A.	2	1	1	3	2	3	1			
Section-B	Q.	1	2	3	4	5	6	7	8		
	A.	200	5	13	5	100	1	1	25		

JEE (Advanced) Practice Paper

Section-I	Q.	1	2	3	4	5	6	7	8
	A.	D	C	D	A	D	B	B	D
Section-II	Q.	9	10	11	12				
	A.	ABC	AB	BC	AD				
Section-III	Q.	13	14	15	16	17	18		
	A.	9	266	26	11	23	1		