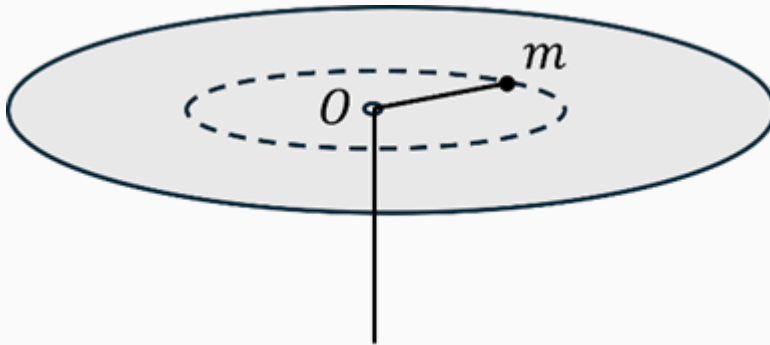


# Quiz Questions — olympiad2026

Q1.

Quiz Multichoice Single Answer Questions

A particle of mass  $m$  moves in a horizontal circle of radius 60 cm on a smooth table with speed  $v_0$ . The particle is connected by a light inextensible string that passes through a small frictionless hole  $O$  at the centre of the table, as shown in the figure. The string is then slowly pulled downward until the radius becomes 20 cm. The work done by the person pulling the string is



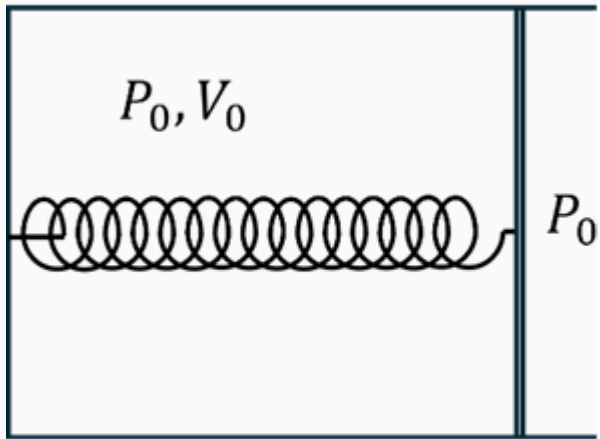
1.  $2mv_0^2$
2.  $3mv_0^2$
3.  $4mv_0^2$  (correct)
4.  $8mv_0^2$

Score: 4    Negative Score: 1

**Q2.**

Quiz Multichoice Single Answer Questions

As shown in the figure, one mole of a monatomic ideal gas is enclosed in a horizontal cylinder fitted with a frictionless movable piston of area  $A$ . The piston is attached to a spring of spring constant  $k$ . The outer side of the piston is exposed to the atmosphere at pressure  $P_0$ . Initially, the spring is in its natural length, and the gas has pressure  $P_0$ , volume  $V_0$ , and temperature  $T_0$ , such that  $kV_0 = A^2P_0$ . The gas is now heated very slowly. Consider a very small rise in temperature  $dT$  starting from this initial state. The heat supplied to the gas is



1.  $\frac{3}{2}RdT$

2.  $2RdT$  (correct)

3.  $\frac{5}{2}RdT$

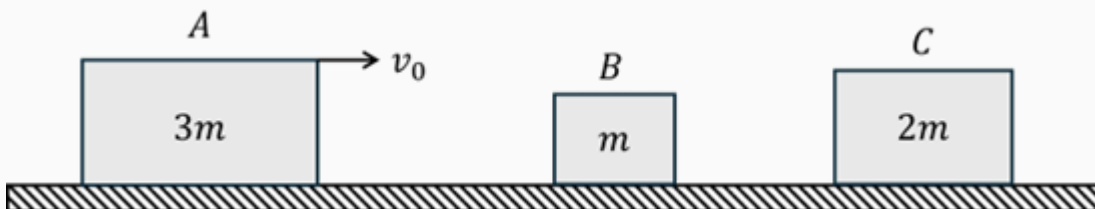
4.  $3RdT$

Score: 4 Negative Score: 1

**Q3.**

Quiz Multichoice Single Answer Questions

Three blocks of mass  $A$ ,  $B$  and  $C$  are placed on a co-linear smooth track in the order from left to right, respectively, as shown in the figure. Their masses are respectively,  $3m$ ,  $m$ , and  $2m$ , respectively. Initially, blocks  $B$  and  $C$  are at rest, while block  $A$  moves to the right with speed  $V_0$ . All collisions are perfectly elastic and take place along the same straight line. The final speed of block  $A$  is



1. 0 (correct)

2.  $\frac{v_0}{2}$

3.  $\frac{v_0}{4}$

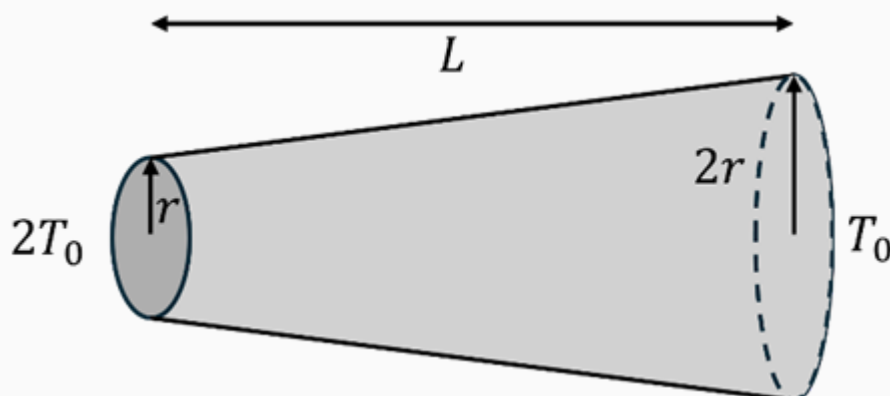
4.  $\frac{v_0}{6}$

Score: 4 Negative Score: 1

**Q4.**

Quiz Multichoice Single Answer Questions

As shown in the figure, a truncated-cone shaped object of length  $L$  is made of a material of thermal conductivity  $k$ . The radius of the object is  $r$  at the left end and increases uniformly to  $2r$  at the right end. The surface of the object is perfectly insulated. The left end is kept at temperature  $2T_0$ , and the right end is kept at temperature  $T$ . After steady state is reached, the temperature at the point midway along the length of the object is

1.  $4T_0/3$  (correct)2.  $3T_0/2$ 3.  $5T_0/4$ 4.  $7T_0/5$ 

Score: 4 Negative Score: 1

**Q5.**

Quiz Multichoice Single Answer Questions

A geostationary satellite moves in a circular orbit of radius  $R$  around Earth with speed  $v_0$ . An impulse gives it an additional speed  $\Delta v$  in the radially outward direction. Ignore the atmosphere. The minimum value of  $\Delta v$  needed for the satellite to escape Earth's gravity is

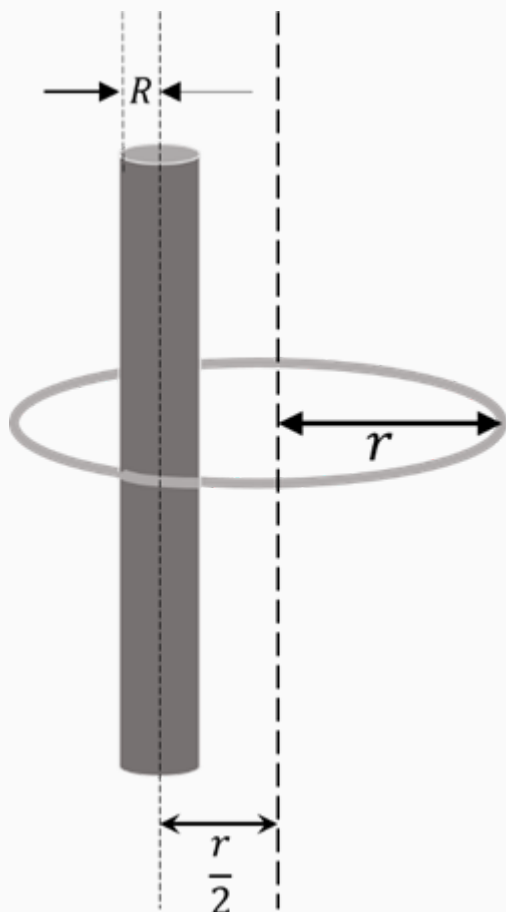
1.  $(\sqrt{2} - 1)v_0$ 2.  $(\sqrt{2} + 1)v_0$ 3.  $\sqrt{2} v_0$ 4.  $v_0$  (correct)

Score: 4 Negative Score: 1

**Q6.**

Quiz Multichoice Single Answer Questions

An infinitely long, ideal solenoid of radius  $R$  has  $n$  turns per unit length and carries a time-dependent current  $I(t) = I_0 e^{-\alpha t}$ , where  $\alpha$  is a small, positive constant. A circular metallic wire loop of radius  $r$  ( $r > R$ ) is positioned such that the solenoid is completely enclosed by the loop and the distance between the centre of the loop and the centre of the solenoid is  $r/2$  as shown in the figure. The radius of the cross-section of the wire is  $a \ll r$  and the conductivity of the metal wire is  $\sigma$ . Find the magnitude of the magnetic field  $B$  on the surface of the external loop during the time  $t > 0$ .



1.  $B = 0$  at all times  $t > 0$ .
2.  $B = \frac{1}{2} \pi \sigma \alpha \mu_0^2 n I_0 e^{-\alpha t} a R^2$ . **(correct)**
3.  $B = \frac{1}{2} \pi \sigma \alpha \mu_0^2 n I_0 e^{-\alpha t} a^2 R$ .
4.  $B = \frac{3\pi}{4} \sigma \alpha \mu_0^2 n I_0 e^{-\alpha t} a (r^2 - R^2)$ .

Score: 4    Negative Score: 1

**Q7.**

Quiz Fill In The Blanks Questions

Consider an infinitely long cylindrical plasma column with radius  $R = 500$  m, and carrying a steady current due to the motion of charged particles. The non-uniform current density varies with radial distance  $r$  from the central axis as  $J(r) = J_0(1 - r/R)$  for  $0 \leq r \leq R$ , where  $J_0 = 0.020$  A/m<sup>2</sup> is the current density at the centre. The current flows in the  $+z$  direction (along the axis of the column). Find the ratio of the magnetic fields at a radial distance of 250 m and 500 m from the centre of the column. (Given:  $\mu_0 = 4\pi \times 10^{-7}$  H/m)

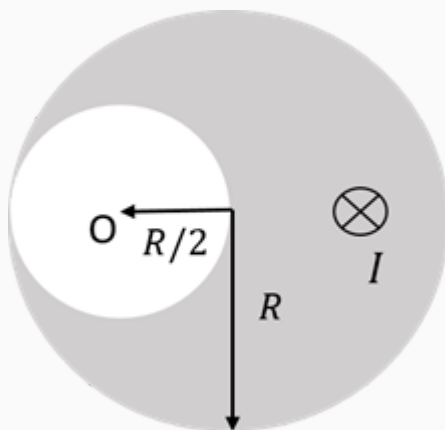
**Correct Answer: 1**

Score: 4    Negative Score: 1

**Q8.**

Quiz Multichoice Single Answer Questions

A long cylindrical wire of radius  $R$  carries a total current  $I$  along the axial direction (into the page) as shown in the figure. The current is uniformly distributed over its cross-section. The wire has a hollow cylindrical cavity of radius  $R/2$  whose boundary touches the centre of the wire and the outer surface of the wire as shown in the figure. Find the magnitude of the magnetic field at the centre O of the hollow cylindrical region.



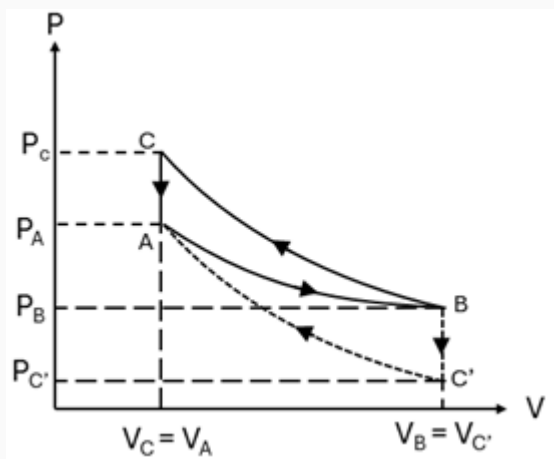
1.  $\frac{\mu_0 I}{2\pi R}$
2.  $\frac{\mu_0 I}{3\pi R}$  · (correct)
3.  $\frac{\mu_0 I}{4\pi R}$
4. 0

Score: 4    Negative Score: 1

### Q9.

Quiz Fill In The Blanks Questions

One mole of an ideal monatomic gas ( $\gamma = 5/3$ ) is initially in state A. The gas expands isothermally to state B. Consider two different reversible thermodynamic cycles ABC and ABC', both starting from A and having the A  $\rightarrow$  B isothermal expansion in common. Each cycle involves adiabatic compression and the isochoric process, as shown in the figure. Find the volume ratio  $V_B/V_A$  such that the  $\frac{|P_C - P_A|}{|P_B - P_{C'}|} = 32$ .



Correct Answer: 8

Score: 4 Negative Score: 1

### Q10.

Quiz Fill In The Blanks Questions

A UV light with wavelength  $\lambda = 290$  nm is incident on a metal with work-function  $W = 4.050$  eV. Find the maximum speed  $v_{max}$  of the emitted photo-electron as a fraction of the speed of light  $c$ . Express your answer as  $\frac{v_{max}}{c} \approx 1 \times 10^{-n}$ , where  $n$  is an integer. Find  $n$ .

(Given:  $h = 6.626 \times 10^{-34}$  J s;  $m_e c^2 = 511.9$  keV)

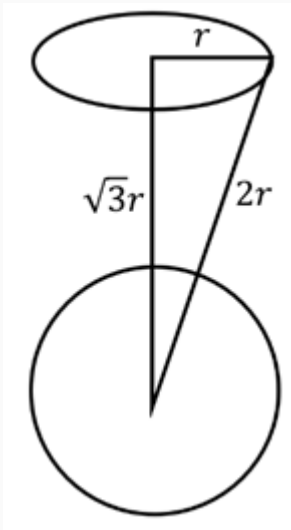
Correct Answer: 3

Score: 4 Negative Score: 1

**Q11.**

Quiz Multichoice Single Answer Questions

A uniform ring of mass  $m$  and radius  $r$  is placed above a uniform spherical shell of same radius and mass  $M$ . The center of the spherical shell is in the same line as the center of the ring at a distance  $\sqrt{3}r$ , as shown in the figure. The amplitude of the gravitational force exerted by the spherical shell on the ring is:



1.  $\frac{GMm}{8r^2}$

2.  $\frac{GMm}{4r^2}$

3.  $\frac{GMm}{8\sqrt{3}r^2}$

4.  $\frac{\sqrt{3}GMm}{8r^2}$  (correct)

Score: 4 Negative Score: 1

**Q12.**

Quiz Multichoice Single Answer Questions

A particle is dropped from a height of  $h$ , and another particle is projected vertically up from the ground at the same instant. They meet when the upper one has descended to a height  $h/2$ . What is the velocity of the upward travelling particle at the instant of meeting the downward falling particle

1. Same as downward falling particle

2. Twice that of the downward falling particle

3. Zero (correct)

4. None of these

Score: 4 Negative Score: 1

### Q13.

Quiz Fill In The Blanks Questions

Consider a cylinder of length  $l$  and radius  $r$  is subjected to an external compressive force. Poisson's ratio is defined as the ratio between the strain along the force and the strain perpendicular to the force. Assuming the force is within the elastic limit of the cylinder, at what value of Poisson's ratio can the change in volume be zero.

**Correct Answer:** Lower Limit: 0.49 Upper Limit: 0.51 **OR** Lower Limit: 1.9 Upper Limit: 2.1

**Score:** 4 **Negative Score:** 1

### Q14.

Quiz Multichoice Single Answer Questions

A fluid with density  $\rho$  satisfies the equation of state  $\rho = \rho_0 \exp(\alpha P)$ , when subjected to a gravitational field. Here,  $P$  is the pressure,  $\rho_0$  sets the density at zero pressure and  $\alpha$  is a characteristic constant measured in the units of the inverse of the pressure. Which of the following statements would be correct?

1. Pressure varies linearly with height
2. Density varies linearly with height
3. Pressure varies logarithmically with height (**correct**)
4. Pressure does not vary

**Score:** 4 **Negative Score:** 1

### Q15.

Quiz Fill In The Blanks Questions

A liquid drop of radius 10 cm is sprayed into  $10^8$  droplets of equal size. Assuming the surface tension of the liquid is 171 mN/m, what is the energy spent in J in this process?

**Correct Answer:** Lower Limit: 9.8 Upper Limit: 10

**Score:** 4 **Negative Score:** 1

### Q16.

Quiz Multichoice Single Answer Questions

A particle is subjected to the potential given here  $u(x) = \frac{u_0}{a^4}(x^4 + 4ax^3 - 8a^2x^2)$  where  $u_0$  sets the energy scale and  $a$  is in the units of length. How many stable equilibrium points are there?

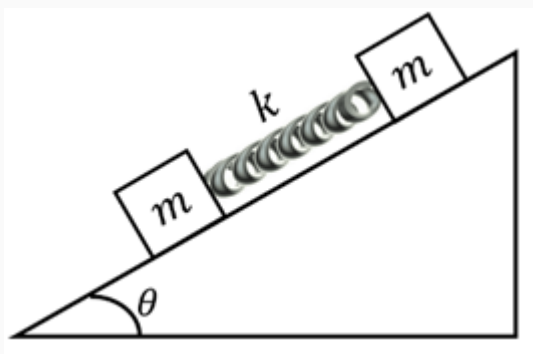
1. 3
2. 2 (**correct**)
3. 1
4. 0

**Score:** 4 **Negative Score:** 1

### Q17.

Quiz Multichoice Single Answer Questions

Consider two blocks of equal masses connected to a spring of stiffness  $k$  is kept on a frictionless floor tilted at an angle  $\theta$  with respect to the ground. How will the oscillation frequency of the coupled mass spring system depend on the tilt angle  $q$ .



1. Increase linearly with  $q$
2. Increase quadratically with  $q$
3. Decrease with  $q$
4. Does not depend on  $q$  (correct)

Score: 4 Negative Score: 1

### Q18.

Quiz Fill In The Blanks Questions

In a new unit system, the units of mass, length and time are chosen as  $\alpha$  in kg,  $\beta$  in m and  $\gamma$  in s, respectively. In this system the values of Planck's constant and universal gravitation constant are found to be unchanged. If  $\gamma = 4\sqrt{2}$  then the value of the ratio  $\alpha/\beta$  is

**Correct Answer:** Lower Limit: 0.24 Upper Limit: 0.26

Score: 4 Negative Score: 1

### Q19.

Quiz Fill In The Blanks Questions

Four concentric spherical soap bubbles, centered at origin, of radius 2, 4, 6 and 8 cm are made of the same soap solution. The excess pressure at radial distance  $r = 1, 3, 5$  and 7 cm from origin are denoted as  $p_1, p_3, p_5$  and  $p_7$ , respectively. The value of the ratio  $p_1/p_5$  will be

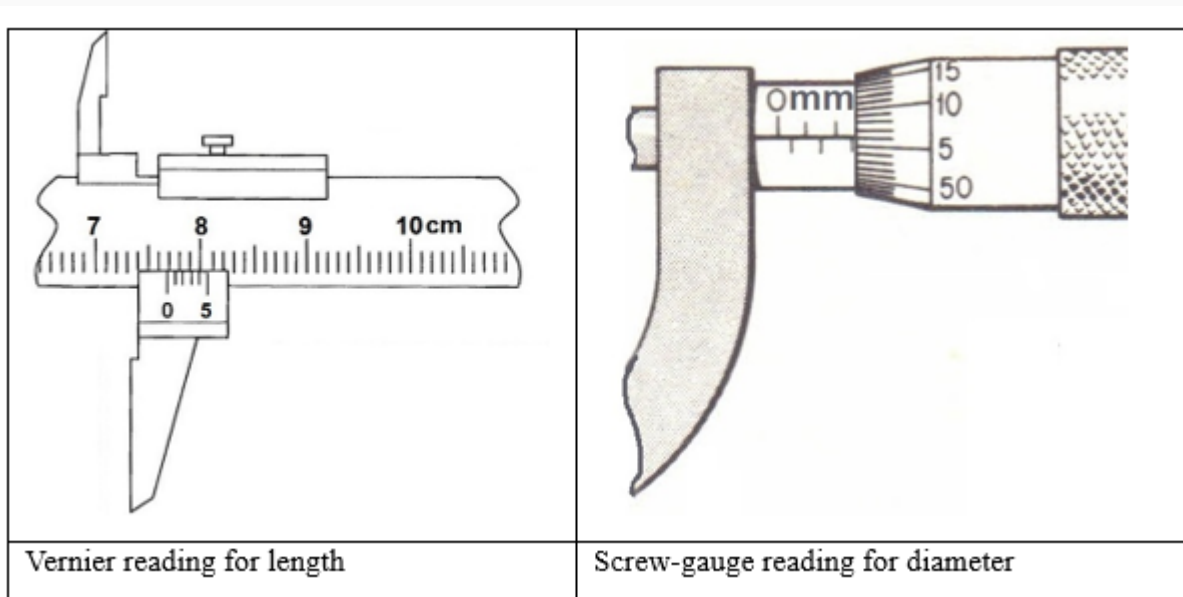
**Correct Answer:** Lower Limit: 3.5 Upper Limit: 3.7

Score: 4 Negative Score: 1

**Q20.**

Quiz Fill In The Blanks Questions

The length and diameter of a thin rod are measured using a Vernier calipers and screw-gauge, respectively. The figures below show the respective scales during this measurement:



The volume of the wire is thus deduced as  $V$  with error  $\Delta V$ . The value of the ratio  $V/\Delta V$  will be:

**Correct Answer:** Lower Limit: 95 Upper Limit: 97

Score: 4 Negative Score: 1

**Q21.**

Quiz Fill In The Blanks Questions

In an Ohm's law experiment, an ideal cell of 1.5 V emf, a non-ideal voltmeter with resistance  $R_V$  and a non-ideal Ammeter with resistance  $R_A$  are used to measure the voltage across and current through an ideal resistor of  $15\Omega$ . If the measured values of the voltage and current are 1.44 V and 0.1 A, respectively, then the value of the ratio  $R_V/R_A$  will be:

**Correct Answer:** Lower Limit: 599 Upper Limit: 601

Score: 4 Negative Score: 1

**Q22.**

Quiz Fill In The Blanks Questions

Equal moles of a monoatomic ideal gas are kept in two parts of a chamber of uniform cross-section area  $A$ . The two-parts are separated by a thermally insulating but movable piston. Initially both sides are in equilibrium at temperature  $T_0$  and with same volume  $V_0$ . The left-side gas is heated quasi-statically to temperature  $T_1$  while the right-side gas remains thermally isolated. If the piston moves by a distance  $x = \frac{19V_0}{27A}$ , then the value of  $(16T_1/T_0)$  will be:

**Correct Answer:** Lower Limit: 206 Upper Limit: 208

Score: 4 Negative Score: 1

### Q23.

Quiz Multichoice Single Answer Questions

A circularly polarized light beam of intensity  $I_0$  is incident at the Brewster angle  $\theta_B$ . After reflection the light passes through an ideal polarizer and is detected on a detector. The polarizer orientation is given below. Which of the following is true?

1. For polarizer pass axis perpendicular to the plane of incidence, the detected intensity is zero.
2. For polarizer pass axis parallel to the plane of incidence, the detected intensity is zero. **(correct)**
3. For polarizer pass axis perpendicular to the plane of incidence, the detected intensity is  $I_0/4$
4. For polarizer pass axis parallel to the plane of incidence, the detected intensity is  $I_0/4$

Score: 4    Negative Score: 1

### Q24.

Quiz Multichoice Single Answer Questions

Two separate experiments for imaging a real object are conducted, one using a lens and the other using a mirror. A virtual image is formed for all possible object distances in both the experiments. Which of the following optical elements were used in the two experiments?

1. Concave mirror and a concave lens.
2. Concave mirror and a convex lens.
3. Convex mirror and a convex lens.
4. Convex mirror and a concave lens. **(correct)**

Score: 4    Negative Score: 1

### Q25.

Quiz Fill In The Blanks Questions

An experiment is carried out using the Young's double slit interferometer, where the double slits are fixed and the screen is kept at a distance  $D$ . When a coherent blue light of wavelength 400 nm is used the width of the central bright fringe is found to be  $w$  at the screen placed at a distance  $D_b$ . The experiment is repeated with a green light of wavelength 560 nm, the width of the central bright fringe is adjusted to be the same as  $w$  at a screen distance  $D_g$ . Calculate the ratio of  $D_b/D_g$

**Correct Answer:** Lower Limit: 1.39    Upper Limit: 1.41

Score: 4    Negative Score: 1

**Q26.**

Quiz Multichoice Single Answer Questions

Two polarizers  $P_1$  and  $P_2$  are placed at a distance  $d$  from each other along the path of light. Their pass axes are oriented perpendicular to each other. A third polarizer  $P_0$  is introduced in between them, at a distance  $d/2$ . What should be the orientation of the pass angle of the polarizer  $P_0$  such that the transmitted light through them is maximized?

1.  $45^\circ$  with respect to the first polarizer. **(correct)**
2.  $30^\circ$  with respect to the first polarizer.
3.  $60^\circ$  with respect to the first polarizer.
4. For all orientations of the pass axis of  $P_0$ , the transmitted intensity will be zero.

Score: 4 Negative Score: 1

**Q27.**

Quiz Fill In The Blanks Questions

A metallic sphere of radius  $R = 0.5$  m is moved with a constant velocity  $v_0 \hat{x}$  in a uniform magnetic field  $B_0 \hat{z}$ . In steady state, if the potential difference between  $y = \pm R$  of the sphere is 10 V, then the magnitude of the electric field in V/m inside the sphere is:

**Correct Answer:** 10

Score: 4 Negative Score: 1

**Q28.**

Quiz Fill In The Blanks Questions

Two triangular prisms have apex angles  $90^\circ$  and  $60^\circ$ , respectively. The refractive indices of the two prisms are chosen such that the angle of minimum deviation is half the angle of their respective apex angles. The ratio of the refractive indices of the two prisms is:

**Correct Answer:** Lower Limit: 1.07 Upper Limit: 1.09 **OR** Lower Limit: 0.91 Upper Limit: 0.93

Score: 4 Negative Score: 1

**Q29.**

Quiz Multichoice Single Answer Questions

A freshly prepared sample contains two radioactive isotopes  $X$  and  $Y$  in the ratio of number of undecayed nuclei  $N_X : N_Y = 2 : 1$ . Their half-lives are  $T$  and  $2T$ , respectively. After time  $t$  the ratio of the remaining undecayed nuclei become  $N_X : N_Y = 1 : 1$ . Then  $t$  is

1.  $2T$  (correct)

2.  $4T$

3.  $6T$

4.  $8T$

Score: 4    Negative Score: 1