

**JEE (MAIN)**

**TEST PAPER**

**SUBJECT : PHYSICS, CHEMISTRY, MATHEMATICS**

**TEST CODE : TEST PAPER-1**

**QUESTION PAPER**

**TIME : 3 HRS**

**MARKS : 300**

**INSTRUCTIONS**

**GENERAL INSTRUCTIONS :**

1. This test consists of 75 questions.
2. There are three parts in the question paper A, B, C consisting of Physics, Chemistry and Mathematics having 25 questions in each part
3. 20 questions will be Multiple choice questions & 5 questions will have answer to be filled as numerical value.
4. Marking scheme :

Type of Questions	Total Number of Questions	Correct Answer	Incorrect Answer	Unanswered
MCQ's	20	+4	Minus One Mark(-1)	No Mark (0)
Numerical Values	5	+4	No Mark (0)	No Mark (0)

5. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.

**OPTICAL MARK RECOGNITION (OMR) :**

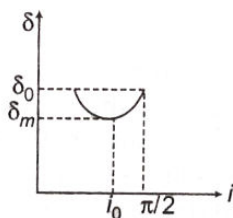
6. The OMR will be provided to the students.
7. Darken the appropriate bubbles on the OMR sheet by applying sufficient pressure.
8. The OMR sheet will be collected by the invigilator at the end of the examination.
9. Do not tamper with or mutilate the OMR. Do not use the OMR for rough work.
10. Write your name, Batch name, name of the center, Test Code, roll number and signature with pen in the space provided for this purpose on the OMR. Do not write any of these details anywhere else on the OMR.

**DARKENING THE BUBBLES ON THE OMR :**

11. Use a BLACK BALL POINT PEN to darken the bubbles on the OMR.
12. Darken the bubble COMPLETELY.
13. Darken the bubbles ONLY IF you are sure of the answer. There is NO WAY to erase or "un-darken" a darkened bubble.

## Part A - PHYSICS

- Q.1. Electromagnetic waves are produced by  
 (a) a static charge (b) a moving charge  
 (c) an accelerating charge (d) chargeless particle
- Q.2. During charging and discharging of a capacitor  
 (a) current flows in the circuit, which is constant during charging or discharging duration  
 (b) no current flows in the circuit  
 (c) current flows in the circuit and is varying with time  
 (d) during charging current is constant but while discharging current is variable
- Q.3. Internal energy of gas (ideal) depends only on  
 (a) pressure (b) temperature (c) volume (d) temperature and pressure
- Q.4. A stone has been thrown in vertical upward direction, from a balloon going up with an acceleration  $a$ . The acceleration of the stone after the throw is  
 (a)  $(g - a)$  upward (b)  $(g + a)$  upward (c)  $g$  upward (d)  $g$  downward
- Q.5. In the diagram, a plot between  $\delta$  (deviation) versus  $i$  (angle of incidence) for a triangular prism is given. From the observed plot, some conclusions can be withdrawn.



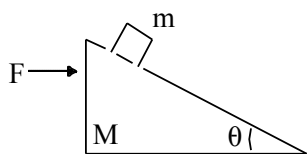
Mark out the correct conclusions.

- (a) the range of deviation for which two angles of incidence are possible for same deviation is  $\delta_0 - \delta_m$   
 (b) The curve is unsymmetrical about  $I_0$   
 (c) For a given  $\delta$ ,  $I$  is unique  
 (d) Both (a) and (b) are correct
- Q.6. If electric potential due to some charge distribution is given by  $V = 3/r^2$ , when  $r$  is radial distance, then find electric field at  $(1,1,1)$   
 (a)  $\frac{2}{\sqrt{3}}$  (b)  $\frac{2(\hat{i} + \hat{j} + \hat{k})}{3}$  (c)  $\frac{2}{8(\hat{i} + \hat{j} + \hat{k})}$  (d)  $\frac{3}{2(\hat{i} + \hat{j} + \hat{k})}$
- Q.7. The diagram showing the variation of gravitational potential of earth with distance from the centre of earth is
- (a)

(b)

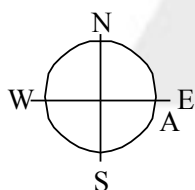
(c)

(d)
- Q.8. Which is untrue regarding molar heat capacity?  
 (a) it is path dependent (b) it is varying with phase  
 (c) it is path independent (d) None of the above
- Q.9. Find the force  $F$  to be applied on  $M$ , so that  $m$  remains stationary with respect to  $M$ ?



- (a)  $(M + m)g$  (b)  $(M + m)g \sin \theta$   
 (c)  $(M + m)g \cos \theta$  (d)  $(M + m)g \tan \theta$

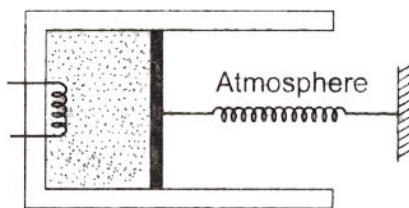
- Q.10 The diffusion current in a  $p-n$  junction is  
 (a) from the  $n$ -side to the  $p$ -side  
 (b) from the  $p$ -side to the  $n$ -side  
 (c) from the  $n$ -side to the  $p$ -side, if the junction is forward-biased and in the opposite direction, if it is reverse-biased  
 (d) from the  $p$ -side to the  $n$ -side, if the junction is forward-biased and in the opposite direction, if it is reverse-biased.
- Q.11 Consider two observers moving with respect to each other at a speed  $v$  along a straight line. They observe a block of mass  $m$  moving a distance  $l$  on a rough surface. The following quantities will be same as observed by the two observers  
 (a) kinetic energy of the block at time (b) work done by friction  
 (c) total work done on the block (d) acceleration of the block
- Q.12 Why does a glass sometimes break, if we quickly pour boiling water into it?  
 (a) Hot water expands, pushing the glass out  
 (b) The hot water cools when it touches the glass, shrinking and pulling the glass in  
 (c) The glass becomes hot and expands causing the molecules to break  
 (d) The inside of the glass expands faster than the outside of the glass, causing the glass to break
- Q.13 All the photons emitted by a source of light do not have the same energy. Now Mark the correct option  
 (a) it is not possible at all (b) Source is monochromatic  
 (c) Source is not monochromatic (d) Source must emit white light
- Q.14 A body is moving with uniform speed  $v$  in a horizontal circle in anti-clockwise direction as shown in figure. The motion starts from point A, find the change in velocity in second quarter of revolution.



- (a)  $\sqrt{2}v$  N - W (b)  $\sqrt{2}v$  N - E  
 (c)  $\sqrt{2}v$  S - W (d)  $\sqrt{2}v$  S - E

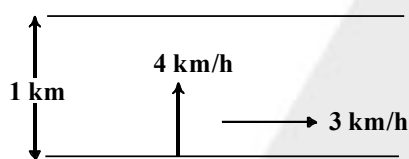
- Q.15 A parallel plate capacitor is made up of two plates having area  $10\text{cm}^2$  and are separated by 2 mm. There is a vacuum in between the plates. If we double the amount of initial charge on the capacitor, then what would be the final capacitance?  
 (a)  $8.85 \times 10^{-12} \text{ F}$  (b)  $4.425 \times 10^{-12} \text{ F}$  (c)  $17.7 \times 10^{-12} \text{ F}$  (d) None of these
- Q.16 Find the maximum potential difference which may be applied across an X-ray tube with tungsten target without emitting any characteristic K or L X-ray. The energy levels of tungsten atoms are as follows (K shell - 69.5 keV, L shell - 11.3 keV, M shell - 2.3 keV)  
 (a) 69.5 keV (b) 11.3 keV (c) 2.3 keV (d) 13.6 keV

- Q.17 An ideal monatomic gas is confined in a cylinder, fitted with piston, which is connected to spring as shown in figure,



The gas is heated by a small electric heater until the piston moves out slowly by 0.1 m. Find the work done by the gas. (Spring constant = 8000 N/m, piston area =  $8 \times 10^{-3} \text{ m}^2$ , atmospheric pressure =  $10^5 \text{ Pa}$ )

- (a) 40 J                      (b) 80 J                      (c) 120 J                      (d) 60 J
- Q.18 A mass of 250 g hangs on a spring and oscillates vertically with a period of 1.1 s. To double the period, what mass must be added to the 250 g ? (Ignore the mass of the spring)
- (a) 250 g                      (b) 450 g                      (c) 750 g                      (d) 550 g
- Q.19 A nearby massless rod is pivoted at one end so that it can swing freely as a pendulum. Two masses, 2 m and m, are attached to it at distances b and 3b, respectively, from the pivot. The rod is held horizontal and then released. Find its angular acceleration at the instant it is released.
- (a)  $2g/11b$                       (b)  $4g/17b$                       (c)  $5g/11b$                       (d)  $5g/12b$
- Q.20 A man can swim with a speed of 4 km/h in still water. How long does it take to cross a river 1 km wide, if the river flows steadily at 3 km/h and he makes his strokes normal to the river current ? How far down the river does he go when he reaches the other bank ?



- (a)  $1/3 \text{ h}, 1 \text{ km}$                       (b)  $1/4 \text{ h}, 4/3 \text{ km}$                       (c)  $1/3 \text{ h}, 3/4 \text{ km}$                       (d)  $1/4 \text{ h}, 3/4 \text{ km}$
- Q.21 A ball has been dropped from a height of 64 m above the ground level. Find the distance travelled by the ball in 4th second of its flight. Assume ball comes to rest after collision with ground [Take  $g = 9.8 \text{ m/s}^2$ ]
- Q.22 Consider a parallel beam of light of wavelength 800 nm and intensity  $200 \text{ W/m}^2$ , determine the number of photons crossing  $1 \text{ cm}^2$  perpendicular to the beam in 2 s.
- Q.23 As a prank, someone drops a water-filled balloon out of a window. The balloon is released from rest at a height of 10 m above the ears of a man who is the target. Because of guilty conscience, the prankster shouts a warning after the balloon is released. The warning will do no good, if he shouted after the balloon reaches a certain point, even if the man could react infinitely quickly. Assuming that velocity of sound in air is 343 m/s, Find out how far above the man's ears this point is ?
- Q.24 Two charge particles  $+3\mu\text{C}$  and  $-2\mu\text{C}$  are placed 2 m apart. Half of the region between them is filled with a medium having relative permittivity 9. Find the electric force between two charges.
- Q.25 1 kg of water at  $0^\circ\text{C}$  is heated to  $100^\circ\text{C}$ , calculate its change in entropy [Swater =  $4190 \text{ J/kg-K}$ ]

**Part B - CHEMISTRY**

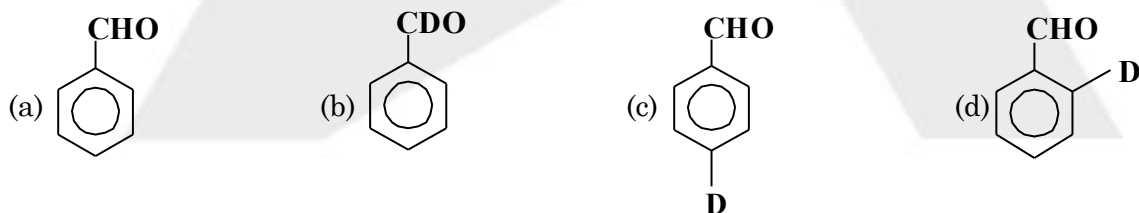
- Q.26 The tendency to form complexes is maximum for  
(a) normal elements  
(b) transition elements  
(c) inner-transition elements  
(d) metals containing fully filled d-orbitals
- Q.27  $\text{TiH}_{1.73}$  is an example of which type of the hydride ?  
(a) Metallic (b) Ionic (c) Covalent (d) Polymeric
- Q.28 Which of the following is incorrect about vulcanisation of rubber ?  
(a) Vulcanised rubber has excellent elasticity  
(b) Vulcanised rubber increases resistance to oxidation and organic solvent  
(c) Vulcanisation usually establishes cross links at allylic position type reactive sites  
(d) Vulcanised rubber has high-water absorption tendency
- Q.29 The vapour density of a chloride of a metal is 81.5 ( $H = 1$ ) and the chloride contains 34.46 % metal. The specific heat of the metal is 0.115. The molecular formula of chloride is  
(a)  $\text{MCl}_2$  (b)  $\text{M}_2\text{Cl}_3$  (c)  $\text{MCl}_3$  (d)  $\text{MCl}_4$
- Q.30 Which of the following doesn't cause origin of charge on colloid ?  
(a) Preferential adsorption (b) Bredig's arc method  
(c) Micell's formation (d) Brownian movement
- Q.31 Transition metals have the electronic configuration  $(n-1)d^{1-10} ns^{1-2}$ . The d-orbitals are degenerate, Colour of transition metal ions is due to absorption of some wavelength. This result in  
(a) d-s transition (b) s-d transition  
(c) s-s transition (d) d-d transition
- Q.32 In the commercial electrochemical process for aluminium extraction, the electrolyte used is  
(a)  $\text{Al}(\text{OH})_3$  in  $\text{NaOH}$  solution  
(b) An aqueous solution of  $\text{Al}_2(\text{SO}_4)_3$   
(c) A molten mixture of  $\text{Al}_2\text{O}_3$  and  $\text{Na}_3\text{AlF}_6$   
(d) A molten mixture of  $\text{Al}_2\text{O}_3$  and  $\text{Al}(\text{OH})_3$
- Q.33 When  $\text{CS}_2$  layer containing both  $\text{Br}_2$  and  $\text{I}_2$  is shaken with excess of  $\text{Cl}_2$  water, the violet colour due to  $\text{I}_2$  disappears and orange colour due to  $\text{Br}_2$  appears. The disappearance of violet colour is due to the formation of,  
(a)  $\text{I}_3^-$  (b)  $\text{HIO}_3$  (c)  $\text{ICl}_2$  (d)  $\text{I}^-$
- Q.34 Which of the following reaction doesn't support the acidic nature of alkyne ?  
(a) Reaction with  $\text{HBr}$  (b) Reaction with Grignard reagent  
(c) Reaction with ammoniacal silver salt (d) Reaction with metallic sodium
- Q.35 Which of the following is known as pseudo alum ?  
(a)  $\text{KMn}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$  (b)  $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$   
(c)  $\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$  (d)  $\text{FeSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
- Q.36 A pale yellow precipitate and a gas with pungent odour are formed on warming dilute hydrochloric acid with an aqueous solution containing  
(a) Sulphate ion (b) Sulphide ion  
(c) thiosulphate ion (d) Sulphate ion
- Q.37 Schottky defect in crystals is observed when  
(a) unequal number of cations and anions are missing from the lattice  
(b) equal number of cations and anions are missing from the lattice

- (c) an ion leaves its normal site and occupies an interstitial site.  
 (d) density of the crystal is increased.

- Q.38 The vapour density of  $\text{PCl}_5$  at  $250^\circ\text{C}$  is found to be 57.9. Percentage dissociation at this temperature is  
 (a) 80 % (b) 22% (c) 40% (d) 60%
- Q.39 Which of the following statements is not correct ?  
 (a) Helium has the lowest boiling point among the noble gases  
 (b) Argon is used in electric bulbs  
 (c) Krypton is obtained during radioactive disintegration  
 (d) Xe forms  $\text{XeF}_6$
- Q.40 Which of the following has zero electron density in xy plane ?  
 (a)  $d_{z^2}$  (b)  $d_{x^2-y^2}$  (c)  $p_z$  (d)  $d_{xy}$
- Q.41 Which of the following alkali metal carbonates gives  $\text{CO}_2$  on heating as well as on treating with acids ?  
 (a)  $\text{Na}_2\text{CO}_3$  (b)  $\text{K}_2\text{CO}_3$  (c)  $\text{Rb}_2\text{CO}_3$  (d)  $\text{Li}_2\text{CO}_3$
- Q.42 Which of the following is incorrect about thermosetting polymers ?  
 (a) They soften on heating and harden on cooling irreversibly  
 (b) By heating polymer can be reshaped and reused  
 (c) They possess three dimensional network structure containing cross links  
 (d) They are strong-hard and more brittle
- Q.43 The process of zone refining is based upon  
 (a) fractional crystallisation  
 (b) fractional distillation  
 (c) magnetic properties of impurities  
 (d) impurities are less fusible than metals



The product formed is



- Q.45 The non existence of  $\text{PbI}_4$  is due to  
 (a) small size of  $\text{Pb}^{4+}$  ions and large size of  $\text{I}^-$  ions  
 (b) Highly oxidising power of  $\text{Pb}^{4+}$  ions  
 (c) Highly reducing power of  $\text{I}^-$  ions  
 (d) Both (b) and (c)
- Q.46 A metal electrode has a reduction potential of 0.136 V when measured against a standard calomel electrode ( $E^\circ$  calomel (oxidn) = -0.244 V). The potential of metal electrode against SHE is
- Q.47 5.39 g of a mixture of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  and anhydrous ferric sulphate requires 80 mL = of 0.125 N permanganate solution for complete conversion to the ferric sulphate. the individual weight of ferric sulphate in the original mixture is \_\_\_\_\_ .

- Q.48 A viral preparation was inactivated in a chemical bath. The inactivation process was found to be first order in virus concentration and at the beginning of the experiment 2.0% of the virus was found to be inactivated per minute. The value of  $k$  for the inactivation process is
- Q.49 At which pressure and temperature conditions is the behaviour of a real gas closest to that of an ideal gas ?
- Q.50 The ionic product of water at  $25^\circ\text{C}$  is  $1 \times 10^{-14}$ . The dissociation constant of water at  $25^\circ\text{C}$  is \_\_\_\_\_ .

## Part C - MATHEMATICS

- Q.51 If  $x > 1, y > 1, z > 1$  are in GP, then  $\frac{1}{1 + \ln x}, \frac{1}{1 + \ln y}, \frac{1}{1 + \ln z}$  are in  
 (a) AP (b) HP (c) GP (d) None of these
- Q.52 If  $\log_{0.3}(x-1) < \log_{0.09}(x-1)$ , then  $x$  lies in the interval  
 (a)  $(2, \infty)$  (b)  $(1, 2)$  (c)  $(-2, -1)$  (d) None of the above
- Q.53 From the top of a tower, the angle of depression of a point on the ground is  $60^\circ$ . If the distance of this point from the tower is  $\frac{1}{\sqrt{3} + 1}$  m, then the height of the tower is \_\_\_\_\_ .  
 (a)  $\frac{4\sqrt{3}}{2}$  m (b)  $\frac{\sqrt{3} + 3}{2}$  m (c)  $\frac{3 - \sqrt{3}}{2}$  m (d)  $\frac{\sqrt{3}}{2}$  m
- Q.54 If the normals from any point to the parabola  $x^2 = 4y$  cuts the line  $y = 2$  in points whose abscissae are in AP, then the slopes of the tangents at the 3 conormal points are in  
 (a) AP (b) GP (c) HP (d) None of these
- Q.55 The equation  $16x^2 - 3y^2 - 32x + 12y - 44 = 0$  represents a hyperbola  
 (a) The length of whose transverse axis is  $4\sqrt{3}$   
 (b) The length of whose conjugate axis is 4  
 (c) whose centre is  $(-1, 2)$   
 (d) Whose eccentricity is  $\sqrt{\frac{19}{3}}$ .
- Q.56 The point on the curve  $3y = 6x - 5x^3$ , the normal at which passes through the origin is.....?  
 (a)  $\left(1, \frac{1}{3}\right)$  (b)  $\left(\frac{1}{3}, 1\right)$  (c)  $\left(2, -\frac{28}{3}\right)$  (d)  $\left(-1, \frac{1}{3}\right)$
- Q.57 The function  $f(x) = \sqrt{\cos(\sin x)} + \sin^{-1}\left(\frac{1+x^2}{2x}\right)$  is defined for?  
 (a)  $x \in \{-1, 1\}$  (b)  $x \in [-1, 1]$  (c)  $x \in \mathbb{R}$  (d)  $x \in (-1, 1)$

- Q.58 Let  $F(\alpha) = \begin{bmatrix} \cos \alpha & -\sin \alpha & 0 \\ \sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$ , where  $\alpha \in \mathbb{R}$ . Then,  $[F(\alpha)]^{-1}$  is equal to .....
- (a)  $F(2\alpha)$                       (b)  $F(\alpha^{-1})$                       (c)  $F(-\alpha)$                       (d) None of these
- Q.59 Ratio of the area cut off a parabola by any double ordinates is that of the corresponding rectangle contained by that double ordinate and tangent at vertex is
- (a)  $1/2$                       (b)  $1/3$                       (c)  $2/3$                       (d) 1
- Q.60 The interval in which the function  $f(x) = xe^{2-x}$  increases is
- (a)  $(2, \infty)$                       (b)  $(-\infty, 1)$                       (c)  $(0, 2)$                       (d) None of these
- Q.61 If  $z_1$  and  $z_2$  are two non-zero complex number such that  $|z_1 + z_2| = |z_1| + |z_2|$ , then  $\arg z_1 - \arg z_2$  is equal to
- (a)  $-\pi$                       (b)  $-\frac{\pi}{2}$                       (c) 0                      (d)  $\frac{\pi}{2}$
- Q.62 If B, C are square matrices of order n and if  $A = B + C, BC = CB, C^2 = 0$  then for any positive integer p,  $A^{p+1} = B^k [B + (p+1)C], k$  is
- (a)  $p+1$                       (b) p                      (c)  $p-1$                       (d)  $p+2$
- Q.63 If  $\alpha + i\beta$  is one of the roots of the equation  $x^3 + qx + r = 0$ , then  $2\alpha$  is one of the roots of equation
- (a)  $x^3 + qx + r = 0$                       (b)  $x^3 - px - r = 0$                       (c)  $x^3 + qx - r = 0$                       (d) None of these
- Q.64 Total number of solutions of  $|\cot x| = \cot x + \frac{1}{\sin x}, x \in [0, 3\pi]$  is equal to
- (a) 1                      (b) 3                      (c) 2                      (d) zero
- Q.65 The equation of the normal to the curve  $y(x-2)(x-3) - x + 7 = 0$  at the point, where it cuts the x-axis is
- (a)  $20x + y = 140$                       (b)  $20x - y = 7$                       (c)  $x - 20y = 7$                       (d)  $20x - y = 14$
- Q.66 If  $\int \frac{\cos 4x + 1}{\cot x - \tan x} dx = A \cos 4x + B$ , then
- (a)  $A = -\frac{1}{2}$                       (b)  $A = -\frac{1}{8}$                       (c)  $A = -\frac{1}{4}$                       (d) None of these
- Q.67  $\cos^{-1}[\cos\{2 \cot^{-1}(\sqrt{2}-1)\}]$  is equal to
- (a)  $\sqrt{2}-1$                       (b)  $\pi/4$                       (c)  $3\pi/4$                       (d) None of these
- Q.68 Which statement is correct ?
- (a)  $ac < 0$                       (b)  $ac > 0$                       (c)  $ab > 0$                       (d) None of these
- Q.69 The equation of the common tangent to the curves  $y^2 = 8x$  and  $xy = -1$  is
- (a)  $3y = 9x + 2$                       (b)  $y = 2x + 1$                       (c)  $2y = x + 8$                       (d)  $y = x + 2$



- Q.70 If the tangent from a point P to the circle  $x^2 + y^2 = 1$  is perpendicular to the tangent from P to the circle  $x^2 + y^2 = 3$ , then the locus of P is
- (a) a circle of radius 2 (b) a circle of radius 4  
(c) a circle of radius 3 (d) None of these
- Q.71 If n is an even natural number, then  $\sum_{r=0}^n \frac{(-1)^r}{{}^n C_r}$  equals to\_\_\_\_\_ .
- Q.72 If P(x, y, z) is a point on the line segment joining Q(2, 2, 4) and R(3, 5, 6) such that the projections of OP on the axes are  $\frac{13}{5}, \frac{19}{5}, \frac{26}{5}$  respectively, then P divides QR in the ratio ?
- Q.73 Let y be an implicit function of x defined by  $x^{2x} - 2x^x \cot y - 1 = 0$ , then y (1) equals
- Q.74 The elevation of an object on a hill is observed from a certain point in the horizontal plane through its base, to be  $30^\circ$ , After walking 120 m towards it on level ground, the elevation is found to be  $60^\circ$ , Then, the height of the object (in metres) is.....
- Q.75 The angle between two diagonals of a cube is.....

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