Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 09/12/2024

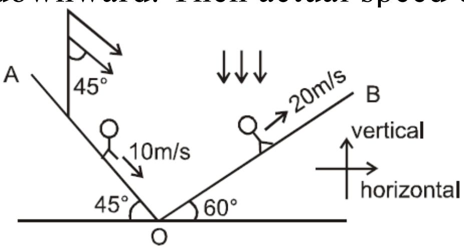
Time: 3 hours **Max. Marks:** 300

Pratham-1 (24-25)_FST

Physics

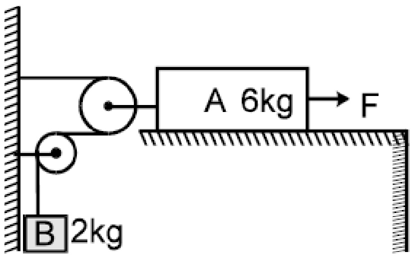
Single Choice Question

Q1 There are two inclined planes AO and OB inclined at 45° and 60° respectively with the horizontal as shown in figure. When a man moves on the inclined plane AO, he observes that the rain drops are falling at 45° with the vertical. When the man moves on the inclined plane OB, he observes that the raindrops are falling vertically downward. Then actual speed of rain w.r.t. ground is :



a) $5\sqrt{2}\,m/s$ **b)** $20\sqrt{3}\,m/s$ **c)** $10\sqrt{2}\,m/s$ **d)** None of these

Q2 The system starts from rest and A attains a velocity of 5 m/s after it has moved 5 m towards right .Assuming the arrangement to be frictionless every where and pulley & strings to be light, if the constant force F applied on A then find the value of F.

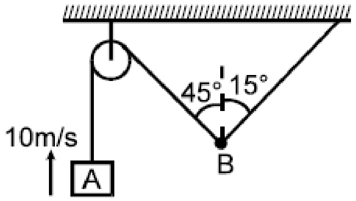


a) 75 **b)** 85 **c)** 95 **d)** 100

Q3 A uniform metallic spherical shell of inner radius R has a thickness t, such that $\frac{R}{t} = 1000$. The shell is kept in vacuum and also, there is vacuum inside the shell. If absolute temperature of metallic spherical shell is doubled, then the ratio of new radius to new thickness $\frac{R'}{t'}$ will be

a) 2000 **b)** 500 **c)** 1000 **d)** $\sqrt{2000}$

Q4 A system is shown in the figure. Block A moves with velocity 10 m/s. The speed of the mass B will be:



a) $10\sqrt{2}\,m/s$ b) $5\sqrt{3}\,m/s$ c) $\frac{20}{\sqrt{3}}\,m/s$ d) 10 m/s

Q5 The ratio of r.m.s. speed to the r.ms. angular speed of a diatomic gas at certain temperature is: (assume m = mass of one molecule, M = molecular mass, I = moment of inertia of the molecules)

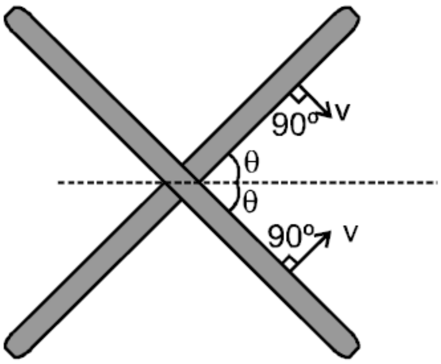
a) $\sqrt{\frac{3}{2}}$ b) $\sqrt{\frac{3I}{2M}}$ c) $\sqrt{\frac{3I}{2m}}$ d) 1

Q6 A particle with total mechanical energy, which is small and negative, is under the influence of a one dimensional potential $U(x) = x^4/4 - x^2/2$ J where x is in meters. At time t = 0 s, it is at x = – 0.5 m. Then at a later time it can be found.

a) anywhere on the x axis b) between x = – 1.0 m to x = 1.0 m

c) between x = – 1.0 m to x = 0.0 m d) between x = 0.0 m to x = 1.0 m.

Q7 Two rods are moving with constant velocity v in perpendicular direction to their length as shown in figure. The velocity of point of intersection of two rods will be :



a) v cosecθ b) v cosθ c) v sinθ d) 2vsinθ

Q8 A particle is moving with constant angular acceleration = α in a circular path of radius $\sqrt{3}\,m$. At t = 0, it was at rest and at t = 1 sec, the magnitude of its acceleration becomes $\sqrt{6}\,m/s^2$, then α is :

a) 2 rad/s^2 b) $\sqrt{3}$ rad/s^2 c) $\sqrt{2}$ rad/s^2 d) 1 rad/s^2

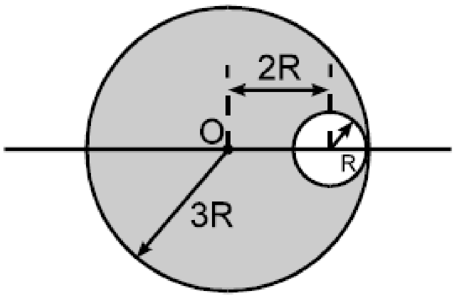
Q9 The energy density U/V of an ideal monoatomic gas is related to its pressure P as :

a) $\frac{U}{V} = 3P$ b) $\frac{U}{V} = \frac{3}{2}P$ c) $\frac{U}{V} = \frac{P}{3}$ d) $\frac{U}{V} = \frac{5}{2}P$

Q10 A body of mass m moving with velocity V makes a head-on elastic collision with another body of mass 2m which is initially at rest. The ratio of kinetic energies of colliding body before and after collision will be –

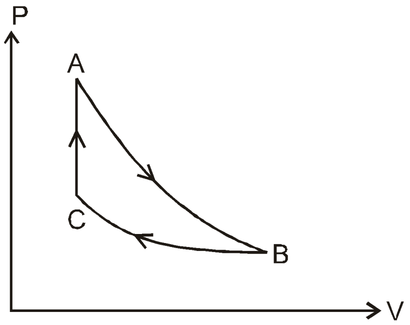
a) 9 : 1 b) 1 : 1 c) 4 : 1 d) 2 : 1

Q11 In the figure shown find out the distance of centre of mass of a system of a uniform circular plate of radius 3 R from O in which a hole of radius R is cut whose centre is at 2R distance from centre of large circular plate.



a) R/4 **b)** R/5 **c)** R/2 **d)** none of these

Q12 An ideal gas undergoes a cyclic process, in which one process is isochoric, one process is isothermal and one process is adiabatic. During the isothermal process, 40 J heat is released by the gas, and during the isochoric process, 80 J heat is absorbed by the gas. If work done by the gas during adiabatic process is W_1 and during isothermal process is W_2 then $\frac{W_1}{W_2}$ will be equal to :

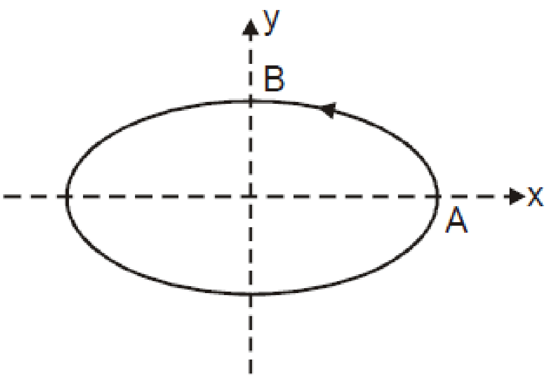


a) –2 **b)** 2 **c)** 4 **d)** –1/2

Q13 Two small boats are 10m apart on a lake. Each pops up and down with a period of 4.0 seconds due to wave motion on the surface of water. When one boat is at its highest point, the other boat is at its lowest point. Both boats are always within a single cycle of the waves. The speed of the waves is :

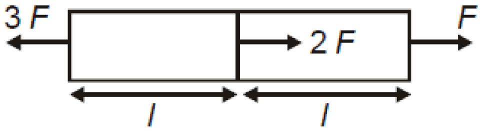
a) 2.5 m/s **b)** 5.0 m/s **c)** 14 m/s **d)** 40 m/s

Q14 A particle is moving along an elliptical path with a constant speed. As it moves from A to B, magnitude of its acceleration :



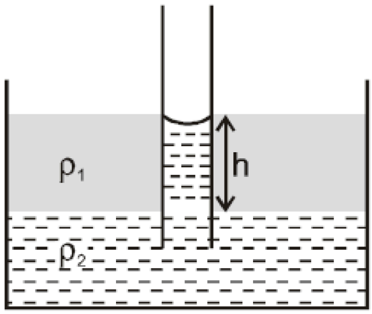
a) continuously increases **b)** continuously decreases **c)** Remains constant
d) first increases and then decreases

Q15 A bar is subjected to an axial forces as shown in figure. Find the total elongation in the bar. (E is the
modulus of elasticity of the bar and A is its area of cross-section)



a) $\frac{Fl}{AE}$ b) $\frac{2Fl}{AE}$ c) $\frac{3Fl}{AE}$ d) $\frac{4Fl}{AE}$

Q16 A container is partially filled with a liquid of density ρ_2. A capillary tube of radius r is vertically inserted in this liquid. Now another liquid of density ρ_1 ($\rho_1 < \rho_2$) is slowly poured in the container to a height h as shown. There is only denser liquid in the capillary tube. The rise of denser liquid in the capillary tube is also h. Assuming zero contact angle, the surface tension of heavier liquid is



a) $r\rho_2 gh$ b) $2\pi r\rho_2 gh$ c) $\frac{r}{2}(\rho_2 - \rho_1)gh$ d) $2\pi r(\rho_2 - \rho_1)gh$

Q17 A metre stick swinging in vertical plane about an fixed horizontal axis passing through its one end undergoes small oscillation of frequency f_0. If the bottom half of the stick were cut off, then its new frequency of small oscillation would become :

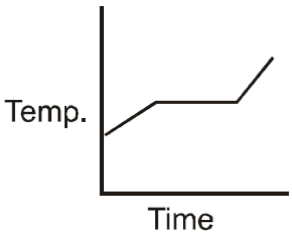
a) f_0 b) $\sqrt{2} f_0$ c) $2f_0$ d) $2\sqrt{2} f_0$

Q18 a piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is
absorbed by the ice and all energy of ice gets converted in to heat during its fall. The value of h is :
[Latent heat of ice is 3.4×10^5 J/Kg and g = 10 N/kg]

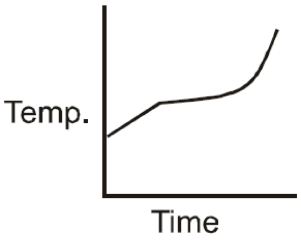
a) 68 km b) 34 km c) 544 km d) 136 km

Q19 Liquid oxygen at 50K is heated to 300 K at constant pressure of 1 atm. The rate of heating is constant.
Which one of the following graphs represents the variation of temperature with time ?

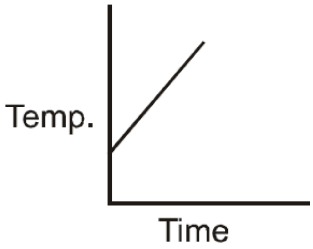
a)



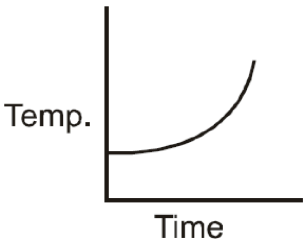
b)



c)



d)

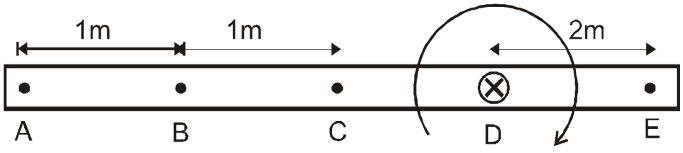


Q20 A uniform elastic rod of cross-section area A, natural length L and Young's modulus Y is placed on a smooth horizontal surface. Now two horizontal forces (of magnitude F and 3F) directed along the length of rod and in opposite direction act at two of its ends as shown. After the rod has acquired steady state, the extension of the rod will be

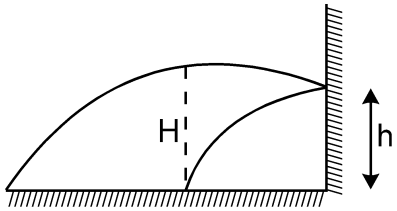
a) $\frac{2F}{YA}L$ **b)** $\frac{4F}{YA}L$ **c)** $\frac{F}{YA}L$ **d)** $\frac{3F}{2YA}L$

Numerical

Q21 The rod shown in figure is rotated with constant angular speed 2 rad/sec about an axis passing through point D and perpendicular to the rod. If K/3 is the ratio of angular speed of point B with respect to A to the angular speed of point E with respect to B then K = ?

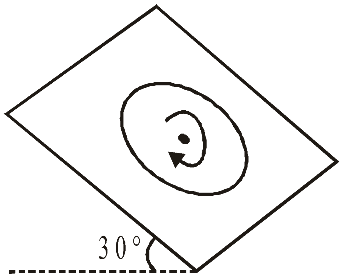


Q22 A stone is projected from a horizontal plane. It attains maximum height 'H' and strikes a stationary smooth wall and falls on the ground vertically below the maximum height. Assuming the collision to be elastic and the height of the point on the wall where ball will strike is $\frac{nH}{4}$, find the value of n?

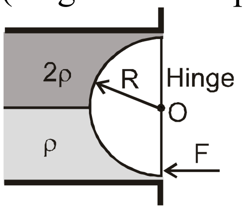


Q23 A particle moving in a straight line has magnitude of velocity v given by $v^2 = 12 - 3x^2$, where v is in m/s and x is in m. Find the amplitude of the oscillation of the particle in m.

Q24 An old record player of 10 cm radius turns at 10 rad/s while mounted on a 30° incline as shown in the figure. A particle of mass m can be placed any where on the rotating record. If the least possible coefficient of friction μ that must exist for no slipping to occur is μ, find $2\sqrt{3}\mu$.



Q25 A semi-cylindrical massless gate is hinged at O holding two immiscible liquids of densities 2ρ and ρ = 10^3 kg/m^3 as shown in figure. A horizontal force F is applied at its lowest position to keep it stationary. Find the magnitude of the force (in N). (Neglect atmospheric pressure) (R = 1m)



Chemistry

Single Choice Question

Q26 8 g of O^{2-} ion has amount of charge equal to : ($N_A = 6.02 \times 10^{23}$)

a) $5\ N_Ae$ **b)** $2\ N_Ae$ **c)** N_Ae **d)** $\frac{1}{2}N_Ae$

Q27 In a 1 L container following equilibrium is establlished with equal moles of $NO_2(g)$ & $N_2O_4(g)$. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at equilibrium $M_{avg.} = \frac{184}{3}$, then ratio of KC & total initial moles is.

a) 3 **b)** $\frac{3}{2}$ **c)** $\frac{27}{4}$ **d)** 6

Q28 The sequence of molecular orbitals for the carbide ion (C_2^{2-}) is -

a) $\sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma^*2s^2\ \pi2p^4$ **b)** $\sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma^*2s^2\ \pi2p^4\ \sigma2p^2$

c) $\sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma2p^2\ \pi2p^4\ \sigma^*2s^2$ **d)** $\sigma1s^2\ \sigma^*1s^2\ \sigma2s^2\ \sigma^*2s^2\ \sigma2p^2\ \pi2p^4$

Q29 The enthalipies of decomposition of methane (CH_4) (g) and ethane (C_2H_6)(g) are 400 and 670 kJ. mol^{-1}, respectively. The ΔH_{C-C} in $kJmol^{-1}$ is

a) 270 **b)** 70 **c)** 200 **d)** 240 ml

Q30 Photoelectric emission is observed from a surface for frequencies ν_1 and ν_2 of incident radiations ($\nu_1 > \nu_2$). If the maximum K.E. of photoelectrons in two cases are in the ratio of 2 : 1, then threshold frequency ν_0 is given by -

a) $\frac{\nu_2 - \nu_1}{2}$ **b)** $\frac{2\nu_1 - \nu_2}{(2-1)}$ **c)** $\frac{2\nu_2 - \nu_1}{(2-1)}$ **d)** $\nu_2 - \nu_1$

Q31 The incorrect statement among the following is:

a) beryllium oxide is amphoteric in nature

b) solubility of sulphates of second group elements decreases down the group

c) reducing power of hydride of alkali metal decreases down the group

d) Berylium has diagonal relationship with alumunium

Q32 Which is the correct order of 2nd I.E.

a) Si < S < P < Cl **b)** Si < P < S < Cl **c)** P < Si < Cl < S **d)** Si < P < Cl < S

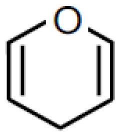
Q33 What is the molar solubility of $Mn(OH)_2$ in a buffer solution containing equal amount of NH_4^+ and $NH_3(aq)$.

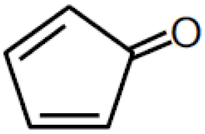
Given that – $(K_{SP})_{Mn(OH)_2} = 4.5 \times 10^{-14}$

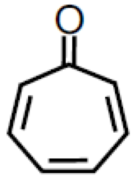
$(K_b)_{NH_3} = 1.8 \times 10^{-5}$

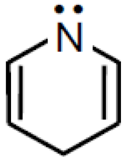
a) 1.38×10^{-3} **b)** 1.38×10^{-4} **c)** 2.38×10^{-4} **d)** 3.2×10^{-4}

Q34 Which of the following compound has aromatic character ?

a) 

b) 

c) 

d) 

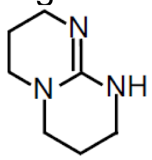
Q35 Which of the following relation is correct with respect to first (I) and second (II) ionization potentials of sodium and magnesium

a) $I_{Mg} = II_{Na}$ b) $I_{Na} > I_{Mg}$ c) $II_{Mg} > II_{Na}$ d) $II_{Na} > II_{Mg}$

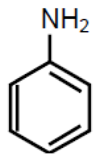
Q36 Among the following pairs, identify the pair in which both are diamagnetic and bond order is more than one?

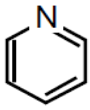
a) N_2 , O_2 b) B_2, O_2^{2-} c) C_2, O_2^{2+} d) F_2, O_2

Q37 Arrange the following in order of their pKb value

(A) 

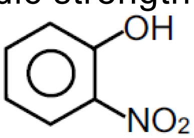
(B) CH_3–NH–CH_3

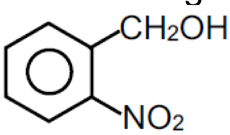
(C) 

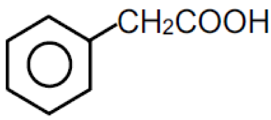
(D) 

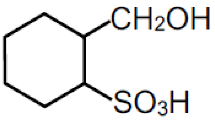
a) C > D > A > B b) A > B > D > C c) C > D > B >A d) D > C > B > A

Q38 Acidic strength order of the following compounds is ?

(A) 

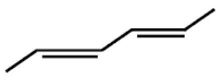
(B) 

(C) 

(D) 

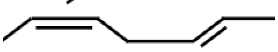
a) D > C > A > B b) D > A > B > C c) C > D > A > B d) C > A > B > D

Q39 Which is correct order for heat of hydrogenation of the following molecules?

(A) 

(B) 

(C) 

(D) 

a) D > C > B > A b) A > B > C > D c) D > B > A > C d) C > D > B > A

Q40 In which pair hybridisation of central atom or dorbitals used in hybridisation or both is/are wrong ?

a) BrF_5; sp^3d^2; $d_{z^2}, d_{x^2-y^2}$

b) SF_6; sp^3d^2; $d_{z^2}, d_{x^2-y^2}$

c) XeO_2F_2; sp^3d^2; $d_{z^2}, d_{x^2-y^2}$

d) IO_6^{5-}; sp^3d^2; $d_{z^2}, d_{x^2-y^2}$

Q41 In which compound C–Cl bond length is shortest?

a) Cl–CH=CH_2 b) Cl–CH=CH–CH_3 c) Cl–CH=CH–OCH_3 d) Cl–CH=CH–NO_2

Q42 Which of the following names is wrong according to IUPAC rules?

a) 4-Chloropentan-2-ol
b) 1-Bromohex-4-yne
c) 3-Hydroxybenzene-1-carbonitrile
d) 3-Bromo-1,1-dimethyl cyclopentane

Q43 Which of the following pairs of a chemical reaction is certain to result in spontaneous reaction ?

a) Exothermic and decreasing disorder
b) Endothermic and increasing disorder
c) Exothermic and increasing disorder
d) Endothermic and decreasing disorder

Q44 The ΔS for the vaporisation of 1 mol of water is 88.3 *J/mole K*. The value of ΔS for the condensation of 1 *mol* of vapour will be

a) 88.3 j/mol K
b) $(88.3)^2$ J/mol K
c) –88.3 J/mol K
d) $\frac{1}{88.3}$ J/mol K

Q45 The entropy change involved in the isothermal expansion of 1 moles of an ideal gas from a volume of 1 dm3 to a volume of 100 dm3 at 27°C is : (R = 8.3 J K^{-1} mol^{-1})

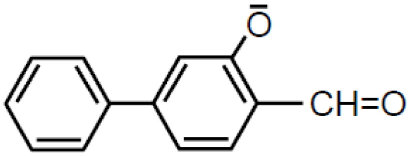
a) 38.2
b) 40.2
c) 36
d) 42

Numerical

Q46 For how many species the Ostwald dilution law is not applicable.
(i) H_2SO_4 (ii) KOH (iii) CH_3COOH (iv) $HClO_4$ (v) NaOH (vi) HI

Q47 How many structure isomers of carbonyl compounds (Aldehydes & ketones only) are possible for molecular formula $C_5H_{10}O$?

Q48 Negative charge of the given anion is delocalized at how many carbon atoms?



Q49 When oxygen gas is passed through Siemen's ozoniser, it completely gets converted into ozone gas. The volume of ozone gas produced at STP, if initally 96 g of oxygen gas was taken, is; if your answer is x, then what will be the value of $\frac{x}{22.4}$.

Q50 The heat of atomisation of methane and ethane are 360 kJ/mol and 639 kJ/mol, respectively. The longest wavelength of light capable of breaking the C-C bond in nm is if your answer if x then what will be value of $\frac{x}{100}$, write down your answer in terms of nearest integer.
(Avogadro number = 6×10^{23}, h = 6.6×10^{-34} J s) :

Mathematics

Single Choice Question

Q51 If 1 lies between the roots of $3x^2 - 3(\sin)\theta x - 2\cos^2\theta = 0$ then complete set of values of $\sin\theta$ is

a) $-\frac{1}{2} < \sin\theta < \frac{1}{2}$ **b)** $-\frac{1}{2} < \sin\theta < 0$ **c)** $\frac{1}{2} < \sin\theta < 1$ **d)** $0 < \sin\theta < \frac{1}{2}$

Q52 The number of integer value of m, for which the x – coordinate of the point of intersection of the lines $3x + 4y = 9$ and $y = mx + 1$ is also an integer is

a) 2 **b)** 0 **c)** 4 **d)** 1

Q53 If the roots of equation $x^3 + ax^2 + b = 0$ are α_1, α_2 and α_3; $(a, b \neq 0)$ then the equation whose roots are $\frac{\alpha_1\alpha_2 + \alpha_2\alpha_3}{\alpha_1\alpha_2\alpha_3}$, $\frac{\alpha_2\alpha_3 + \alpha_3\alpha_1}{\alpha_1\alpha_2\alpha_3}$, $\frac{\alpha_1\alpha_3 + \alpha_1\alpha_2}{\alpha_1\alpha_2\alpha_3}$

a) $ax^3 + bx - 1 = 0$ **b)** $bx^3 + ax - 1 = 0$ **c)** $ax^3 - bx - 1 = 0$ **d)** $bx^3 + ax + 1 = 0$

Q54 If $x^2 + 2ax + b \leq c, \forall x \in R$, then

a) $b - c \leq a^2$ **b)** $c - a \leq b^2$ **c)** $a - b \leq c^2$ **d)** None of these

Q55 If log 2, log $(2^n - 1)$ and log $(2^n + 3)$ are in arithmetic progression, then the value of n will be

a) $\frac{5}{2}$ **b)** $\log_2 5$ **c)** $\log_3 5$ **d)** $\frac{3}{2}$

Q56 For any $0 \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$, the expression $3(\sin\theta - \cos\theta)^4 + 6(\sin\theta + \cos\theta)^2 + 4\sin^6\theta$ equals :

a) $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$ **b)** $13 - 4\cos^2\theta + 6\cos^4\theta$ **c)** $13 - 4\cos^6\theta$

d) $13 - 4\cos^4\theta + 2\sin^2\theta\cos 2\theta$

Q57 If equations $ax^2 + bx + c = 0$ & $3x^2 + 4x + 5 = 0$ have a common root when a, b, c are sides of a triangle ABC, then $\angle A + \angle B = 30k$ where k equals

a) 3 **b)** 4 **c)** 6 **d)** 8

Q58 The equation of a tangent to the parabola $y^2 = 8x$ is $y = x + 2$. The point on this line from which the other tangent to the parabola is perpendicular to the given tangent is

a) (2, 4) **b)** (–2, 0) **c)** (–2, 0) **d)** (0, 2)

Q59 If a circle passes through the point (1, 2) and cuts the circle $x^2 + y^2 = 4$ orthogonally, then the equation of the locus of its centre is

a) $3x + 4y = 11$ **b)** $2x + 4y = 9$ **c)** $4x - 2y = 9$ **d)** $4x - 2y = 7$

Q60 If letters of the word “PARKAR' are written down in all possible manner as they are in a dictionary, then the rank of the word “PARKAR' is $k\left(\sum_{r=1}^{4} r!\right)$. Then find k

a) 3 **b)** 4 **c)** 6 **d)** 1

Q61 If the radius of in circle of a triangle with its sides 5p, 6p and 5p is 6, then find the value of p.

a) 3 **b)** 4 **c)** 5 **d)** 7

Q62 In an equilateral Δ, $r : R : r_1 =$

a) 1 : 2 : 3 **b)** 3 : 2 : 1 **c)** 3 : 1 : 2 **d)** None of these

Q63 Consider the set of all lines px + qy + r = 0 such that 3p + 2q + 4r = 0. Which one of the following statements is true?

a) The lines are all parallel **b)** The lines are not concurrent

c) The lines are concurrent at the point $\left(\frac{3}{4}, \frac{1}{2}\right)$

d) Each line passes through the origin

Q64 5 students of a class have an average height 150 cm and variance 18 cm^2. A new student, whose height is 156 cm, joined them. The variance (in cm^2) of the height of these six students is

a) 18 **b)** 20 **c)** 22 **d)** 16

Q65 If the fractional part of the number $\frac{2^{403}}{15}$ is $\frac{k}{15}$, then k is equal to

a) 8 **b)** 4 **c)** 6 **d)** 14

Q66 Incentre of the triangle formed by common tangents of the circles $x^2 + y^2 - 6x = 0$ and $x^2 + y^2 + 2x = 0$ is

a) (3, 0) **b)** (– 1, 0) **c)** (– 1/2, 0) **d)** (–5/2, 0)

Q67 If the parabolas $y^2 = 4b(x - c)$ and $y^2 = 8ax$ have a common normal, then which one of the following is a valid choice for the ordered triad (a, b, c)?

a) $\left(\frac{1}{2}, 2, 0\right)$ **b)** $\left(\frac{1}{2}, 2, 3\right)$ **c)** (1, 1, 0) **d)** (1, 1, 3)

Q68 If hyperbola $\frac{x^2}{b^2} - \frac{y^2}{a^2} = 1$ passes through the focus of ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ then eccentricity of hyperbola is -

a) $\sqrt{2}$ **b)** $\frac{2}{\sqrt{3}}$ **c)** $\sqrt{3}$ **d)** None of these

Q69 In a class of 100 students there are 70 boys whose average marks in a subject are 75. If the average marks of the complete class is 72. Then find the average of the girls.

a) 61 **b)** 65 **c)** 70 **d)** 72

Q70 If the sides a, b, c of a triangle ABC are in A.P. then $\frac{b}{c}$ belongs to

a) $\left(0, \frac{2}{3}\right)$ b) $(1, 2)$ c) $\left(\frac{2}{3}, 2\right)$ d) $\left(\frac{2}{3}, \frac{7}{3}\right)$

Numerical

Q71 Assuming the balls to be identical except for difference in colours, the number of ways in which one or more balls can be selected from 10 white, 9 green and 7 black balls is

Q72 The constant term in the expansion of $\left(x^2 - \frac{1}{x}\right)^9$ is

Q73 The sum of the coefficients in the expansion of $(1 + x - 3x^2)^{3148}$, is

Q74 Product of three consecutive terms of a G.P. is 512. If 4 is added to the first and the second terms, then three numbers now form an A.P. Sum of the original three terms of the given G.P. is

Q75 AB is a chord of the parabola $y^2 = 4x$ with vertex at A. BC is drawn perpendicular to AB meeting the axis at C. The projection of BC on the axis of the parabola is

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**C**	**A**	**C**	**C**	**C**	**C**	**A**	**D**	**B**	**A**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**A**	**A**	**B**	**B**	**D**	**C**	**B**	**D**	**A**	**A**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**3**	**2**	**6**	**0**	**C**	**B**	**B**	**B**	**C**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**C**	**D**	**B**	**C**	**D**	**C**	**C**	**A**	**A**	**C**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**D**	**B**	**C**	**C**	**A**	**5**	**7**	**3**	**2**	**12**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**C**	**A**	**B**	**D**	**B**	**C**	**A**	**B**	**B**	**A**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**B**	**A**	**C**	**B**	**A**	**B**	**D**	**C**	**B**	**C**
Que.	71	72	73	74	75					
Ans.	**879**	**84**	**1**	**28**	**4**					