Competishun

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

Date: 28/10/2024

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

PRATHAM-1 (24-25)-MCT-4

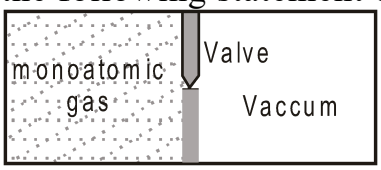
Physics

Single Choice Question

Q1 An ice block at 0°C is dropped from height 'h' above the ground. What should be the value of 'h' so that it just melts completely by the time it reaches the bottom assuming the loss of whole gravitational potential energy is used as heat by the ice ? [Given : L_f = 80 cal/gm]

a) 33.6 m **b)** 33.6 km **c)** 8 m **d)** 8 km

Q2 A non-conducting container is divided into two chambers that are separated by a valve. The left chamber contains one mole of a monoatomic gas and right chamber is evacuated. The valve is opened and gas rushes freely into the right chamber. Which of the following statement concerning this process is false.



a) There is no workdone by gas. **b)** The temperature of gas remain constant.

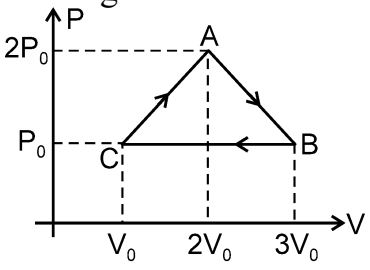
c) Pressure of the gas decreases. **d)** Root mean square velocity of gas increases.

Q3 A uniform horizontal meter scale (length = 1m) of mass m is suspended by two vertical strings attached to its two ends. A small body of mass 2 m is placed on the 75 cm from one end . The tension in the two strings are respectively :

a) $T_1 = mg, T_2 = 2mg$ **b)** $T_1 = 2mg, T_2 = mg$ **c)** $T_1 = 3mg/2, T_2 = 3mg/2$

d) $T_1 = 2mg/3, T_2 = 7mg/3$

Q4 P-V diagram of a cyclic process A → B → C → A is shown in figure. The temperature of the gas will be maximum at :



a) A **b)** B **c)** a point between A and B **d)** a point between B and C

Q5 The height of Victoria falls is 63 m. What is the difference in temperature of water at the top and at the bottom of fall? [Given 1 cal = 4.2 J and specific heat of water = 1 cal $g^{-1}\,{}^0C^{-1}$]

a) 0.147° C **b)** 14.76° C **c)** 1.476° C **d)** 0.014° C

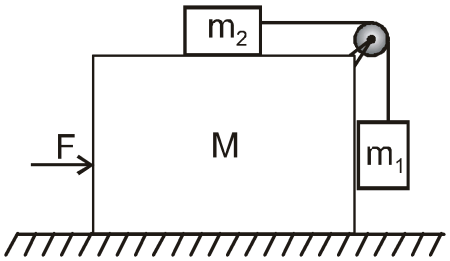
Q6 An unknown metal of mass 192 g heated to a temperature of 100°C was immersed into a brass calorimeter of mass 128 g containing 240 g of water at a temperature of 8.4°C. Calculate the specific heat of the unknown metal if water temperature stabilizes at 21.5°C. (Specific heat of brass is 394 J $kg^{-1}K^{-1}$)

a) 916 J $kg^{-1}K^{-1}$ **b)** 1232 J $kg^{-1}K^{-1}$ **c)** 654 J $kg^{-1}K^{-1}$ **d)** 458 J $kg^{-1}K^{-1}$

Q7 If at t = 0 a travelling wave pulse on a string is described by the function $y = \frac{10}{(5+x^2)}$, the wave function representing the pulse at time t, if the pulse is travelling along positive x axis with speed 2 ms^{-1} will be (y and x are in meter)

a) $\frac{10}{5+(x+2t)^2}$ **b)** $\frac{10+2t}{5+x^2}$ **c)** $\frac{10}{5+(x-2t)^2}$ **d)** none

Q8 A large cubical shaped block of mass M rests on a fixed horizontal surface. Two blocks of mass m_1 and m_2 are connected by a light inextensible string passing over a light pulley as shown. Neglect friction everywhere. Then the constant horizontal force of magnitude F that should be applied to M so that m_1 and m_2 do not move relative to M is :



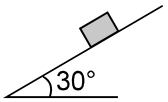
a) $F = \frac{m_2}{m_1}(m_1 + m_2 + M)g$ **b)** $F = \frac{m_1}{m_2}(m_1 + m_2 + M)g$ **c)** $F = \frac{m_1}{m_2}(m_1 + M)g$

d) $F = \frac{m_2}{m_1}(m_1 + M)g$

Q9 A uniform cylindrical rod of length L and radius r, is made from a material whose Young's modulus of Elasticity equals Y. When this rod is heated by temperature T and simultaneously subjected to a net longitudinal compressional force F, its length remains unchanged. The coefficient of volume expansion, of the material of the rod, is (nearly) equal to:

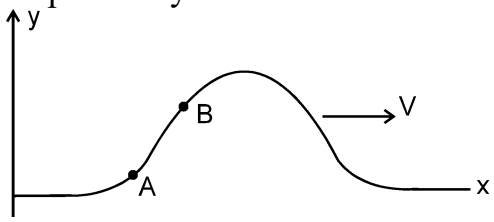
a) $9F / (\pi r^2 YT)$ **b)** $3F / (\pi r^2 YT)$ **c)** $F / (3\pi r^2 YT)$ **d)** $6F / (\pi r^2 YT)$

Q10 Figure shows a block kept on a rough inclined plane. The maximum external force along the plane downwards for which the block remains at rest is 1N while the maximum external force along the incline upwards for which the block is at rest is 7 N. The coefficient of static friction μ is



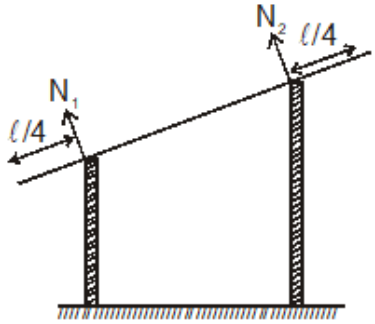
a) $\frac{\sqrt{3}}{2}$ **b)** $\frac{1}{\sqrt{6}}$ **c)** $\sqrt{3}$ **d)** $\frac{4}{3\sqrt{3}}$

Q11 A wave pulse is generated in a string that lies along x-axis. At the points A and B, as shown in figure, if R_A and R_B are ratio of wave speed to the particle speed respectively then :



a) $R_A > R_B$ **b)** $R_B > R_A$ **c)** $R_A = R_B$ **d)** Information is not sufficient to decide.

Q12 A uniform rod of length ℓ is placed symmetrically on two walls as shown in figure. The rod is in equilibrium. If N_1 and N_2 are the normal forces exerted by the walls on the rod then



a) $N_1 > N_2$ **b)** $N_1 > N_2$ **c)** $N_1 = N_2$

d) N_1 and N_2 would be in the vertical directions.

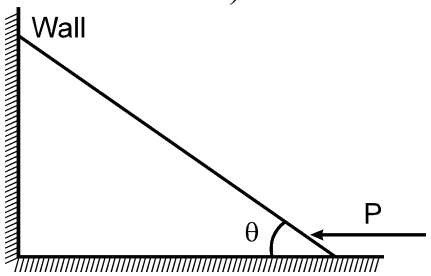
Q13 A vessel is partly filled with liquid. When the vessel is cooled to a lower temperature, the space in the vessel, unoccupied by the liquid remains constant. Then the volume of the liquid (V_L), volume of the vessel (V_v), the coefficients of cubical expansion of the material of the vessel (γ_v) and of the liquid (γ_L) are related as

a) $\gamma_L > \gamma_v$ **b)** $\gamma_L < \gamma_v$ **c)** $\gamma_v/\gamma_L = V_v/V_L$ **d)** None of these

Q14 Young's modules of material of a wire of length 'L' and cross-sectional area A is Y. If the length of the wire is doubled and cross-sectional area is halved then Young's modules will be :

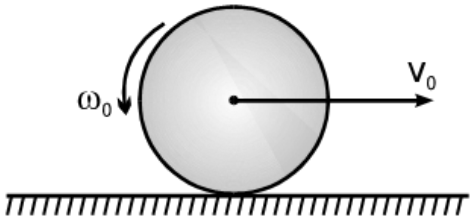
a) $\frac{Y}{4}$ **b)** 4 Y **c)** Y **d)** 2 Y

Q15 Assuming frictionless contacts, then the magnitude of external horizontal force P applied at the lower end for equilibrium of the rod will be : (The rod is uniform and its mass is ' m ')



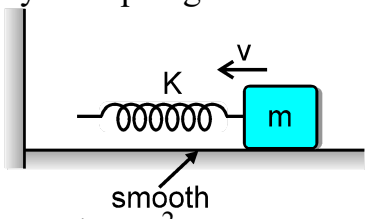
a) $\frac{mg}{2}$ **b)** $\frac{mg}{2}\cot\theta$ **c)** $\frac{mg}{2}\tan\theta$ **d)** $\frac{mg}{2}\sec\theta$

Q16 A uniform circular disc placed on a horizontal rough surface has initially a velocity v_0 and an angular velocity ω_0 as shown in the figure. The disc comes to rest after moving some distance in the direction of motion. Then v_0/ω_0 is:



a) R/2 **b)** R **c)** 3 R/2 **d)** 2

Q17 A block is attached with a spring and is moving towards a fixed wall with speed v as shown in figure. As the spring reaches the wall, it starts compressing. The work done by the spring on the wall during the process of compression is :



a) $1/2\ mv^2$ **b)** mv^2 **c)** Kmv **d)** zero

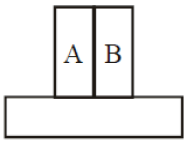
Q18 A force is applied to a steel wire 'A', rigidly clamped at one end. As a result elongation in the wire is 0.2 mm. If same force is applied to another steel wire 'B' of double the length and a diameter 2.4 times that of the wire 'A', the elongation in the wire 'B' will be (wires having uniform circular cross sections)

a) 6.06×10^{-2} mm **b)** 2.77×10^{-2} mm **c)** 3.0×10^{-2} mm **d)** 6.9×10^{-2} mm

Q19 The Young's modulus of a steel wire of length 6 m and cross-sectional area 3 mm^2, is 2×11^{11} N/m^2. The wire is suspended from its support on a given planet. A block of mass 4 kg is attached to the free end of the wire. The acceleration due to gravity on the planet is $\frac{1}{4}$ of its value on the earth. The elongation of wire is (Take g on the earth =10 m/s^2):

a) 1 cm **b)** 1 mm **c)** 0.1 mm **d)** 0.1 cm

Q20 A bimetallic strip consists of metals A and B. It is mounted rigidly as shown. The metal A has higher coefficient of expansion compared to that of metal B. When the bimetallic strip is placed in a cold both, it will :

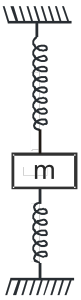


a) Bend towards the right **b)** Not bend but shrink **c)** Neither bend nor shrink

d) Bend towards the left

Numerical

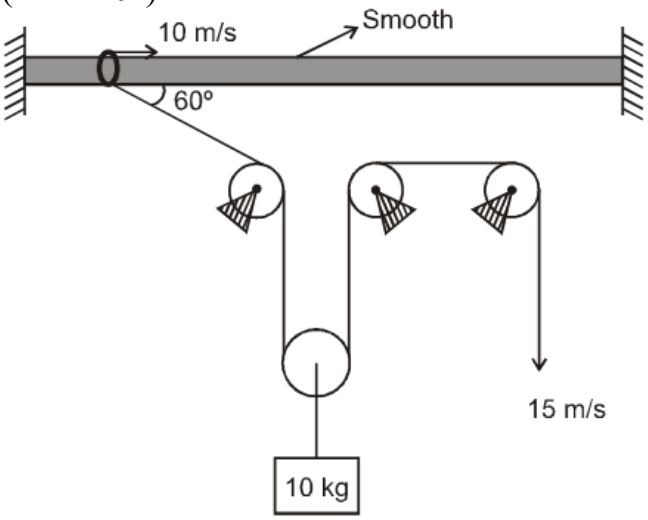
Q21 One end of a spring is fixed to the ceiling and other end is attached to a block. The block is released when spring is relaxed. The product of time period and amplitude is 8 S.I. units. If spring is cut in two equal parts and the two springs are attached to the block as shown in figure. The block is released when both springs are relaxed. Now find the product of time period and amplitude in S.I. units.



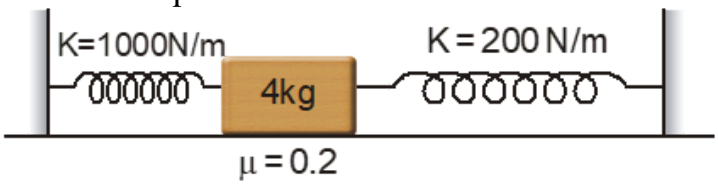
Q22 A rocket of total mass 1000kg initially is launched from ground. The gases are ejected at the rate 20kg/s with velocity 1000 m/s relative to rocket vertically downwards. The initial acceleration of the rocket is a (in m/s^2). Find $\frac{a}{g}$. (Take g = $10 m/s^2$)

Q23 A particle of mass 2kg starts to move at position x = 0 and time t = 0 under the action of force F = (10 + 4x) N along the x-axis on a frictionless horizontal track. Find the power delivered by the force in watts at the instant the particle has moved by the distance 5m.

Q24 All the pulleys are ideal, string is massless then rate of work done by gravity at the given instant is
$(-x \times 10^2)$ W then calculate x :



Q25 A block of mass 4 kg is connected with two light, horizontal springs in an arrangement as shown. Friction coefficient between the block and the surface is 0.2. Initially the block is held in a position in which the spring on the left side is compressed by 5 cm and the spring on the right side is non–deformed. Now block is moved very slowly. Find the minimum displacement of the block in mm after which it comes in equilibrium.



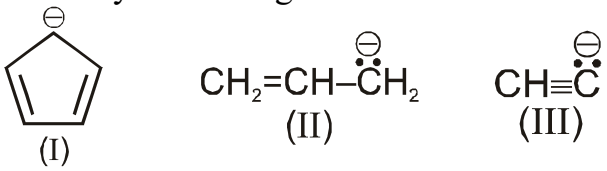
Chemistry

Single Choice Question

Q26 Which is most basic in aqueous solution?

a) CH_3NH_2 **b)** $(CH_3)_2NH$ **c)** $(CH_3)_3N$ **d)** $Ph–NH_2$

Q27 Stability order of given anions is :



a) I > III > II **b)** I > II > III **c)** III > II > I **d)** III > I > II

Q28 Pyridine is less basic than triethylamine because :

a) Pyridine has aromatic character **b)** Nitrogen in pyridine is sp^2 hybridised

c) Pyridine is a cyclic system **d)** In pyridine, lone pair of nitrogen is delocalised

Q29 At 25°C and 1 atm pressure, the enthalpy of combustion of benzene (ℓ) and acetylene (g) are –3268 kJ mol^{-1} and –1300 kJ mol^{-1}, respectively. The change in enthalpy for the reaction

$3\ C_2H_2(g) \rightarrow C_6H_6(\ell)$, is

a) + 324 kJ mol^{-1} **b)** +632 kJ mol^{-1} **c)** – 632 kJ mol^{-1} **d)** – 732 kJ mol^{-1}

Q30 In thermodynamics, a process is called reversible when :

a) surrounding and system change into each other.

b) there is no real boundary between system and surrounding.

c) the surrounding is always in equilibrium with the system.

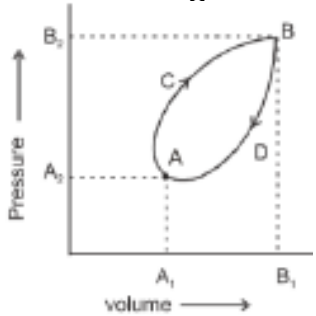
d) the system changes into the surrounding spontaneously

Q31 K_p of N_2O_4 and NO_2 at 1 atm and 384 K is 0.5 atm. Density of equilibrium mixture of the following reaction is :

$N_2O_4 \rightleftharpoons 2NO_2$

a) 2.54 g/dm^3 **b)** 2.18 g/dm^3 **c)** 3.87 g/dm^3 **d)** 6.5 g/dm^3

Q32 A thermodynamic system goes in cyclic reversible process as represented in the following P–V diagram:



The net work done during the complete cycle is given by the area :

a) cycle ACBDA **b)** AA_1B_1BDA **c)** AA_2B_2B **d)** AA_1B_1BCA

Q33 Which of the following are not state functions?
(I) q + W (II) q (III) W (IV) H – TS
a) (I) and (IV) **b)** (II), (III) and (IV) **c)** (I), (II) and (III) **d)** (II) and (III)

Q34 The decrease of pressure on ice ⇌ water system at constant temperature will lead to :
a) a decrease in the entropy of the system
b) an increase in the Gibbs energy of the system **c)** no effect on the equilibrium
d) a shift of the equilibrium in the backward direction

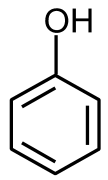
Q35 Molar concentration of 96 g of O_2 contained in a 2 litre vessel is :
a) 16 mol/litre **b)** 1.5 mol/litre **c)** 4 mol/litre **d)** 24 mol/litre

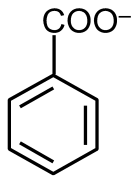
Q36 Which is correct order of ionic mobility in aqueous medium –
a) $Li^+_{(aq)} < Na^+_{(aq)} < Rb^+_{(aq)}$ **b)** $Al^{3+}_{(aq)} < Mg^{2+}_{(aq)} < Na^+_{(aq)}$ **c)** $Li^+_{(aq)} < Na^+_{(aq)} < K^+_{(aq)}$
d) Both (A) & (B)

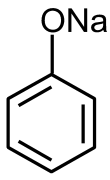
Q37 Which of the following group shows more polarization in sigma bond.
a) CH_3 –CN **b)** H_3C – OH **c)** H_3C – SH **d)** H_3C – Br

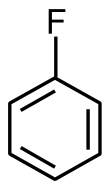
Q38 In which C – C bond of
$H_3\overset{1}{C} - \overset{2}{C}H_2 - \overset{3}{C}H_2 - \overset{4}{C}H_2 - Br$ the inductive effect is expected to be least?
a) $C_3 – C_4$ **b)** $C_2 – C_3$ **c)** $C_1 – C_2$ **d)** same in all bonds

Q39 Which statement is incorrect from the following ?
a) In Resonance only parallel p–orbital electron are shifted.
b) As Resonance energy increases stability of molecule increases.
c) Resonance hybrid is real structure.
d) In Resonance atoms does not changes its position.

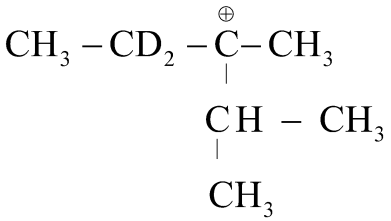
Q40 Which of the following group shows both +M & + I.
a) 

b) 

c) 

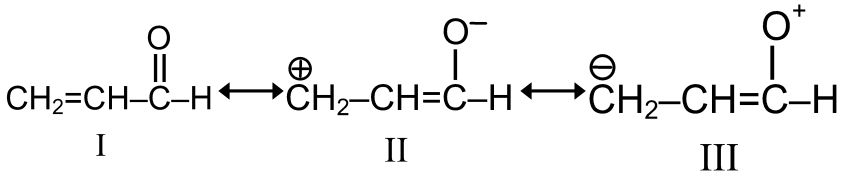
d) 

Q41 Calculate number of Hyperconjugative structure in the given molecules.



a) 5 **b)** 6 **c)** 4 **d)** 9

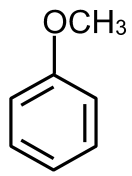
Q42 Following are the resonance structures of CH_2=CH–CHO Indicate relative stability of the resonance structures.

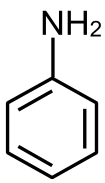


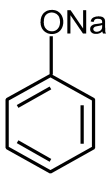
I II III

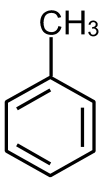
a) I > II > III **b)** I > II = III **c)** II > I > III **d)** I = II > III

Q43 In which compound electron density on ring is maximum.

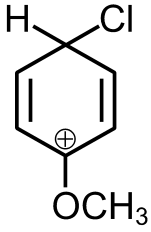
a) 

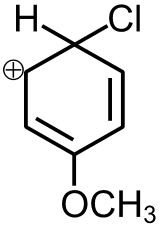
b) 

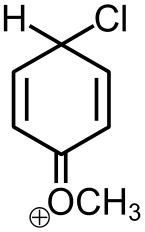
c) 

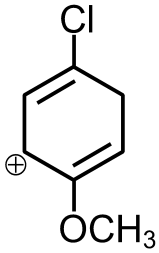
d) 

Q44 Which one of the following is most stable ?

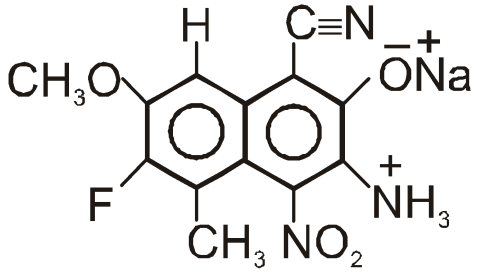
a) 

b) 

c) 

d) 

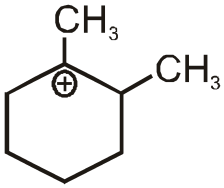
Q45 Few groups are attached with naphthalene out of the following how many groups exerts –I effect.



a) 3 **b)** 4 **c)** 5 **d)** 6

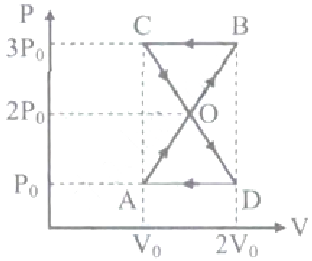
Numerical

Q46 Write the total number of hyperconjugable hydrogen atoms in the following species :



Q47 In a system, where $\Delta E = -15$ kJ, a piston expanded against a external pressure of 1.2 atm giving a change in volume of 75 lt. What was the magnitude of change in heat energy of this system (in kJ) ? (Take 1 lt atm = 100 J).

Q48 A thermodynamic system undergoes cyclic process ABCDA as shown in figure. Calculate the value of work done.



Q49 A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C, then the internal energy for vaporization in kJ mol^{-1} is ________. [nearest integer]
[Assume steam to be an ideal gas. Given $A_{vap}H^{\ominus}$ for water at 373 K and 1 bar is $41.1 kJmol^{-1}$; $R=8.31 JK^{-1}mol^{-1}$]

Q50 For reaction : $SO_2 (g) + \frac{1}{2} O_2 (g) \rightleftharpoons SO_3 (g)$, $K_P = 2 \times 10^{12}$ at 27°C and 1 atm pressure. The K_c for the same reaction is _______ $\times 10^{13}$. (Nearest integer)
(Given R = 0.082 L atm K^{-1} mol^{-1})

Mathematics

Single Choice Question

Q51 Sum of the non-real roots of $(x^2 + x - 2)(x^2 + x - 3) = 12$ is :

a) 1 **b)** -1 **c)** -6 **d)** 6

Q52 The equation $x^2 - 6x + 8 + \lambda(x^2 - 4x + 3) = 0$, $\lambda \in R$, has :

a) real and unequal roots for all λ **b)** real roots for $\lambda < 0$ only

c) real roots for $\lambda > 0$ only **d)** real and unequal roots for $\lambda = 0$ only

Q53 The sum of all the values of 'm' for which the roots x_1, x_2 of quadratic equation $x^2 - 2mx + m = 0$ satisfy $x_1^3 + x_2^3 = x_1^2 + x_2^2$ is

a) 3/4 **b)** 1 **c)** 4/3 **d)** 5/4

Q54 If $\tan A = \frac{3}{4}$ and A lies in third quadrant then $\frac{\sin A + \cos A}{\cot A}$ is equal to

a) $\frac{-20}{21}$ **b)** $\frac{-21}{20}$ **c)** $\frac{20}{21}$ **d)** $\frac{21}{20}$

Q55 If $\sin^2\theta = \frac{(1+x)^2}{4x}$ is true then

a) $x = 0, 1$ **b)** $x = -1, 1$ **c)** $x = -1, 0$ **d)** $x \in R^+ \cup \{-1\}$

Q56 The value of $\frac{(1+\tan 8^o)(1+\tan 37^o)}{(1+\tan 22^o)(1+\tan 23^o)}$ is

a) 0 **b)** 2 **c)** 8 **d)** 1

Q57 P is a variable point on the circle with centre C and radius 9 units. CA and CB are perpendiculars from C on x-axis and y-axis respectively, then centroid of the triangle PAB always lies on a circle of radius.....

a) 1 **b)** 4 **c)** 3 **d)** 2

Q58 If $x^2 + 9y^2 + 25z^2 = xyz\left(\frac{15}{x} + \frac{5}{y} + \frac{3}{z}\right)$ then x, y, z are in :

a) A.P. **b)** G.P. **c)** H.P. **d)** A.G.P.

Q59 The coefficient of x^{20} in the expansion of $(1 + x^2)^{40} \cdot \left(x^2 + 2 + \frac{1}{x^2}\right)^{-5}$ is

a) ${}^{30}C_{10}$ **b)** ${}^{30}C_{25}$ **c)** ${}^{30}C_{15}$ **d)** ${}^{30}C_{20}$

Q60 Number of divisors of the number $N = {}^{2000}C_0 + {}^{2000}C_1 + {}^{2000}C_2 + \ldots\ldots {}^{2000}C_{2000}$ is

a) 2001 **b)** 4002 **c)** 2000 **d)** 4000

Q61 A straight line through P(2,3) is such that its intercept between the coordinate axes is bisected at P its equation is

a) $x + 2y = 5$ **b)** $x + y - 3 = 0$ **c)** $4x + 6y + 1 = 0$ **d)** $3x + 2y - 12 = 0$

Q62 Let PS be the median of the triangle with vertices P(2, 2), Q(6, –1) and R(7, 3). The equation of the line passing through (1, –1) and parallel to PS is

a) $2x - 9y - 7 = 0$ **b)** $2x - 9y - 11 = 0$ **c)** $2x + 9y - 11 = 0$ **d)** $2x + 9y + 7 = 0$

Q63 There are n seats round a table marked 1, 2, 3------n. The number of ways in which m persons take seats is

a) ${}^{n-1}C_m \times (m-1)!$ **b)** ${}^{n}P_{m-1}$ **c)** $\frac{{}^{n-1}C_m}{m}$ **d)** ${}^{n}C_m \times m!$

Q64 If t_1 and t_2 be the ends of a focal chord of the parabola $y^2 = 4ax$, then the equation $t_1x^2 + ax + t_2 = 0$ has

a) imaginary roots **b)** both roots positive **c)** one positive and one negative roots

d) both roots negative

Q65 The mean of five observations is 5 and their variance is 9.20. If three of the given five observations are 1, 3 and 8, then a ratio of other two observations is

a) 4 : 9 **b)** 6 : 7 **c)** 10 : 3 **d)** 5 : 8

Q66 The number of non-negative integral solutions of $x_1 + x_2 + x_3 + x_4 \leq n$ (where n is a positive integer) is

a) ${}^{n+3}C_3$ **b)** ${}^{n+4}C_4$ **c)** ${}^{n+5}C_5$ **d)** ${}^{n+4}C_5$

Q67 If $a_1, a_2, \ldots\ldots a_n$ are positive number in A.P. then $\frac{\sqrt{a_1}+\sqrt{a_n}}{\sqrt{a_1}+\sqrt{a_2}} + \frac{\sqrt{a_1}+\sqrt{a_n}}{\sqrt{a_2}+\sqrt{a_3}} + \ldots. + \frac{\sqrt{a_1}+\sqrt{a_n}}{\sqrt{a_{n-1}}+\sqrt{a_n}}$ is equal to :

a) n + 1 **b)** n – 1 **c)** n **d)** n + 2

Q68 Greatest integer less than the number $\log_2 15 \,.\, \log_{1/6}2 \,.\, \log_3 1/6$ is

a) 4 **b)** 3 **c)** 2 **d)** 1

Q69 The complete solution set of inequality $||x - 3| - 2| > 4$ is

a) $(-\infty, -6) \cup (2, \infty)$ **b)** $(4, \infty)$ **c)** $(-\infty, -3) \cup (9, \infty)$ **d)** $(-\infty, -5] \cup (9, \infty)$

Q70 Consider a triangular plot ABC with sides AB = 7 m, BC = 5 m and CA = 6 m. A vertical lamp-post at the mid point D of AC subtends an angle 30° at B. The height (in m) of the lamp-post is

a) $2\sqrt{21}$ **b)** $7\sqrt{3}$ **c)** $\frac{2}{3}\sqrt{21}$ **d)** $\frac{3}{2}\sqrt{21}$

Numerical

Q71 If P be a point on the parabola $y^2 = 3(2x-3)$ and M is foot of perpendicular drawn from P on the directrix of the parabola, then length of each side of an equilateral triangle SMP, where S is focus of the parabola is :

Q72 If $\sum_{r=1}^{10}\left(\frac{1}{2(2r+1)} + \frac{1}{r(2r-1)}\right) = \frac{a}{b}$, where a and b are co-prime then value of a + b is

Q73 The number of arrangements which can be made out of the letters of the word ALGEBRA, without changing the relative order (positions) of vowels and consonants, is

Q74 The equation of the latus rectum of a parabola is $x + y = 8$ and the equation of tangent at the vertex is $x + y = 12$ then the square of length of the latus rectum is

Q75 Tangents PA and PB are drawn to circle $x^2 + y^2 = r^2$ from a point $P(7, \sqrt{15})$, then circum-radius of ΔPAB is...

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**B**	**D**	**A**	**C**	**A**	**A**	**C**	**B**	**B**	**D**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**A**	**C**	**A**	**C**	**B**	**A**	**D**	**D**	**C**	**D**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**1**	**1**	**3**	**5**	**35**	**B**	**A**	**B**	**C**	**C**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**B**	**A**	**D**	**D**	**B**	**D**	**A**	**C**	**A**	**C**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**B**	**A**	**C**	**C**	**C**	**6**	**6**	**0**	**38**	**1**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**B**	**A**	**D**	**B**	**B**	**D**	**C**	**C**	**B**	**A**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**D**	**D**	**D**	**C**	**A**	**B**	**B**	**C**	**C**	**C**
Que.	71	72	73	74	75					
Ans.	**6**	**61**	**72**	**128**	**4**					