Competishun

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

Date: 03/06/2024

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

$$\boxed{\text{PRAVEEN-2\_(24-25)-MPT-2}}$$

Physics

Single Choice Question

Q1 Two blocks A and B of masses m and 2m respectively are held at rest such that the string is in natural length. Find out the accelerations of both the blocks just after release.

a) $g \downarrow, g \downarrow$

b) $\frac{g}{3} \downarrow, \frac{g}{3} \uparrow$

c) $0, 0$

d) $g \downarrow, 0$

Q2 Three blocks are arranged as shown in which ABCD is a horizontal plane. Strings are massless and both pulley stands vertical while the strings connecting blocks m_1 and m_2 are also vertical and are perpendicular to faces AB and BC which are mutually perpendicular to each other. If m_1 and m_2 are 3 kg and 4 kg respectively. Coefficient of friction between the block $m_3 = 10$ kg and surface is $\mu = 0.6$ then, frictional force on m_3 is -

a) 30 N   b) 40 N   c) 50 N   d) 60 N

Q3 The block of mass m is placed on a rough horizontal floor and it is pulled by an ideal string by a constant force F as shown. As the block moves towards right on the floor, then the frictional force on block -

a) remains constant   b) increases   c) decreases   d) can not be calculated
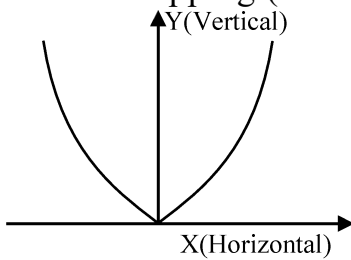
Q4 A parabolic bowl with its bottom at origin has the shape $\mathbf{y} = x^2/20$. Here x and y are in metres. The maximum height at which a small mass **m** can be placed on the bowl without slipping (coefficient of static friction is 0.5) is :

a) 2.5 m   **b)** 1.25 m   **c)** 1.0 m   **d)** 4.0 m

Q5 Three blocks A, B and C of equal mass m are placed one over the other on a smooth horizontal ground as shown in figure. Coefficient of friction between any two blocks of A, B and C is 1/2. The maximum value of mass of block D so that the blocks A, B and C move without slipping over each other is –
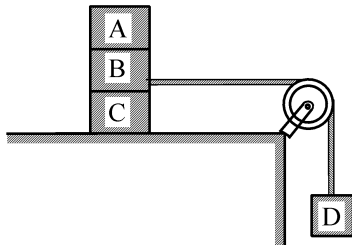
a) 6 m   **b)** 5 m   **c)** 3 m   **d)** 4 m

Q6 A stone is projected at time t = 0, with a speed V_0 and at angle θ with the horizontal in uniform gravitational field. The rate of work done (P) by the gravitational force plotted against time (t) will be as

a)   **b)**   **c)**   **d)**
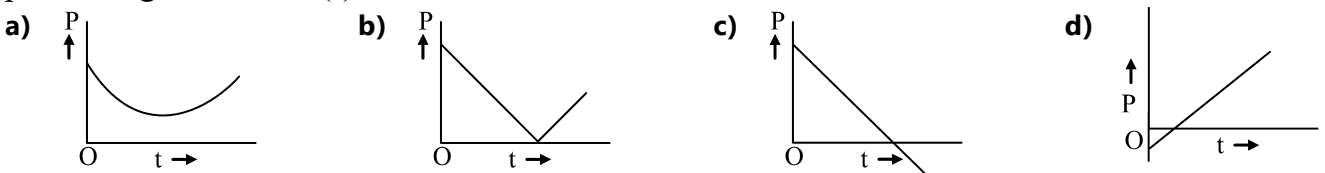
Q7 The only force acting on a block is along x-axis is given by $F = -\left(\dfrac{4}{x^2 + 2}\right)N$. When the block moves from x = – 2 m to x = 4 m, the change in kinetic energy of block is

**a)** Positive   **b)** Negative   **c)** Zero   **d)** May be positive or negative

Q8 A particle moves in x-y plane. The position vector of particle at any time t is $\vec{r} = \{(2t)\hat{i} + (2t^2)\hat{j}\}$ m. The rate of change of θ at time t = 2s. (where θ is the angle which its velocity vector makes with positive x-axis) is

a) $\dfrac{2}{17}$ rad/s   **b)** $\dfrac{1}{14}$ rad/s   **c)** $\dfrac{4}{7}$ rad/s   **d)** $\dfrac{6}{5}$ rad/s

Q9 A ray is incident perpendicularly on the surface AB of a transparent glass slab & is totally reflected at the surface CD. The minimum refractive index of the material of the slab is –
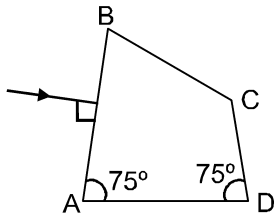

a) $\dfrac{2}{\sqrt{3}}$ b) $\sqrt{2}$ c) 2 d) $\dfrac{3}{2}$

Q10 A ray of light is incident at an $\angle$ of 30º on a plane mirror M_1. Another plane mirror M_2 is inclined at angle θ to M_1. What is the value of angle θ so that light reflected from M_2 is parallel to M_1.
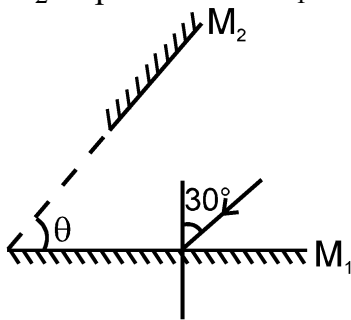

a) 60º   b) 75º   c) 67.5º   d) None of these

Q11 When light passes from one medium to another, then there is a change in its :
a) frequency, wavelength, and velocity   b) wavelength and velocity

c) frequency and wavelength   d) frequency and velocity

Q12 A luminous point object is moving along the principal axis of a concave mirror of focal length 12 cm towards it. When its distance from the mirror is 20 cm its velocity is 4 cm/s. The velocity of the image in cm/s at that instant is
a) 6, towards the mirror   b) 6, away from the mirror Z   c) 9, away from the mirror

d) 9, towards the mirror

**Q13** In the figure shown $\dfrac{\sin i}{\sin r}$ is equal to:
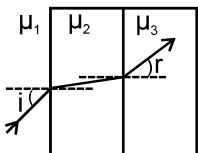
a) $\dfrac{\mu_2^2}{\mu_3\,\mu_1}$ b) $\dfrac{\mu_3}{\mu_1}$ c) $\dfrac{\mu_3\,\mu_1}{\mu_2^2}$ d) none of these

Q14 If a prism having refractive index $\sqrt{2}$ has angle of minimum deviation equal to the angle of refraction of the prism, then the angle of refraction of the prism is
a) 30°   b) 45º   c) 60º   d) 90º

Q15 r and r' denote the angles inside an equilateral prism, as usual, in degrees. Consider that during some time interval from t = 0 to t = t, r' varies with time as r' = $10 + t^2$. During this time r will vary as : (Assume that r and r' are in degree) :
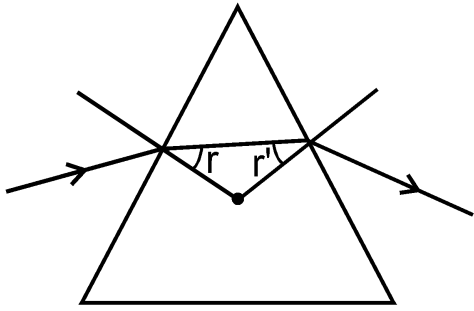

  a) $50 - t^2$ **b)** $50 + t^2$ **c)** $60 - t^2$ **d)** $60 + t^2$

Q16 A lens is placed between a source of light and a wall. It forms images of area A_1 and A_2 on the wall, for its two different positions. The area of the source of light is (source and wall are fixed)-

  a) $(A_1 A_2)^{1/2}$ **b)** $\dfrac{A_1 + A_2}{2}$ **c)** $\left(\dfrac{1}{A_1} + \dfrac{1}{A_2}\right)^{-1}$ **d)** $\left(\dfrac{\sqrt{A_1} + \sqrt{A_2}}{2}\right)^2$

Q17 A thief is running away on a straight road with a speed of 9 m s^{-1}. A police man chases him on a jeep moving at a speed of 10 m s^{-1}. If the instantaneous separation of the jeep from the motorcycle is 100m, how long will it take for the police man to catch the thief?

  a) 1s   **b)** 19s   **c)** 90s   **d)** 100s

Q18 A car is moving towards south with a speed of 20 m/s. A motorcylist is moving towards east with a speed of 15 m/s. At a certain instant (t = 0) the motorcyclist is due south of the car and is at a distance of 50m from the car. The shortest distance between the motorcyclist and the car is and the time after which they are nearest to each other after t = 0 :

  a) 10 m, 1.6 sec   **b)** 20 m, 1 sec   **c)** 30 m, 1.6 sec   **d)** 40 m, 1 sec

Q19 A block of mass 10 kg is released on a fixed wedge inside a cart which is moved with constant velocity 10 m/s towards right. Take initial velocity of block with respect to cart zero. Then work done by normal reaction (with respect to ground) on block in two seconds will be: (g = 10 m/s^2).
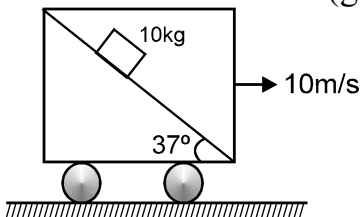
  a) zero   **b)** 960 J   **c)** 1200 J   **d)** none of these

Q20 A body of mass m is moving in a circle of radius r with a constant speed v. The force on the body is mv^2/r and is directed towards the centre. What is the work done by the force in moving the body half the circumference of the circle.

  a) $\dfrac{m v^2}{r} \cdot \pi r$ **b)** $m v^2$ **c)** $\dfrac{1}{2}m v^2$ **d)** zero

Numerical

Q21   A system consisting of man on platform is in equilibrium. Mass of man and platform are equal. If tension in left string is T_1 and that in right string in T_2. Length of platform is 3 m and man is standing at 1 m distance from left end of platform then $5T_1/T_2$ is -
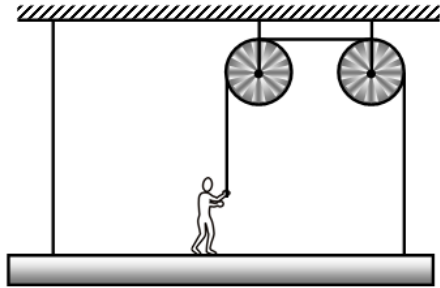
Q22 Two particles A and B are initially 40 m apart. A is behind B. Particle A is moving with uniform velocity of 10m/s towards B. Particle B starts from rest moving away from A with constant acceleration of 2 m/s². The minimum distance (in m) between the two is :

Q23 A river is flowing with a speed of 1 km/hr. A swimmer wants to go to point 'C' starting from 'A'. He swims with a speed of 5 km/hr, at an angle θ w.r.t. the river. If AB = BC = 400 m . Then the value of θ (in degree) is:
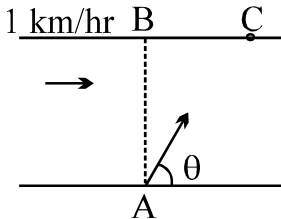
Q24 The position of a particle moving along x-axis is given as $x = t - t^2$ where x is in meter and t is in seconds, then work done (in J) by external agent having force $\vec{F} = (-3\hat{i} + 4\hat{j} + 12\hat{k})N$ between t = 0 to t = 2s is :

Q25 Find the velocity of A (in m/s).
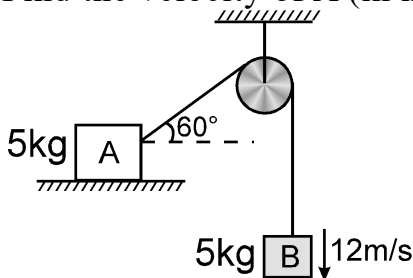
Q26 In the system shown in figure assume that all the pulleys are ideal and strings are inextensible. Velocities of block A and B are shown in figure.

Find velocity of C (in m/sec.).

Q27 A particle of mass 2 kg experience a net force of 8N towards North. With respect to a reference frame S acceleration of the particle is 4m/s^2 towards 30° North of west. Another particle of mass 1 kg experience force of $2\sqrt{3}$ towards east. What should be magnitude acceleration of the particle with respect to frame S.
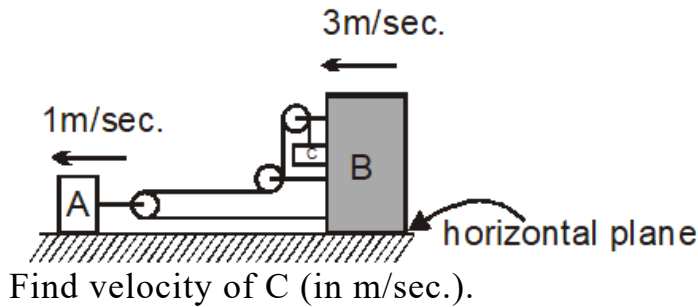
Q28 Two parallel beams of light pass through an isosceles prism of refractive index 1.4 as shown in the figure. The angle (in degree) between the two emergent rays is _____.
[$\sin 35^0 = 0.57$, $\sin^{-1}(0.798) = 53^0$]
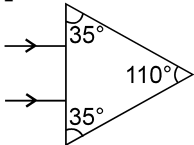
Q29 A concave mirror of radius of curvature 10 cm is filled with water upto a very small thickness ($\mu_{water} = \dfrac{4}{3}$). Paraxial converging rays are incident of the system, whose intersection is 15 cm behind the mirror. At how much distance from the mirror, final image will be formed. Write the answer in cm.
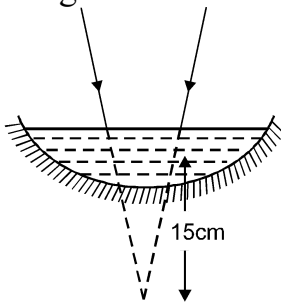
Q30 A thin parallel light beam of diameter d and intensity I_0 falls on a convex lens parallel to the principal axis. Light refracted from lens is obtained on screen, which is perpendicular to the principal axis. Intensity obtained on screen is $9I_0$ for two position of screen seperated by a distance of 10cm. Focal length of lens (in cm) is.

Chemistry

Single Choice Question

Q31 The properties which are not common to both groups 1 and 17 elements in the periodic table are :

   a) Electropositive character increases down the groups.

   b) Reactivity decreases from top to bottom in these groups.

   c) Atomic radii increases as the atomic number increases.

   d) Electronegativity decreases on moving down a group.

Q32 Which of the following pair of compounds is not functional isomers ?

   a)

   b)

   c)

   d)

Q33 are related as :

   a) Functional Isomers   **b)** Position Isomers   **c)** Chain Isomers   **d)** Metamers

Q34 Which of the following is correctly matched.

   a) chain somer

   b) Identical

   c) Positional isomer

   d) Metamer

Q35 The lanthanide contraction refers to :

   a) radius of the series.   **b)** valence electrons of the series

   c) the density of the series   **d)** electronegativity of the series

Q36 A large difference between the third and fourth ionization energies indicates the presence of :

   a) 4 valence electrons in an atom   **b)** 5 valence electrons in an atom

   c) 3 valence electrons in an atom   **d)** 2 valence electrons in an atom

Q37 Select equation having exothermic step :

   a) $S^-(g) \longrightarrow S^{2-}(g)$ **b)** $Na^+(g) + Cl^-(g) \longrightarrow NaCl(s)$ **c)** $N(g) \longrightarrow N^-(g)$

   d) $Al^{2+}(g) \longrightarrow Al^{3+}(g)$

Q38 The structures of beryllium chloride in the solid state and vapour phase, respectively, are

a) Chain and dimeric   **b)** Dimeric and dimeric   **c)** Dimeric and chain

d) Chain and chain

Q39 An ionic compound $A^+ B^-$ is most likely to be formed when

a) Ionization energy of A is low   **b)** Electron affinity of B is high

c) Electron affinity of B is low   **d)** Both (A) and (B)

Q40 During change of O_2 to O_2^- ion, the electron adds in which one of the following orbitals?

a) $\sigma^*\ 2p_z$ orbital   **b)** $\sigma\ 2p_z$ orbital   **c)** $\pi^*\ 2p_x\ /\ \pi^*\ 2p_y$ orbital

d) $\pi\ 2p_x\ /\ \pi\ 2p_y$ orbital

Q41 C_{60}, an allotrope of carbon contains

a) 16 hexagons and 16 pentagons   **b)** 18 hexagons and 14 pentagons

c) 20 hexagons and 12 pentagons   **d)** 12 hexagons and 20 pentagons

Q42 The relative strength of interionic/ intermolecular forces in decreasing order is :

a) ion-ion > ion-dipole > dipole-dipole   **b)** ion-dipole > dipole-dipole > ion-ion

c) ion-dipole > ion-ion > dipole-dipole   **d)** dipole-dipole > ion-dipole > ion-ion

Q43 The predominant intermolecular forces present in ethyl acetate, a liquid, are

a) Dipole-dipole and hydrogen bonding   **b)** London dispersion and dipole-dipole

c) Hydrogen bonding and London dispersion

d) London dispersion, dipole-dipole and hydrogen bonding

Q44 The acidic, basic and amphoteric oxides, respectively, are

a) Na_2O, SO_3, Al_2O_3 **b)** Cl_2O, CaO, P_4O_{10} **c)** MgO, Cl_2O, Al_2O_3

d) N_2O_3, Li_2O, Al_2O_3

Q45 The molecular geometry of SF_6 is octahedral. What is the geometry of SF_4 (including lone pair(s) of electrons, if any)?

a) Tetrahedral   **b)** Trigonal bipyramidal   **c)** Square planar   **d)** Pyramidal

Q46 When two reactants, A and B are mixed to give products C and D, the reaction quotient Q at the initial stages of the reaction

a) is zero.   **b)** decreases with time.   **c)** is independent of time

d) increases with time.

Q47 The number of S-S bonds in sulphur trioxide trimer (S_3O_9) is

a) 3   **b)** 0   **c)** 1   **d)** 2

Q48 Which of the following statement is incorrect ?

  a) During N^+_2 formation, one electron is removed from the bonding molecular orbital of N_2.

  b) During O^+_2 formation, one electron is removed from the antibonding molecular orbital of O_2.

  c) During O^-_2 formation, one electron is added to the bonding molecular orbital of O_2.

  d) During CN^- formation, one electron is added to the bonding molecular orbital of CN.

Q49 Which of the following are polar

  a) XeF_4 **b)** SO_3 **c)** $XeOF_4$ **d)** ICl_4^-

Q50 Which of the following statemets is true?

  a) The dipole moment of NF_3 is zero

  b) The dipole moment of NF_3 is less than NH_3

  c) The dipole moment of NF_3 is more than NH_3

  d) The dipole moment of NH_3 is zero

Numerical

Q51 How many compound which show zero dipole moment.
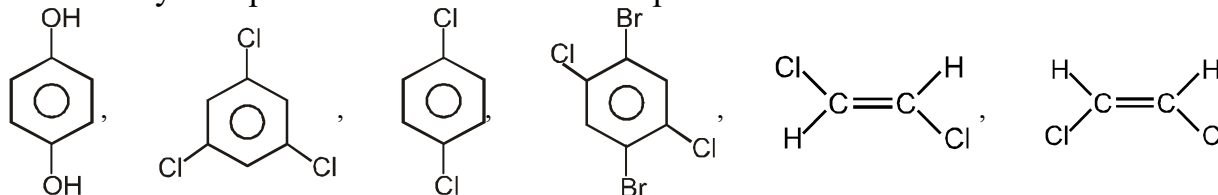
Q52 $COF_2(g)$ passed over catalyst at 1000°C comes to equilibrium $2COF_2(g) \rightleftharpoons CO_2(g) + CF_4(g)$. Analysis of the equilibrium mixture (after quick cooling to freeze the equilibrium) shows that 500 ml of the equilibrium mixture (STP) contains 300 ml (STP) of $(COF_2 + CO_2)$ taking the total pressure to be 10 atm. The value of K_P for the reaction is

Q53 An element has highest negative electron gain enthalpy in periodic table. In its outer most shell total number of electrons are x and it has total p-electrons y. What will be the value of y-x.

Q54 How many acyclic structural isomeric carbonyl compound having molecular formula $C_6H_{12}O$ can gives haloform test.

Q55 Observe the the following compounds.

(I)   (II)   (III)   (IV)   (V)   (VI)

(VII)   (VIII)   (XI)
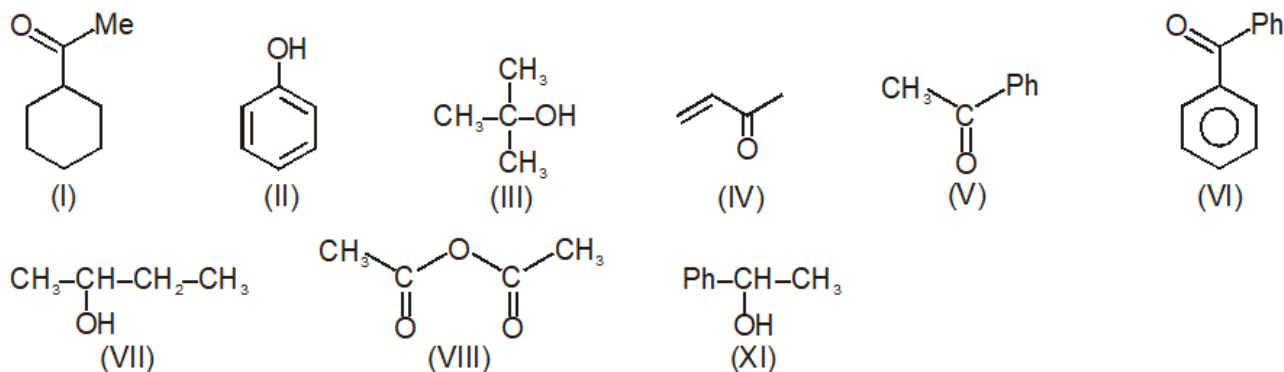
Number of compound which can gives positive Haloform test = (x)
Number of compound which can gives positive Lucas reagent test = (y)
Report your answer (x + y)

Q56 Structure of Ascorbic acid is represented as follows.
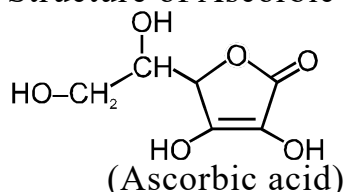
(Ascorbic acid)
How many of the following reagents can give positive test with ascorbic acid.

$Cu_2Cl_2 + NH_4OH$	2,4-DNP	Na Metal	$HCl + ZnCl_2$	$FeCl_3$	NaOH + Phenopthalein
(I)	(II)	(III)	(IV)	(V)	(VI)

dil.$KMnO_4$	Br_2/H_2O	$AgNO_3 + NH_4OH$	$I_2 + NaOH$
(VII)	(VIII)	(XI)	(X)
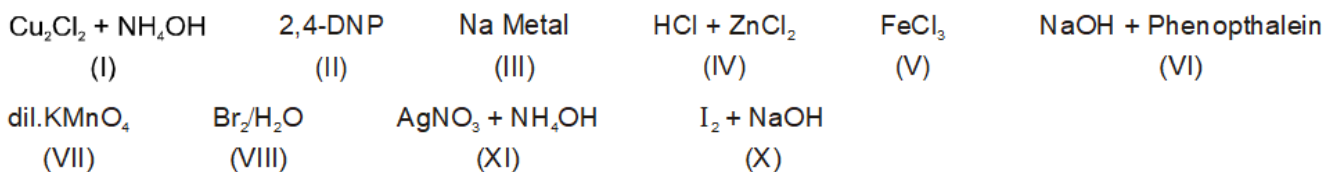
Q57 P_4O_{10} has two different types of P–O bonds. Find the no. of P–O bonds with shorter bond length.

Q58 The number of possible alkynes (strucutral only) for the compound having molecular formula $C_3FClBrI$ is:

Q59 Difference in the oxidation number of sulphur atom is in $Na_2S_4O_6$ is x, that of $H_2S_2O_5$ is y. Find value of x × y is :

Q60 In a P_4O_6 molecule, the total number of P–O–P bonds is :

Mathematics

Single Choice Question

Q61 If $\frac{mx^2+3x+4}{x^2+2x+2} < 5$ for all x $\in$ R then
a) m > 5
b) $m < \frac{71}{24}$
c) m < 5
d) $m > \frac{71}{24}$

Q62 Roots of the quadratic equation $(x^2 - 4x + 3) + \lambda(x^2 - 6x + 8) = 0$, $\lambda \in$ R will be
a) always real
b) real only when λ is positive
c) real only when λ is negative
d) always imaginary

Q63 Solution set of the inequality $2 - \log_2 (x^2 + 3x) \geq 0$ is
a) $[-4, 1]$
b) $[-4, -3) \cup (0, 1]$
c) $(-\infty, -3) \cup (1, \infty)$
d) $(-\infty, -4) \cup [1, \infty)$

Q64 If α and β are roots of equation $x^2 - 7x + 1 = 0$, then the value of $\frac{1}{(\alpha-7)^2} + \frac{1}{(\beta-7)^2}$
a) 45
b) 47
c) 49
d) 50

Q65 Let α, β, γ be the roots of the equation $8x^3 + 1001x + 2008 = 0$, then the value of $(\alpha + \beta)^3 + (\beta + \gamma)^3 + (\gamma + \alpha)^3$ is
a) 251
b) 753
c) 735
d) -753

Q66 Sum of all real roots of the equation $(x - 1)(x - 3)(x - 5)(x - 7) = 9$ is
a) 4
b) 8
c) 16
d) -8

Q67 Roots of equation $2x^2 - 5x + 1 = 0$ and $x^2 + 5x + 2 = 0$ are
a) reciprocal and of same sign
b) reciprocal and of opposite sign
c) equal in product
d) none of these

Q68 The set of all values of x satisfying the inequality $\log_2\sqrt{x} - 2(\log_{1/4}x)^2 + 1 > 0$ is
a) $(0, 1)$
b) $(4, \infty)$
c) $\left(\frac{1}{2}, 4\right)$
d) $\left(\frac{1}{4}, \frac{1}{2}\right)$

Q69 $\frac{\log_{2x} 3}{\cos^{-1}(2x - 1)}$ is defined for
a) $(0, 1)$
b) $(0, 1/2) \cup (1/2, 1)$
c) $(1, 2)$
d) None of these

Q70 If the 3rd, 6th and last term of H.P. are $\frac{1}{3}, \frac{1}{5}, \frac{3}{203}$ then the number of terms in H.P. are
a) 100
b) 150
c) 200
d) 250

Q71 If sum of n, 2n, 3n terms of an A.P. are S_1 S_2, S_3 respectively then the value of $\frac{S_3}{S_2-S_1}$ is equal to
a) 4
b) 5
c) 2
d) 3

Q72 Let a_1, a_2, a_3……in A.P. and h_1, h_2, h_3 …… in H.P if $a_1 = 2 = h_1$ and $a_{30} = 25 = h_{30}$ then $a_7 h_{24} + a_{14} h_{17}$ is equal to

a) 50   b) 100   c) 200   d) 400

Q73 The domain of the function $f(x) = {}^{16-x}C_{2x-1} + {}^{20-3x}P_{4x-5}$, where the symbols have their usual meanings is the set

a) $\{1, 2, 3, 4, 5\}$ b) $\{2, 3, 4\}$ c) $\{2, 3\}$ d) None of these

Q74 The harmonic mean of the roots of the equation $(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + 8 + 2\sqrt{5} = 0$ is

a) 2   b) 4   c) 6   d) 8

Q75 If $f(x) = 2 \sin x$, $g(x) = \cos^2 x$, then $(f + g)\left(\frac{\pi}{3}\right) =$

a) 1   b) $\frac{2\sqrt{3}+1}{4}$ c) $\sqrt{3} + \frac{1}{4}$ d) none of these

Q76 Range of the function $f(x) = \frac{1}{2-\cos 3x}$ is

a) $\left[\frac{1}{3}, 1\right]$ b) $\left[0, \frac{1}{3}\right]$ c) $\left(\frac{1}{3}, 1\right)$ d) none of these

Q77 Domain of $f(x) = \sqrt{\log_2(x^2 - 6x + 6)}$ is :

a) $(-\infty, 3 - \sqrt{3}] \cup [3 + \sqrt{3}, \infty)$ b) $(-\infty, 3 - \sqrt{3}) \cup (3 + \sqrt{3}, \infty)$

c) $(-\infty, 1] \cup [5, \infty)$ d) $(-\infty, 1) \cup (5, \infty)$

Q78 The range of the function $f(x) = \log(3x^2 - 4x + 5)$ is

a) $(-\infty, \infty)$ b) $\left[\log\left(\frac{11}{3}\right), \infty\right)$ c) $\left(\log\left(\frac{11}{3}\right), \infty\right)$ d) none of these

Q79 The value of $\tan\left[\cos^{-1}\left(\frac{4}{5}\right) + \tan^{-1}\left(\frac{2}{3}\right)\right]$ is

a) 6/17   b) 7/16   c) 16/7   d) None of these

Q80 Solution of the equation $3 \sin^{-1}\left(\frac{2x}{1+x^2}\right) - 4 \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right) + 2 \tan^{-1}\left(\frac{2x}{1-x^2}\right) = \frac{\pi}{3}$ is

a) $x = \sqrt{3}$ b) $x = \frac{1}{\sqrt{3}}$ c) $x = 1$ d) $x = 0$

Numerical

Q81 If the equation $x^2 + 2(\lambda+1) x + \lambda^2 + \lambda + 7 = 0$ has only negative roots, then the least value of λ is

Q82 Find the sum of the infinitely decreasing G.P. whose first term is equal to $p + 2$ and the common ratio is $\frac{2}{q}$, where p is the least value of the product of the roots of the equation $(m^2 + 1) x^2 - 3x + (m^2 + 1)^2 = 0$ and q is the greatest value of the sum of its root

Q83 Let $A = \{1, 2, 3, \ldots 7\}$ and let $P(1)$ denote the power set of A. If the number of functions $f : A \to P(A)$ such that $a \in f(a), \forall a \in A$ is m^n, m and $n \in N$ and m is least, then $m + n$ is equal to

Q84 $\sin^{-1} \frac{x}{5} + \operatorname{cosec}^{-1} \frac{5}{4} = \frac{\pi}{2}$ then x =

Q85 If x > 0 and $\sin^{-1}\left(\frac{5}{x}\right) + \sin^{-1}\left(\frac{12}{x}\right) = \frac{\pi}{2}$ then x =

Q86 The number of real solutions of $\tan^{-1}\sqrt{x(x+1)} + \sin^{-1}\sqrt{x^2 + x + 1} = \frac{\pi}{2}$ is :

Q87 If minimum value of $(\sin^{-1} x)^2 + (\cos^{-1} x)^2$ is $\frac{\pi^2}{k}$, then the value of k is

Q88 If range of the function $f(x) = \sin^{-1} x + 2 \tan^{-1}x + x^2 + 4x + 1$ is [p, q] then find the value of (p + q)………

Q89 If range of $f(x) = \frac{2\sin^2 x + 2\sin x + 3}{\sin^2 x + \sin x + 1}$ is [p, q] then 6p − 3q equals

Q90 The period of $\sin \frac{\pi}{4}[x] + \cos \frac{\pi x}{2}$ where [x] denotes integral part of x, is :

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**A**	**C**	**C**	**B**	**C**	**D**	**B**	**A**	**C**	**A**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**B**	**C**	**B**	**D**	**A**	**A**	**D**	**C**	**B**	**D**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**6**	**15**	**53**	**6**	**24**	**5**	**2**	**36**	**3**	**15**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**B**	**D**	**A**	**B**	**A**	**C**	**B**	**A**	**D**	**C**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**C**	**A**	**B**	**D**	**B**	**D**	**B**	**C**	**C**	**B**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**4**	**4**	**4**	**4**	**8**	**6**	**4**	**4**	**10**	**6**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**B**	**A**	**B**	**B**	**B**	**C**	**B**	**C**	**B**	**A**
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	**D**	**B**	**C**	**B**	**C**	**A**	**C**	**B**	**D**	**B**
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	**6**	**9**	**44**	**3**	**13**	**2**	**8**	**4**	**4**	**8**