

General Instructions: Same as Mock Test Paper 1.

Physics

Section A

Q. 1. In the integral

$$\int \frac{dx}{(2ax - x^2)^{1/2}} = a^n \sin^{-1} \left(\frac{x}{a} - 1 \right), \text{ the value}$$

of n should be :

- (1) 1 (2) -1
(3) 0 (4) $\frac{1}{2}$

Q. 2. Force acting on a particle is $(2\hat{i} + 3\hat{j})$ N. Work done by this force is zero, when a particle is moved on the line $3y + kx = 5$. Here value of k is :

- (1) 2 (2) 4
(3) 6 (4) 8

Q. 3. A gun fires bullets of mass 40 g horizontally towards a square platform of area 50 sq. cm. Pressure registered by a device connected to the platform is 2.88×10^4 Pa. If speed of bullets is 1200 m/s. How many bullets hit the platform?

- (1) 3 bullets per second
(2) 3 bullets in 2 seconds
(3) 6 bullets per second
(4) 2 bullets in 0.5 seconds

Q. 4. The radiation emitted, when an electron jumps from $n = 3$ to $n = 2$ orbit is a hydrogen atom, falls on a metal to produce photoelectron. The electrons from the metal surface with maximum kinetic energy are made to move perpendicular to a magnetic field of $\frac{1}{320}$ T in a radius of 10^{-3} m. Find the work function of metal :

- (1) 1.03 eV (2) 1.89 eV
(3) 0.86 eV (4) 2.03 eV

Q. 5. In a p -type semiconductor the acceptor level is situated 57 MeV above the valence band. The maximum wavelength of light required to produce a hole will be :

- (1) 57 Å (2) 57×10^{-3} Å
(3) 217100 Å (4) 11.61×10^{-33} Å

Q. 6. The process in which the heat given to a system is completely transformed in to work in form of Ideal Gas:

- (1) Isobaric Process
(2) Isometric Process
(3) Isothermal Process
(4) Adiabatic Process

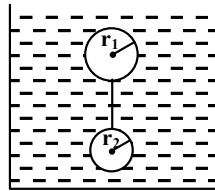
Q. 7. A block of mass is at the end of the string is whirled round in a vertical circle of radius 'R'. The critical speed of the block at the top of its swing below which the string would slacken before the block reaches the bottom.

- (1) $\sqrt{5gR}$ (2) $\sqrt{3gR}$
(3) $\sqrt{6gR}$ (4) \sqrt{gR}

Q. 8. Magnification produced by astronomical telescope for normal adjustment is 10 and length of telescope is 1.1 m. The magnification when the image is formed at least distance of distinct vision ($D = 25$ cm) is :

- (1) 14 (2) 6
(3) 16 (4) 18

Q. 9. Two solid spherical balls of radius r_1 and r_2 ($r_2 < r_1$), of density σ are tied up with a long string and released in a viscous liquid column of lesser density ρ and coefficient of viscosity η , with the string just taut as shown. The terminal velocity of spheres is :



- (1) $\frac{2}{9} \frac{r_2^2 g}{\eta} (\sigma - \rho)$
 (2) $\frac{2}{9} \frac{r_1^2 g}{\eta} (\sigma - \rho)$
 (3) $\frac{2}{9} \frac{(r_1^3 + r_2^3) (\sigma - \rho) g}{r_1 + r_2 \eta}$
 (4) $\frac{2}{9} \frac{(r_1^3 - r_2^3) (\sigma - \rho) g}{r_1 - r_2 \eta}$

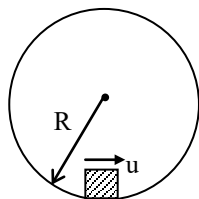
Q. 10. A coaxial cylinder made of glass is immersed in liquid of surface tension 'S'. Radius of inner and outer surface of cylinder are R_1 and R_2 respectively. Height till which liquid will rise is (Density of liquid is ρ):

- (1) $\frac{2S}{R_2 \rho g}$ (2) $\frac{2S}{R_1 \rho g}$
 (3) $\frac{S}{(R_2 - R_1) \rho g}$ (4) $\frac{2S}{(R_2 - R_1) \rho g}$

Q. 11. A body is displaced from (0, 0) to (1 m, 1 m) along the path $x = y$ by a force $\vec{F} = (x^2 \hat{j} + y \hat{i})$ N. The work done by this force will be :

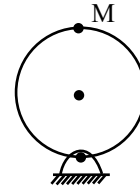
- (1) $\frac{4}{3}$ J (2) $\frac{5}{6}$ J
 (3) $\frac{3}{2}$ J (4) $\frac{7}{5}$ J

Q. 12. A particle is given an initial speed u inside a smooth spherical shell of radius $R = 1$ m that it is just able to complete the circle. Acceleration of the particle when its velocity is vertical is :



- (1) $g \sqrt{10}$ (2) g
 (3) $g \sqrt{2}$ (4) $3g$

Q. 13. A uniform disc of mass M and radius ' R ' is supported vertically by a pivot at its periphery as shown. A particle of mass M is fixed to the rim and raised to highest point above the centre. The system is released from rest and it can rotate about pivot freely. The angular speed of system when it attached object is directly beneath the pivot, is :



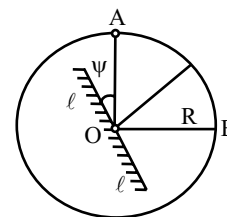
- (1) $\sqrt{\frac{48g}{19R}}$ (2) $\sqrt{\frac{24}{19} \frac{g}{R}}$
 (3) $\sqrt{\frac{48}{11} \frac{g}{R}}$ (4) $\sqrt{\frac{24}{11} \frac{g}{R}}$

Q. 14. A gas undergoes a process in which the pressure and volume are related by $VP^n = \text{constant}$. The bulk modulus of the gas is :

- (1) nP (2) $P^{1/n}$ (3) $\frac{P}{n}$ (4) P^n

Q. 15. The mirror of length $2l$ makes 10 revolutions per minute about the axis crossing its mid-point O and perpendicular to the plane of the figure. There is a light source in point A and an observer at point B of the circle of radius R drawn around centre O ($\angle AOB = 90^\circ$)

What is the proportion $\frac{R}{l}$ if the observer B first sees the light source when the angle of mirror $\psi = 15^\circ$?



- (1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$
 (3) $2\sqrt{2}$ (4) $\frac{1}{2\sqrt{2}}$

Q. 16. An object is 20 cm away from a concave mirror and it is within the focal length of the mirror. If the mirror is changed to a plane

mirror, the image moves 15 cm closer to the mirror.

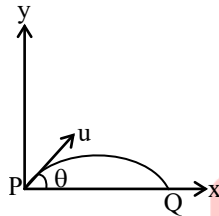
Focal length of the concave mirror is :

- (1) 36.6 cm (2) 56.6 cm
- (3) 66.6 cm (4) 46.6 cm

Q. 17. If the critical angle for total internal reflection from a medium to vacuum is 30° , the velocity of light in the medium is :

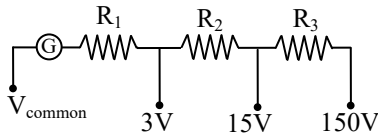
- (1) 3×10^8 m/s (2) 1.5×10^8 m/s
- (3) 6×10^8 m/s (4) $\sqrt{3} \times 10^8$ m/s

Q. 18. Average torque on a projectile of mass m , initial speed u and angle of projection θ between initial and final positions P and Q as shown in figure about the point of projection is :



- (1) $\frac{mu^2 \sin 2\theta}{2}$ (2) $mu^2 \cos\theta$
- (3) $mu^2 \sin\theta$ (4) $\frac{mu^2 \cos\theta}{2}$

Q. 19. A voltmeter of variable ranges 3 V, 15 V, 150 V is to be designed by connecting resistances R_1, R_2, R_3 in series with a galvanometer of resistance $G = 20 \Omega$, as shown in Fig. The galvanometer gives full pass through its coil for 1 mA current i.e. "gives full pass through it's coil for 1 mA current". Then, the resistances R_1, R_2 and R_3 (in kilo ohms) should be, respectively :



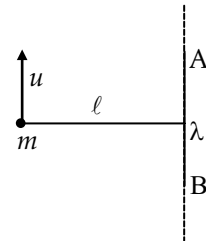
- (1) 3, 12, 135
- (2) 2.98, 12, 135
- (3) 2.98, 14.98, 149.98
- (4) None of these

Q. 20. A magnet is suspended horizontally in the earth's magnetic field. When it is displaced and then released it oscillates in a horizontal plane with a period T . If a piece of wood of same moment of inertia (about the axis of rotation) as the magnet is attached to the magnet, what would the new period of oscillation of the system become ?

- (1) $\frac{T}{3}$ (2) $\frac{T}{2}$
- (3) $\frac{T}{\sqrt{2}}$ (4) $\sqrt{2} \cdot T$

Section B

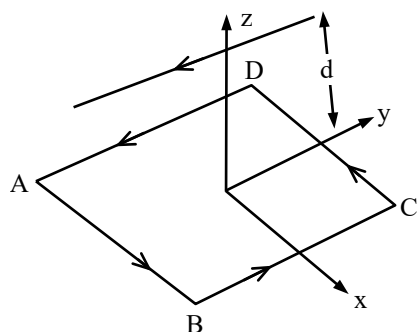
Q. 21. AB is a vertical rigid infinite wire carrying a linear charge of density $\lambda = 10 \mu\text{C/m}$. A particle having mass $m = 2$ g and charge $Q = 1 \mu\text{C}$ is fixed to the wire by means of a light, insulating and inextensible string having length $= 2\sqrt{2}$ m. The vertical velocity u in with which it should be projected under gravity from the shown position so that the string slacks when its angle with vertical becomes 45° is (correct upto the first two decimal places).



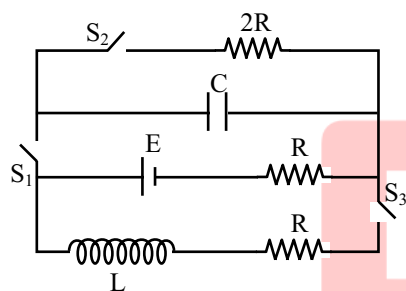
Q. 22. A capacitor has charge $50 \mu\text{C}$. When the gap between the plate is filled with glass wool, then $120 \mu\text{C}$ charge flows through the battery to capacitor. The dielectric constant of glass wool is.....

Q. 23. A block of metal is heated directly by dissipating power in the internal resistance of block. Because of temperature rise, the resistance increases exponentially with time and is given by $R(t) = 0.5 e^{2t}$, where t is in second. The block is connected across a 110 V source and dissipates 7644 J heat energy over a certain period of time. This period of time is..... $\times 10^{-1}$ sec (take $\ln 0.367 = -1$).

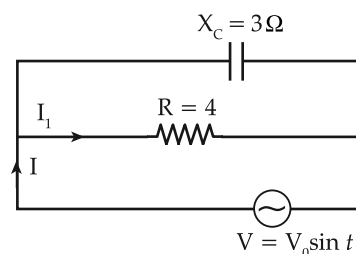
Q. 24. Figure shows a square loop. 20 cm on each side in the x - y plane with its centre at the origin. The loop carries a current of 7 A. Above it at $y = 0, z = 12$ cm is an infinitely long wire parallel to the x axis carrying a current of 10 A. The net force on the loop is $\times 10^{-4}$ N.



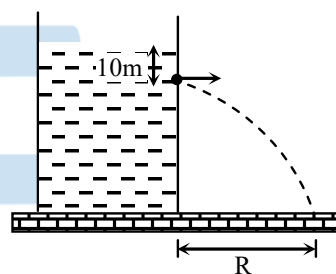
- Q. 25. In the given circuit, initially switch S_1 is closed and S_2 and S_3 are open. After charging of capacitor, at $t = 0$, S_1 is open and S_2 and S_3 are closed. If the relation between inductance capacitance and resistance is $L = 4CR^2$ then the time (in sec) after which current passing through capacitor and inductor will be same is $\dots\dots \times 10^{-4}$ N. (Given $R = \ln(2)$, $m\Omega$, $L = 2$ mH)



- Q. 26. A capacitor and resistor are connected with an AC source as shown in figure. Reactance of capacitor is $X_C = 3 \Omega$ and resistance of resistor is 4Ω . Phase difference between current I and I_1 is approx $\dots\dots$.



- Q. 27. A 40 kg wooden crate is being pushed across a wooden floor with a force of 160 N. If $\mu_k = 0.3$, the acceleration of the crate is $\dots\dots$ m/s^2 . ($g = 10$ m/s^2)
- Q. 28. A single conservative force acts on a body of mass 1 kg that moves along the x -axis. The potential energy $U(x)$ is given by $U(x) = 20 + (x - 2)^2$, where x is in meters. At $x = 5.0$ m the particle has a kinetic energy of 20 J, then the maximum kinetic energy of body is $\dots\dots$ J.
- Q. 29. A large tank is filled with water (density = 10^3 kg/m^3). A small hole is made at a depth 10 m below water surface. The range of water effluxing out of the hole is R on ground. The extra pressure (in atm) must be applied on the water surface so that the range becomes $2R$ is $\dots\dots$. (Take 1 atm = 10^5 Pa and $g = 10$ m/s^2)

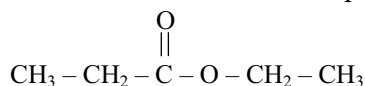


- Q. 30. An insect moves with a constant velocity v from one corner of a room to other corner which is opposite of the first corner along the largest diagonal of room. If the insect can not fly and dimensions of room is $a \times a \times a$, then the minimum time in which the insect can move is $\frac{a}{v}$ times the square root of a number n , then n is equal to $\dots\dots$.

Chemistry

Section A

- Q. 31. The IUPAC name of the compound will be :



- (1) Ethyl propanoate
- (2) Ethyl propionate
- (3) Both (1) and (2)
- (4) None of these

- Q. 32. Which of the following compound is optically active?

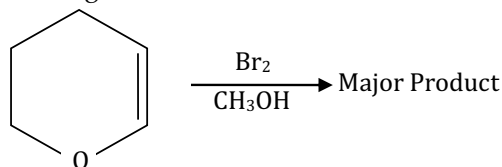
- (1) $\text{CH}_3\text{CH}_2\text{OH}$
- (2) $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$
- (3) $\text{CH}_3\text{CHOHC}_2\text{H}_5$
- (4) CCl_2F_2

- Q. 33. In the flame test of a mixture of salts, a green flame with blue centre was observed. Which

one of the following cations may be present?

- (1) Cu^{2+} (2) Sr^{2+}
 (3) Ba^{2+} (4) Ca^{2+}

Q. 34. Amongst the following, the major product of the given chemical reaction is



- (1)
- (2)
- (3)
- (4)

Q. 35. Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution?

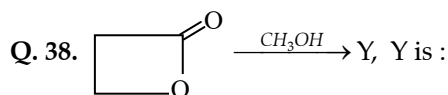
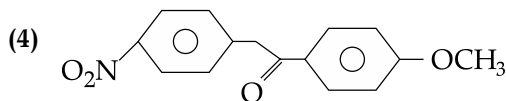
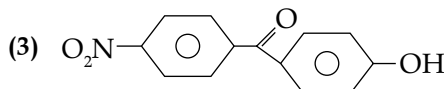
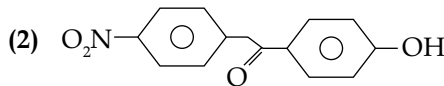
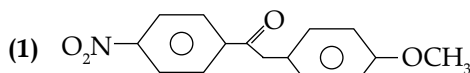
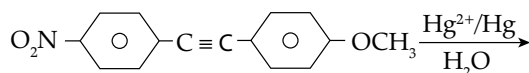
- (1) Be^{2+} (2) Mg^{2+}
 (3) Ca^{2+} (4) Sr^{2+}

Q. 36. 20 mL of 0.1 M NH_4OH is mixed with 40 mL of 0.05 M HCl . The pH of the mixture is nearest to:

(Given: $K_b(\text{NH}_4\text{OH}) = 1 \times 10^{-5}$, $\log 2 = 0.30$, $\log 3 = 0.48$, $\log 5 = 0.69$, $\log 7 = 0.84$, $\log 11 = 1.04$)

- (1) 3.2 (2) 4.2
 (3) 5.2 (4) 6.2

Q. 37. The major product obtained from the reaction is



- (1)
- (2)

(3) Both are correct (4) None is correct

Q. 39. Which of the following statement is not correct?

- (1) Ethyl amine and aniline both have NH_2 group
 (2) Ethyl amine and aniline both dissolve in HCl
 (3) Ethyl amine and aniline both react with CHCl_3 and KOH to form unpleasant gas
 (4) Ethyl amine and aniline both react with HNO_2 to give hydroxy compound

Q. 40. Match List – I with List – II, match the gas evolved during each reaction.

- | | |
|---|--------------------|
| List – I | List – II |
| (1) $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \xrightarrow{\Delta}$ | (I) H_2 |
| (2) $\text{KMnO}_4 + \text{HCl} \rightarrow$ | (II) N_2 |
| (3) $\text{Al} + \text{NaOH} + \text{H}_2\text{O} \rightarrow$ | (III) O_2 |
| (4) $\text{NaNO}_3 \xrightarrow{\Delta}$ | (IV) Cl_2 |

Choose the correct answer from the options given below:

- (1) (1) – (II), (2) – (III), (3) – (I), (4) – (IV)
 (2) (1) – (III), (2) – (I), (3) – (IV), (4) – (II)
 (3) (1) – (II), (2) – (IV), (3) – (I), (4) – (III)
 (4) (1) – (III), (2) – (IV), (3) – (I), (4) – (II)

Q. 41. The lassaigne's extract is boiled with dil. HNO_3 before testing for halogens because :

- (1) Silver halides are soluble in HNO_3
 (2) Na_2S and NaCN are decomposed by HNO_3
 (3) Ag_2S is soluble in HNO_3
 (4) AgCN is soluble in HNO_3

Q. 42. The complex $\text{Hg}[\text{Co}(\text{CNS})_4]$ is correctly named as :

- (1) Mercury tetrathiocyanato cobaltate (II)
- (2) Mercury cobalt tetrasulphocyano (II)
- (3) Mercury tetrasulphocyanide cobaltate (II)
- (4) Mercury sulphocyanato cobalt (II)

Q. 43. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R)

Assertion (A) : Permanganate titrations are not performed in presence of hydrochloric acid.

Reason (R) : Chlorine is formed as a consequence of oxidation of hydrochloric acid.

In the light of the above statements, choose the correct answer from the options given below

- (1) Both A and R are true and R is the correct explanation of A
- (2) Both A and R are true but R is NOT the correct explanation of A
- (3) A is true but R is false
- (4) A is false but R is true

Q. 44. Na_2CO_3 cannot be used in place of $(\text{NH}_4)_2\text{CO}_3$ for the precipitation of V group because :

- (1) NaI interferes in the detection of V group
- (2) Conc. of CO_3^{2-} is very low
- (3) Na will react with acid radicals
- (4) Mg will be precipitated

Q. 45. The hybridisation of carbanion is

- (1) sp^3
- (2) sp^2
- (3) sp
- (4) All may be

Q. 46. The product of reaction between 1,1,2,2-tetrachloro propane and Zn dust/ Δ :

- (1) Propyne
- (2) Propene
- (3) Iso propene
- (4) Acetylene

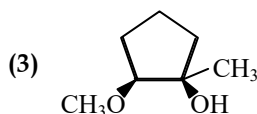
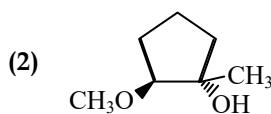
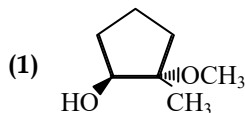
Q. 47. Benzene reacts with benzoyl chloride to form :

- (1) benzophenone
- (2) Acetophenone
- (3) Benzylchloride
- (4) Maleic anhydride

Q. 48. In Finkelstein reaction, which of the following reactants are used ?

- (1) $\text{NaI} + \text{C}_2\text{H}_5\text{OH}$
- (2) $\text{NaF} + \text{acetone}$
- (3) $\text{NaBr} + \text{CH}_3\text{OH}$
- (4) $\text{NaI} + \text{C}_2\text{H}_5 - \text{Br}$

Q. 49. If the starting material is 1-methyl-1, 2-epoxy cyclopentane, of absolute configuration, which one compound correctly represent the product of its reaction with sodium methoxide in methanol ?



- (4) All the above

Q. 50. A monoprotic acid in a 0.1 M solution ionizes to 0.001%. Its ionisation constant is :

- (1) 1.0×10^{-3}
- (2) 1.0×10^{-6}
- (3) 1.0×10^{-8}
- (4) 1.0×10^{-11}

Section B

Q. 51. The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereoisomers)_____.

Q. 52. The line at 434 nm in the Balmer series of the hydrogen spectrum corresponds to a transition of an electron from the n^{th} to second Bohr orbit. The value of n is

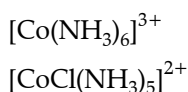
Q. 53. The reaction $\text{SO}_2\text{Cl}_2(\text{g}) \rightarrow \text{SO}_2(\text{g}) + \text{Cl}_2(\text{g})$ is a first order gas reaction with $k = 2.2 \times 10^{-5} \text{ sec}^{-1}$ at 320°C . The percentage of SO_2Cl_2 is decomposed on heating this gas for 90 min, is %.

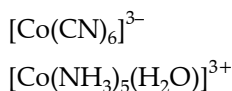
Q. 54. For the cell process :

$\text{Sn}(\text{s}) + \text{Pb}^{+2}(\text{aq}) \rightarrow \text{Pb}(\text{s}) + \text{Sn}^{+2}(\text{aq})$
The ratio of Pb^{+2} to Sn^{+2} ion concentration for spontaneity is

Given, $E_{\text{Sn}^{2+}/\text{Sn}}^0 = -0.136 \text{ V}$, $E_{\text{Pb}^{2+}/\text{Pb}}^0 = -0.126 \text{ V}$

Q. 55. Consider the following metal complexes:





The spin-only magnetic moment value of the complex that absorbs light with shortest wavelength is _____ B.M. (Nearest integer)

- Q. 56. The degree of dissociation of $\text{Ca}(\text{NO}_3)_2$ in a dilute aqueous solution containing 7 g of the salt per 100 g of water at 100°C is 70%. If the vapour pressure of water at 100°C is 760 mm. The vapour pressure of the solution is mm.
- Q. 57. The sum of number of σ -bonds to π -bonds in $\text{C}_2(\text{CN})_4$ molecule is
- Q. 58. 10 ml of H_2O_2 solution when reacted with KI solution produced 0.5 g of iodine. The

percentage of purity of H_2O_2 (by volume) is %.

- Q. 59. Through an aqueous solution of an unknown salt of metal M (Molar mass of M = 200 g/mol) a current of 1.93 A is passed for 50 min. If 4 g of metal is produced at cathode. The charge on metal ion in solution is
- Q. 60. A 0.166 g sample of an organic compound was digested with conc. H_2SO_4 and then distilled with NaOH. The ammonia gas evolved was passed through 50.0 mL of 0.5 N H_2SO_4 . The used acid required 30.0 mL of 0.25 N NaOH for complete neutralization. The mass percentage of nitrogen in the organic compound is _____.

Mathematics

Section A

- Q. 61. A line, with the slope greater than one, passes through the point A(4, 3) and intersects the line $x - y - 2 = 0$ at the point B. If the length of the line segment AB is $\frac{\sqrt{29}}{3}$, then B also lies on the line
- (1) $2x + y = 9$ (2) $3x - 2y = 7$
 (3) $x + 2y = 6$ (4) $2x - 3y = 3$
- Q. 62. The function $f(x) = \frac{|x-1|}{x^2}$ is monotonically decreasing on
- (1) $(0, 1) \cup (2, \infty)$ (2) $(0, \infty)$
 (3) $(-\infty, 1) \cup (2, \infty)$ (4) $(-\infty, \infty)$
- Q. 63. $\int \frac{dx}{\sqrt{5x-6-x^2}}$ equals
- (1) $\sin^{-1}(2x+5) + c$
 (2) $\cos^{-1}(2x+5) + c$
 (3) $\sin^{-1}(2x-5) + c$
 (4) $\cos^{-1}(2x-5) + c$
- Q. 64. If $\beta + 2 \int_0^1 x^2 e^{-x^2} dx = \int e^{-x} dx$, then the value of β is
- (1) e (2) 1 (3) 0 (4) $1/e$

- Q. 65. The area of the region given by $A = \{(x, y) : x^2 \leq y \leq \min\{x+2, 4-3x\}\}$ is
- (1) $\frac{31}{8}$ (2) $\frac{17}{6}$
 (3) $\frac{19}{6}$ (4) $\frac{27}{8}$
- Q. 66. The locus of the point of intersection of the lines $x \cos \alpha + y \sin \alpha = a$ and $x \sin \alpha - y \cos \alpha = b$ (where α is a variable) is
- (1) $x^2 + y^2 = a^2 + b^2$
 (2) $x^2 - y^2 = a^2 + b^2$
 (3) $x^2 + y^2 = a^2 - b^2$
 (4) $x^2 - y^2 = a^2 - b^2$
- Q. 67. The abscissa of two points A and B are the roots of the equation $x^2 + 2ax - b^2 = 0$, and their ordinates are the roots of the equation $x^2 + 2px - q^2 = 0$. The radius of the circle with AB as diameter is
- (1) $\sqrt{a^2 + b^2 + p^2 + q^2}$ (2) $\sqrt{a^2 + p^2}$
 (3) $\sqrt{b^2 + q^2}$ (4) $\sqrt{a^2 + b^2 - p^2 - q^2}$
- Q. 68. Let the locus of the centre (α, β) , $\beta > 0$, of the circle which touches the circle $x^2 + (y-1)^2 = 1$ externally and also touches the x -axis be L. Then the area bounded by L and the line $y = 4$ is

$$(1) \frac{32\sqrt{2}}{3} \quad (2) \frac{40\sqrt{2}}{3}$$

$$(3) \frac{64}{3} \quad (4) \frac{32}{3}$$

Q. 69. If the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ meets the line

$$\frac{x}{7} - \frac{y}{2\sqrt{6}} = 1 \text{ on the } x\text{-axis and the line}$$

$$\frac{x}{7} - \frac{y}{2\sqrt{6}} = 1 \text{ on the } y\text{-axis, then the eccentricity}$$

of the ellipse is

$$(1) \frac{5}{7} \quad (2) \frac{2\sqrt{6}}{7}$$

$$(3) \frac{3}{7} \quad (4) \frac{2\sqrt{5}}{7}$$

Q. 70. Let the foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{7} = 1$ and

the hyperbola $\frac{x^2}{144} - \frac{y^2}{\alpha} = \frac{1}{25}$ coincide.

Then the length of the latus rectum of the hyperbola is

$$(1) \frac{32}{9} \quad (2) \frac{18}{5} \quad (3) \frac{27}{4} \quad (4) \frac{27}{10}$$

Q. 71. The point in which the join of $(-9, 4, 5)$ and $(11, 0, -1)$ is met by the perpendicular from the origin is

$$(1) (2, 1, 2) \quad (2) (2, 2, 1)$$

$$(3) (1, 2, 2) \quad (4) (1, 1, 2)$$

Q. 72. The position vectors of points A, B, C are respectively \vec{a} , \vec{b} , \vec{c} . If L divides AB in 3 : 4 and M divides BC in 2 : 1 both externally, then \vec{LM} is

$$(1) 4\vec{a} - 2\vec{b} + 2\vec{c} \quad (2) 4\vec{a} + 2\vec{b} + 2\vec{c}$$

$$(3) -4\vec{a} + 2\vec{b} + 2\vec{c} \quad (4) 4\vec{a} - 2\vec{b} - 2\vec{c}$$

Q. 73. The total number of matrices formed with the help of 6 different numbers are

$$(1) 6 \quad (2) 6! \quad (3) 2(6!) \quad (4) 4(6!)$$

$$Q. 74. \begin{vmatrix} b+c & c & b \\ c & c+a & a \\ b & a & a+b \end{vmatrix} =$$

$$(1) a + b + c \quad (2) 2a + b + c$$

$$(3) ab + bc + ca \quad (4) 4abc$$

Q. 75. For $n \in N$, let $S_n = \left\{ z \in C; |z - 3 + 2i| = \frac{n}{4} \right\}$.

and $T_n = \left\{ z \in C; |z - 2 + 3i| = \frac{1}{n} \right\}$. Then the

number of elements in the set $\{n \in N; S_n \cap T_n = \emptyset\}$ is

$$(1) 0 \quad (2) 2 \quad (3) 3 \quad (4) 4$$

Q. 76. The variance of first 50 even natural numbers is

$$(1) 437 \quad (2) \frac{437}{4}$$

$$(3) \frac{833}{4} \quad (4) 833$$

Q. 77. The total number of functions, $f: \{1, 2, 3, 4\} \rightarrow \{1, 2, 3, 4, 5, 6\}$ such that $f(1) + f(2) = f(3)$, is equal to

$$(1) 60 \quad (2) 90$$

$$(3) 108 \quad (4) 126$$

Q. 78. If $\alpha, \beta, \gamma, \delta$ are the roots of the equation $x^4 + x^3 + x^2 + x + 1 = 0$, then $\alpha^{2021} + \beta^{2021} + \gamma^{2021} + \delta^{2021}$ is equal to

$$(1) -4 \quad (2) -1 \quad (3) 1 \quad (4) 4$$

Q. 79. The sum of the last eight coefficients in the expansion of $(1 + x)^{16}$ is equal to

$$(1) 2^{15} \quad (2) 2^{14}$$

$$(3) 2^{15} - \frac{1}{2} \frac{(16)!}{(8!)^2} \quad (4) 2^{16} - \frac{161}{(81)^2}$$

Q. 80. Let x and y be real numbers satisfying the equation $x^2 - 4x + y^2 + 3 = 0$. If the maximum and minimum values of $x^2 + y^2$ are a and b respectively. Then the numerical value of $a - b$ is

$$(1) 1 \quad (2) 2 \quad (3) 7 \quad (4) 8$$

Section B

Q. 81. A badminton club has 10 couples as members. They meet to organise a mixed double match. If no husband and wife play in the same game, then the number of different ways can the match off will be

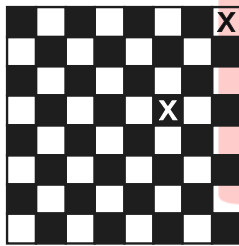
Q. 82. Let $x = \sin(2 \tan^{-1} \alpha)$ and $y = \sin\left(\frac{1}{2} \tan^{-1} \frac{4}{3}\right)$.

If $S = \{a \in R : y^2 = 1 - x\}$, the $\sum_{\alpha \in S} 16\alpha^3$ is equal to

Q. 83. Let $2\cos^2 x + 3\cos x - 2 > 0$ and $x^2 + x - 2 < 0$ (x is measured in radians), then number of integral values of x satisfying both the inequations is

Q. 84. Let $y = y(x)$ be the solution of the differential equation $\frac{dy}{dx} = \frac{4y^3 + 2yx^2}{3xy^2 + x^3}$, $y(1) = 1$. If for some $n \in N$, $y(2) \in [n - 1, n)$, then n is equal to ;

Q. 85. Let P denotes the probability of selecting one white and one black square from the chessboard so that they are not in the same row and also not in the same column (an example of this kind of the choice is shown in figure), then $(1024)P$ is



Q. 86. Consider a set containing function $A = \{\cos^{-1} \cos x, \sin(\sin^{-1} x), \sin x((\sin x)^2 - 1),$

$e \tan\{x\}, e^{|\cos x| + |\sin x|}, \sin(\tan(\cos x)), \sin(\tan x)\}$. B, C, D, are subsets of A, such that B contains periodic functions, C contains even functions, D contains odd functions then the value of $n(B \cap C) + n(B \cap D)$ is where $\{.\}$ denotes the fractional part of functions)

Q. 87. Let $f(x)$ be a quadratic polynomial with leading coefficient 1 such that $f(0) = p$, $p \neq 0$, and $f(1) = \frac{1}{3}$. If the equations $f(x) = 0$ and $f \circ f \circ f \circ f(x) = 0$ have a common real root, then $f(-3)$ is equal to :

Q. 88. If $f(x) = \begin{cases} \frac{\cos\left(\frac{\pi(\sqrt{1+x}-1)}{x}\right)}{x} & , x \neq 0 \\ \frac{\pi}{k} & , x = 0 \end{cases}$ is

continuous at $x = 0$, then k^2 is equal to

Q. 89. If $f'(1) = 3$ and $f'(2) = 2$, then the value of $\lim_{h \rightarrow 0} \frac{f(1+2h) - f(1)}{f(2+3h) - f(2)}$ is equal to

Q. 90. For an increasing G.P. $a_1, a_2, a_3, \dots, a_n$, if $a_6 = 4a_4$, $a_9 - a_7 = 192$, then the value of $\sum_{i=1}^{\infty} \frac{1}{a_i}$ is