PART A – PHYSICS

ALL THE GRAPHS/DIAGRAMS GIVEN ARE SCHEMATIC AND NOT DRAWN TO SCALE.

1. It is found that if a neutron suffers an elastic collinear collision with deuterium at rest, fractional loss of its energy is p_d; while for its similar collision with carbon nucleus at rest, fractional loss of energy is p_c. The values of p_d and p_c are respectively :

(1) (0, 0)

(2) (0, 1)

(3) (·89, ·28)

(4) (·28, ·89)

2. The mass of a hydrogen molecule is 3.32×10^{-27} kg. If 10^{23} hydrogen molecules strike, per second, a fixed wall of area 2 cm^2 at an angle of 45° to the normal, and rebound elastically with a speed of 10^3 m/s, then the pressure on the wall is nearly :

(1) 2.35×10^2 N/m^2

(2) 4.70×10^2 N/m^2

(3) 2.35×10^3 N/m^2

(4) 4.70×10^3 N/m^2

3. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is :

(1) $\frac{mg}{3Ka}$

(2) $\frac{mg}{Ka}$

(3) $\frac{Ka}{mg}$

(4) $\frac{Ka}{3mg}$

4. Two batteries with e.m.f. 12 V and 13 V are connected in parallel across a load resistor of 10 Ω. The internal resistances of the two batteries are 1 Ω and 2 Ω respectively. The voltage across the load lies between :

(1) 11.4 V and 11.5 V

(2) 11.7 V and 11.8 V

(3) 11.6 V and 11.7 V

(4) 11.5 V and 11.6 V

SPACE FOR ROUGH WORK

5. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\frac{k}{2r^2}$. Its total energy is :

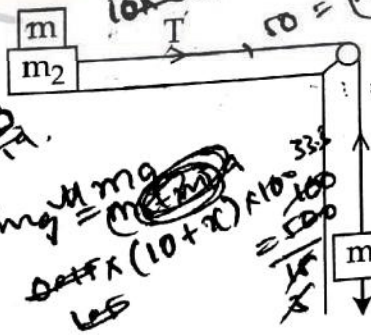
(1) Zero

(2) $-\frac{3}{2}\frac{k}{a^2}$

(3) $-\frac{k}{4a^2}$

(4) $\frac{k}{2a^2}$

6. Two masses $m_1 = 5$ kg and $m_2 = 10$ kg, connected by an inextensible string over a frictionless pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is :



(1) 43.3 kg

(2) 10.3 kg

(3) 18.3 kg

(4) 27.3 kg

7. If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is :

(1) $\nu_L/16$

(2) $\nu_L/25$

(3) $25\,\nu_L$

(4) $16\,\nu_L$

8. Unpolarized light of intensity I passes through an ideal polarizer A. Another identical polarizer B is placed behind A. The intensity of light beyond B is found to be $\frac{I}{2}$. Now another identical polarizer C is placed between A and B. The intensity beyond B is now found to be $\frac{I}{8}$. The angle between polarizer A and C is :

(1) 45°

(2) 60°

(3) 0°

(4) 30°

9. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants)

(1) $\Lambda_n^2 \approx A + B\lambda_n^2$

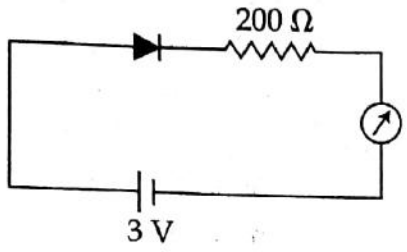
(2) $\Lambda_n^2 \approx \lambda$

(3) $\Lambda_n \approx A + \frac{B}{\lambda_n^2}$

(4) $\Lambda_n \approx A + B\lambda_n$

SPACE FOR ROUGH WORK

10. The reading of the ammeter for a silicon diode in the given circuit is :



(1) 11.5 mA
(2) 13.5 mA
(3) 0
(4) 15 mA

11. An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii r_e, r_p, r_α respectively in a uniform magnetic field B. The relation between r_e, r_p, r_α is :

(1) $r_e < r_p < r_\alpha$
(2) $r_e < r_\alpha < r_p$
(3) $r_e > r_p = r_\alpha$
(4) $r_e < r_p = r_\alpha$

12. A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20 V. If a dielectric material of dielectric constant $K = \frac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be :

(1) 2.4 n C
(2) 0.9 n C
(3) 1.2 n C
(4) 0.3 n C

13. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exibits resonance. The quality factor, Q is given by :

(1) $\frac{R}{(\omega_0 C)}$
(2) $\frac{CR}{\omega_0}$
(3) $\frac{\omega_0 L}{R}$
(4) $\frac{\omega_0 R}{L}$

14. A telephonic communication service is working at carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz ?

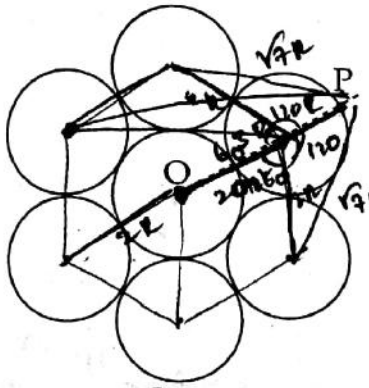
(1) 2×10^5
(2) 2×10^6
(3) 2×10^3
(4) 2×10^4

15. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is 2.7×10^3 kg/m^3 and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations ?

(1) 10 kHz
(2) 7.5 kHz
(3) 5 kHz
(4) 2.5 kHz

SPACE FOR ROUGH WORK

16. Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is :



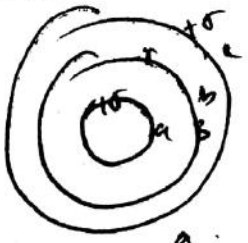
(1) $\frac{73}{2}MR^2$

(2) $\frac{181}{2}MR^2$

(3) $\frac{19}{2}MR^2$

(4) $\frac{55}{2}MR^2$

17. Three concentric metal shells A, B and C of respective radii a, b and c (a < b < c) have surface charge densities $+\sigma$, $-\sigma$ and $+\sigma$ respectively. The potential of shell B is :



(1) $\frac{\sigma}{\epsilon_o}\left[\frac{b^2-c^2}{b}+a\right]$

(2) $\frac{\sigma}{\epsilon_o}\left[\frac{b^2-c^2}{c}+a\right]$

(3) $\frac{\sigma}{\epsilon_o}\left[\frac{a^2-b^2}{a}+c\right]$

(4) $\frac{\sigma}{\epsilon_o}\left[\frac{a^2-b^2}{b}+c\right]$

18. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52 cm of the potentiometer wire. If the cell is shunted by a resistance of 5 Ω, a balance is found when the cell is connected across 40 cm of the wire. Find the internal resistance of the cell.

(1) 2 Ω

(2) 2.5 Ω

(3) 1 Ω

(4) 1.5 Ω

19. An EM wave from air enters a medium. The electric fields are

$\vec{E}_1 = E_{01}\,\hat{x}\cos\left[2\pi\nu\left(\frac{z}{c}-t\right)\right]$ in air and

$\vec{E}_2 = E_{02}\,\hat{x}\cos\left[k(2z-ct)\right]$ in medium, where the wave number k and frequency ν refer to their values in air. The medium is non-magnetic. If ϵ_{r_1} and ϵ_{r_2} refer to relative permittivities of air and medium respectively, which of the following options is **correct** ?

(1) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = \frac{1}{4}$

(2) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = \frac{1}{2}$

(3) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = 4$

(4) $\frac{\epsilon_{r_1}}{\epsilon_{r_2}} = 2$

SPACE FOR ROUGH WORK

20. The angular width of the central maximum in a single slit diffraction pattern is 60°. The width of the slit is 1 μm. The slit is illuminated by monochromatic plane waves. If another slit of same width is made near it, Young's fringes can be observed on a screen placed at a distance 50 cm from the slits. If the observed fringe width is 1 cm, what is slit separation distance ?

(i.e. distance between the centres of each slit.)

(1) 75 μm

(2) 100 μm

(3) 25 μm

(4) 50 μm

21. A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12}/sec. What is the force constant of the bonds connecting one atom with the other ? (Mole wt. of silver = 108 and Avagadro number = 6.02×10^{23} gm mole^{-1})

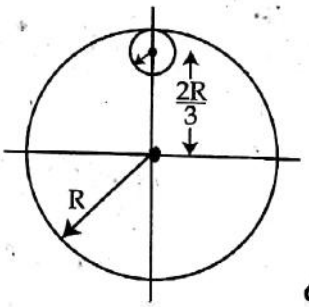
(1) 2.2 N/m

(2) 5.5 N/m

(3) 6.4 N/m

(4) 7.1 N/m

22. From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is :



(1) 10 MR^2

(2) $\frac{37}{9}$ MR^2

(3) 4 MR^2

(4) $\frac{40}{9}$ MR^2

23. In a collinear collision, a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles, after collision, is :

(1) $\frac{v_0}{2}$

(2) $\frac{v_0}{\sqrt{2}}$

(3) $\frac{v_0}{4}$

(4) $\sqrt{2}\, v_0$

SPACE FOR ROUGH WORK

24. The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1. When the dipole moment is doubled by keeping the current constant, the magnetic field at the centre of the loop is B_2. The ratio $\frac{B_1}{B_2}$ is :

(1) $\sqrt{2}$

(2) $\frac{1}{\sqrt{2}}$

(3) 2

(4) $\sqrt{3}$

25. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is :

(1) 4.5%

(2) 6%

(3) 2.5%

(4) 3.5%

26. On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm. The resistance of their series combination is 1 kΩ. How much was the resistance on the left slot before interchanging the resistances ?

(1) 550 Ω

(2) 910 Ω

(3) 990 Ω

(4) 505 Ω

27. In an a.c. circuit, the instantaneous e.m.f. and current are given by

$e = 100 \sin 30\,t$

$i = 20 \sin\left(30\,t - \frac{\pi}{4}\right)$

In one cycle of a.c., the average power consumed by the circuit and the wattless current are, respectively :

(1) $\frac{50}{\sqrt{2}}$, 0

(2) 50, 0

(3) 50, 10

(4) $\frac{1000}{\sqrt{2}}$, 10

28. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up.

(1) position vs time

(2) velocity vs time

(3) velocity vs position

(4) distance vs time

SPACE FOR ROUGH WORK

29. Two moles of an ideal monoatomic gas occupies a volume V at 27°C. The gas expands adiabatically to a volume 2 V. Calculate (a) the final temperature of the gas and (b) change in its internal energy.

(1) (a) 189 K (b) −2.7 kJ

(2) (a) 195 K (b) 2.7 kJ

(3) (a) 189 K (b) 2.7 kJ

(4) (a) 195 K (b) −2.7 kJ

30. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n^{th} power of R. If the period of rotation of the particle is T, then :

(1) $T \propto R^{(n+1)/2}$

(2) $T \propto R^{n/2}$

(3) $T \propto R^{3/2}$ for any n.

(4) $T \propto R^{\frac{n}{2}+1}$

PART B – MATHEMATICS

31. If the tangent at (1, 7) to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ then the value of c is :

(1) 85

(2) 95

(3) 195

(4) 185

32. If L_1 is the line of intersection of the planes $2x - 2y + 3z - 2 = 0$, $x - y + z + 1 = 0$ and L_2 is the line of intersection of the planes $x + 2y - z - 3 = 0$, $3x - y + 2z - 1 = 0$, then the distance of the origin from the plane, containing the lines L_1 and L_2, is :

(1) $\frac{1}{2\sqrt{2}}$

(2) $\frac{1}{\sqrt{2}}$

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

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

33. If $\alpha, \beta \in C$ are the distinct roots, of the equation $x^2 - x + 1 = 0$, then $\alpha^{101} + \beta^{107}$ is equal to :

(1) 1

(2) 2

(3) −1

(4) 0

SPACE FOR ROUGH WORK

34. Tangents are drawn to the hyperbola $4x^2 - y^2 = 36$ at the points P and Q. If these tangents intersect at the point T(0, 3) then the area (in sq. units) of ΔPTQ is :

(1) $60\sqrt{3}$

(2) $36\sqrt{5}$

(3) $45\sqrt{5}$

(4) $54\sqrt{3}$

35. If the curves $y^2 = 6x$, $9x^2 + by^2 = 16$ intersect each other at right angles, then the value of b is :

(1) 4

(2) $\frac{9}{2}$

(3) 6

(4) $\frac{7}{2}$

36. If the system of linear equations

$3x + by + 2z = 0$

$3x + ky - 2z = 0$

$2x + 4y - 3z = 0$

has a non-zero solution (x, y, z), then $\frac{xz}{y^2}$ is equal to :

(1) -30

(2) 30

(3) -10

(4) 10

37. Let $S = \{x \in \mathbf{R} : x \geq 0 \text{ and } 2|\sqrt{x} - 3| + \sqrt{x}(\sqrt{x} - 6) + 6 = 0\}$. Then S :

(1) contains exactly two elements.

(2) contains exactly four elements.

(3) is an empty set.

(4) contains exactly one element.

38. If sum of all the solutions of the equation

$8\cos x \cdot \left(\cos\left(\frac{\pi}{6} + x\right) \cdot \cos\left(\frac{\pi}{6} - x\right) - \frac{1}{2}\right) = 1$

in $[0, \pi]$ is $k\pi$, then k is equal to :

(1) $\frac{8}{9}$

(2) $\frac{20}{9}$

(3) $\frac{2}{3}$

(4) $\frac{13}{9}$

39. A bag contains 4 red and 6 black balls. A ball is drawn at random from the bag, its colour is observed and this ball along with two additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red, is :

(1) $\frac{1}{5}$

(2) $\frac{3}{4}$

(3) $\frac{3}{10}$

(4) $\frac{2}{5}$

40. Let $f(x) = x^2 + \frac{1}{x^2}$ and $g(x) = x - \frac{1}{x}$, $x \in \mathbf{R} - \{-1, 0, 1\}$. If $h(x) = \frac{f(x)}{g(x)}$, then the local minimum value of h(x) is :

(1) $-2\sqrt{2}$

(2) $2\sqrt{2}$

(3) 3

(4) -3

SPACE FOR ROUGH WORK

41. Two sets A and B are as under :

$A = \{(a, b) \in \mathbf{R} \times \mathbf{R} : |a-5| < 1 \text{ and } |b-5| < 1\}$;

$B = \{(a, b) \in \mathbf{R} \times \mathbf{R} : 4(a-6)^2 + 9(b-5)^2 \le 36\}$. Then :

(1) $A \cap B = \phi$ (an empty set)

(2) neither $A \subset B$ nor $B \subset A$

(3) $B \subset A$

(4) $A \subset B$

42. The Boolean expression $\sim(p \vee q) \vee (\sim p \wedge q)$ is equivalent to :

(1) q

(2) ~q

(3) ~p

(4) p

43. Tangent and normal are drawn at P(16, 16) on the parabola $y^2 = 16x$, which intersect the axis of the parabola at A and B, respectively. If C is the centre of the circle through the points P, A and B and $\angle CPB = \theta$, then a value of $\tan\theta$ is :

(1) 3

(2) $\frac{4}{3}$

(3) $\frac{1}{2}$

(4) 2

44. If $\begin{vmatrix} x-4 & 2x & 2x \\ 2x & x-4 & 2x \\ 2x & 2x & x-4 \end{vmatrix} = (A + Bx)(x - A)^2$, then the ordered pair (A, B) is equal to :

(1) (−4, 5)

(2) (4, 5)

(3) (−4, −5)

(4) (−4, 3)

45. The sum of the co-efficients of all odd degree terms in the expansion of $\left(x + \sqrt{x^3 - 1}\right)^5 + \left(x - \sqrt{x^3 - 1}\right)^5$, $(x > 1)$ is :

(1) 1

(2) 2

(3) −1

(4) 0

46. Let $a_1, a_2, a_3, \ldots, a_{49}$ be in A.P. such that $\sum_{k=0}^{12} a_{4k+1} = 416$ and $a_9 + a_{43} = 66$. If $a_1^2 + a_2^2 + \ldots + a_{17}^2 = 140\,m$, then m is equal to :

(1) 34

(2) 33

(3) 66

(4) 68

47. A straight line through a fixed point (2, 3) intersects the coordinate axes at distinct points P and Q. If O is the origin and the rectangle ORRQ is completed, then the locus of R is :

(1) $3x + 2y = xy$

(2) $3x + 2y = 6xy$

(3) $3x + 2y = 6$

(4) $2x + 3y = xy$

48. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2 x}{1 + 2^x}\,dx$ is :

(1) 4π

(2) $\frac{\pi}{4}$

(3) $\frac{\pi}{8}$

(4) $\frac{\pi}{2}$

SPACE FOR ROUGH WORK

49. Let $g(x)=\cos x^2$, $f(x)=\sqrt{x}$, and α, β ($\alpha < \beta$) be the roots of the quadratic equation $18x^2-9\pi x+\pi^2=0$. Then the area (in sq. units) bounded by the curve $y=(gof)(x)$ and the lines $x=\alpha$, $x=\beta$ and $y=0$, is :

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

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

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

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

50. For each $t \in \mathbf{R}$, let $[t]$ be the greatest integer less than or equal to t. Then

$$\lim_{x\to 0+} x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+\ldots..+\left[\frac{15}{x}\right]\right)$$

(1) is equal to 120.

(2) does not exist (in R).

(3) is equal to 0.

(4) is equal to 15.

51. If $\sum_{i=1}^{9}(x_i-5)=9$ and $\sum_{i=1}^{9}(x_i-5)^2=45$, then the standard deviation of the 9 items $x_1, x_2, \ldots.., x_9$ is :

(1) 2

(2) 3

(3) 9

(4) 4

52. The integral

$$\int \frac{\sin^2 x\cos^2 x}{(\sin^5 x+\cos^3 x\sin^2 x+\sin^3 x\cos^2 x+\cos^5 x)^2}dx$$

is equal to :

(1) $\frac{1}{1+\cot^3 x}+C$

(2) $\frac{-1}{1+\cot^3 x}+C$

(3) $\frac{1}{3(1+\tan^3 x)}+C$

(4) $\frac{-1}{3(1+\tan^3 x)}+C$

(where C is a constant of integration)

53. Let $S=\{t \in \mathbf{R} : f(x)=|x-\pi|\cdot(e^{|x|}-1)\sin|x|$ is not differentiable at t$\}$. Then the set S is equal to :

(1) $\{\pi\}$

(2) $\{0, \pi\}$

(3) ϕ (an empty set)

(4) $\{0\}$

54. Let $y=y(x)$ be the solution of the differential equation

$\sin x\frac{dy}{dx}+y\cos x=4x$, $x \in (0,\pi)$. If $y\left(\frac{\pi}{2}\right)=0$, then $y\left(\frac{\pi}{6}\right)$ is equal to :

(1) $-\frac{8}{9}\pi^2$

(2) $-\frac{4}{9}\pi^2$

(3) $\frac{4}{9\sqrt{3}}\pi^2$

(4) $\frac{-8}{9\sqrt{3}}\pi^2$

SPACE FOR ROUGH WORK

55. Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u} \cdot \vec{b} = 24$, then $\left|\vec{u}\right|^2$ is equal to :

(1) 256

(2) 84

(3) 336

(4) 315

56. The length of the projection of the line segment joining the points (5, −1, 4) and (4, −1, 3) on the plane, $x+y+z=7$ is :

(1) $\frac{1}{3}$

(2) $\sqrt{\frac{2}{3}}$

(3) $\frac{2}{\sqrt{3}}$

(4) $\frac{2}{3}$

57. PQR is a triangular park with PQ = PR = 200 m. A T.V. tower stands at the mid-point of QR. If the angles of elevation of the top of the tower at P, Q and R are respectively 45°, 30° and 30°, then the height of the tower (in m) is :

(1) $100\sqrt{3}$

(2) $50\sqrt{2}$

(3) 100

(4) 50

58. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. The number of such arrangements is :

(1) at least 500 but less than 750

(2) at least 750 but less than 1000

(3) at least 1000

(4) less than 500

59. Let A be the sum of the first 20 terms and B be the sum of the first 40 terms of the series

$1^2 + 2\cdot2^2 + 3^2 + 2\cdot4^2 + 5^2 + 2\cdot6^2 + ...$

If $B - 2A = 100\lambda$, then λ is equal to :

(1) 464

(2) 496

(3) 232

(4) 248

60. Let the orthocentre and centroid of a triangle be A(−3, 5) and B(3, 3) respectively. If C is the circumcentre of this triangle, then the radius of the circle having line segment AC as diameter, is :

(1) $3\sqrt{\frac{5}{2}}$

(2) $\frac{3\sqrt{5}}{2}$

(3) $\sqrt{10}$

(4) $2\sqrt{10}$

SPACE FOR ROUGH WORK

PART C – CHEMISTRY

61. Total number of lone pair of electrons in I_3^- ion is :

(1) 9

(2) 12

(3) 3

(4) 6

62. Which of the following salts is the most basic in aqueous solution ?

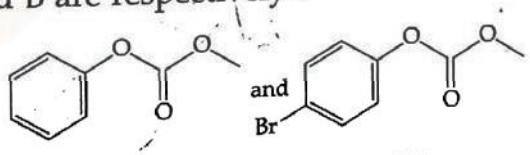
(1) $FeCl_3$

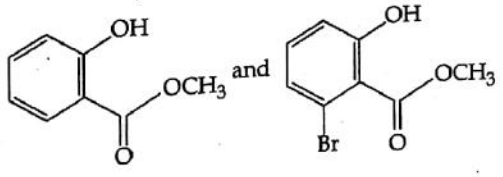
(2) $Pb(CH_3COO)_2$

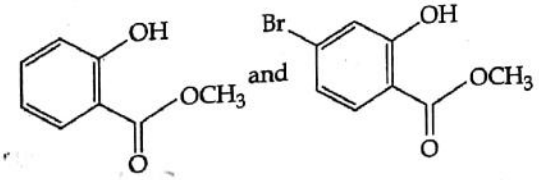
(3) $Al(CN)_3$

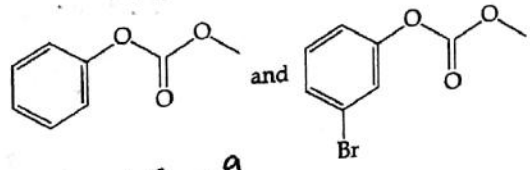
(4) CH_3COOK

63. Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br_2 to form product B. A and B are respectively :

(1) 

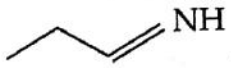
(2) 

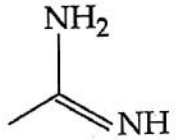
(3) 

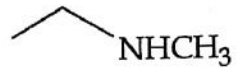
(4) 

64. The increasing order of basicity of the following compounds is :

(a) 

(b) 

(c) 

(d) 

(1) (b) < (a) < (d) < (c)

(2) (d) < (b) < (a) < (c)

(3) (a) < (b) < (c) < (d)

(4) (b) < (a) < (c) < (d)

65. An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination ?

	Base	Acid	End point
(1)	Weak	Strong	Yellow to pinkish red
(2)	Strong	Strong	Pink to colourless
(3)	Weak	Strong	Colourless to pink
(4)	Strong	Strong	Pinkish red to yellow

SPACE FOR ROUGH WORK

66. The *trans*-alkenes are formed by the reduction of alkynes with :

(1) Na/liq. NH_3

(2) Sn - HCl

(3) H_2 - Pd/C, $BaSO_4$

(4) $NaBH_4$

67. The ratio of mass percent of C and H of an organic compound ($C_XH_YO_Z$) is 6 : 1. If one molecule of the above compound ($C_XH_YO_Z$) contains half as much oxygen as required to burn one molecule of compound C_XH_Y completely to CO_2 and H_2O. The empirical formula of compound $C_XH_YO_Z$ is :

(1) $C_3H_4O_2$

(2) $C_2H_4O_3$

(3) $C_3H_6O_3$

(4) C_2H_4O

68. Hydrogen peroxide oxidises $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ in acidic medium but reduces $[Fe(CN)_6]^{3-}$ to $[Fe(CN)_6]^{4-}$ in alkaline medium. The other products formed are, respectively :

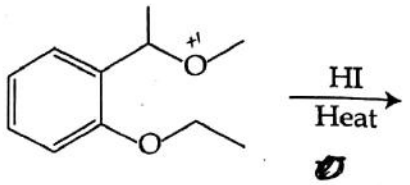
(1) H_2O and $(H_2O + O_2)$

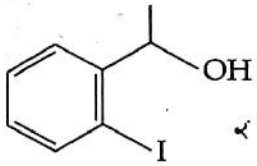
(2) H_2O and $(H_2O + OH^-)$

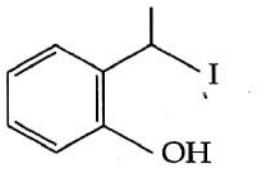
(3) $(H_2O + O_2)$ and H_2O

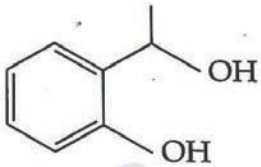
(4) $(H_2O + O_2)$ and $(H_2O + OH^-)$

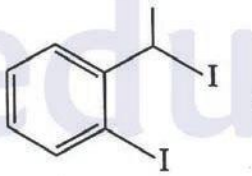
69. The major product formed in the following reaction is :



(1) 

(2) 

(3) 

(4) 

70. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane ?

(Atomic weight of B = 10.8 u)

(1) 3.2 hours

(2) 1.6 hours

(3) 6.4 hours

(4) 0.8 hours

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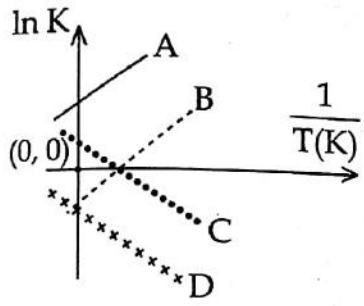
71. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction ?



(1) C and D

(2) A and D

(3) A and B

(4) B and C

72. At 518° C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr, was 1.00 Torr s^{-1} when 5% had reacted and 0.5 Torr s^{-1} when 33% had reacted. The order of the reaction is :

(1) 1

(2) 0

(3) 2

(4) 3

73. Glucose on prolonged heating with HI gives :

(1) Hexanoic acid

(2) 6-iodohexanal

(3) *n*-Hexane

(4) 1-Hexene

74. Consider the following reaction and statements :

$$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$$

(I) Two isomers are produced if the reactant complex ion is a *cis*-isomer.

(II) Two isomers are produced if the reactant complex ion is a *trans*-isomer.

(III) Only one isomer is produced if the reactant complex ion is a *trans*-isomer.

(IV) Only one isomer is produced if the reactant complex ion is a *cis*-isomer.

The correct statements are :

(1) (III) and (IV)

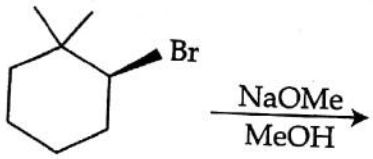
(2) (II) and (IV)

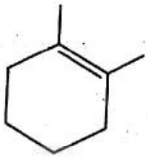
(3) (I) and (II)

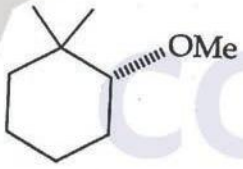
(4) (I) and (III)

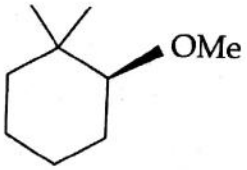
SPACE FOR ROUGH WORK

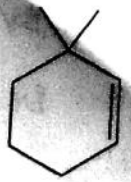
75. The major product of the following reaction is :



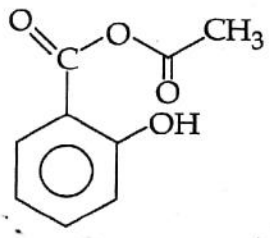
(1) 

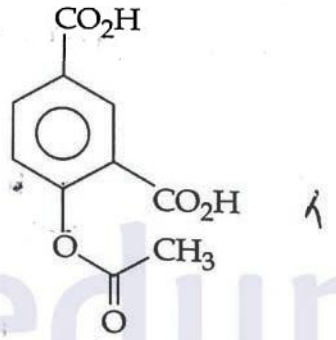
(2) 

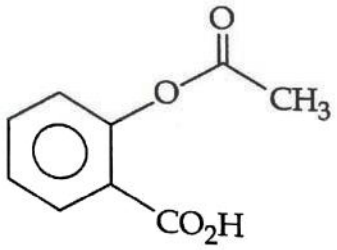
(3) 

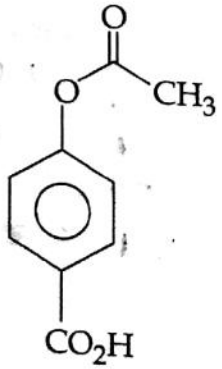
(4) 

76. Phenol on treatment with CO_2 in the presence of NaOH followed by acidification produces compound X as the major product. X on treatment with $(CH_3CO)_2O$ in the presence of catalytic amount of H_2SO_4 produces :

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

77. An aqueous solution contains an unknown concentration of Ba^{2+}. When 50 mL of a 1 M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is 500 mL. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+} ?

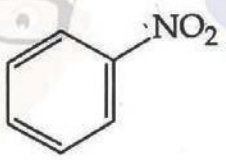
(1) 1.1×10^{-9} M

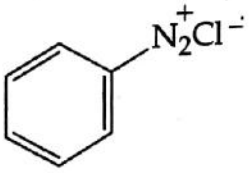
(2) 1.0×10^{-10} M

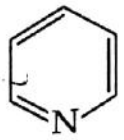
(3) 5×10^{-9} M

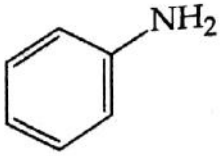
(4) 2×10^{-9} M

78. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation ?

(1) 

(2) 

(3) 

(4) 

79. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is :

(1) Al

(2) Fe

(3) Zn

(4) Ca

80. An aqueous solution contains 0.10 M H_2S and 0.20 M HCl. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is :

(1) 6×10^{-21}

(2) 5×10^{-19}

(3) 5×10^{-8}

(4) 3×10^{-20}

81. The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting $[3Ca_3(PO_4)_2\cdot Ca(OH)_2]$ to :

(1) $[3Ca_3(PO_4)_2\cdot CaF_2]$

(2) $[3\{Ca(OH)_2\}\cdot CaF_2]$

(3) $[CaF_2]$

(4) $[3(CaF_2)\cdot Ca(OH)_2]$

SPACE FOR ROUGH WORK

82. The compound that does not produce nitrogen gas by the thermal decomposition is :

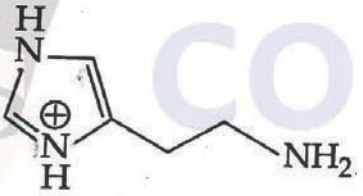
(1) NH_4NO_2

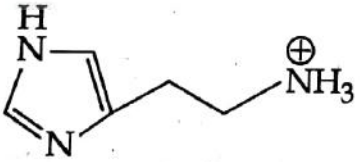
(2) $(NH_4)_2SO_4$

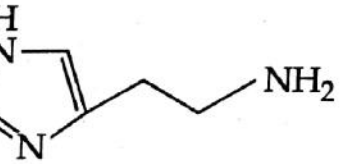
(3) $Ba(N_3)_2$

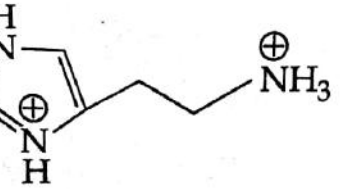
(4) $(NH_4)_2Cr_2O_7$

83. The predominant form of histamine present in human blood is (pK_a, Histidine = 6.0)

(1) 

(2) 

(3) 

(4) 

84. The oxidation states of Cr in $[Cr(H_2O)_6]Cl_3$, $[Cr(C_6H_6)_2]$, and $K_2[Cr(CN)_2(O)_2(O_2)(NH_3)]$ respectively are :

(1) +3, 0, and +6

(2) +3, 0, and +4

(3) +3, +4, and +6

(4) +3, +2, and +4

85. Which type of 'defect' has the presence of cations in the interstitial sites ?

(1) Frenkel defect

(2) Metal deficiency defect

(3) Schottky defect

(4) Vacancy defect

86. The combustion of benzene (l) gives $CO_2(g)$ and $H_2O(l)$. Given that heat of combustion of benzene at constant volume is -3263.9 kJ mol^{-1} at 25° C; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be :

($R = 8.314$ JK^{-1} mol^{-1})

(1) 3260

(2) -3267.6

(3) 4152.6

(4) -452.46

SPACE FOR ROUGH WORK

87. Which of the following are Lewis acids ?

(1) PH_3 and $SiCl_4$

(2) BCl_3 and $AlCl_3$

(3) PH_3 and BCl_3

(4) $AlCl_3$ and $SiCl_4$

88. Which of the following compounds contain(s) no covalent bond(s) ?

KCl, PH_3, O_2, B_2H_6, H_2SO_4

(1) KCl

(2) KCl, B_2H_6

(3) KCl, B_2H_6, PH_3

(4) KCl, H_2SO_4

89. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point ?

(1) $[Co(H_2O)_4Cl_2]Cl.2H_2O$

(2) $[Co(H_2O)_3Cl_3].3H_2O$

(3) $[Co(H_2O)_6]Cl_3$

(4) $[Co(H_2O)_5Cl]Cl_2.H_2O$

90. According to molecular orbital theory, which of the following will **not** be a viable molecule ?

(1) H_2^-

(2) H_2^{2-}

(3) He_2^{2+}

(4) He_2^+

-o0o-

SPACE FOR ROUGH WORK