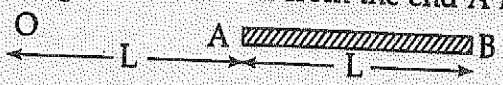
PART A – PHYSICS

1. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at a distance L from the end A is :



(1) $\frac{Q}{4\pi\epsilon_0 L \ln 2}$

(2) $\frac{Q \ln 2}{4\pi\epsilon_0 L}$

(3) $\frac{Q}{8\pi\epsilon_0 L}$

(4) $\frac{3Q}{4\pi\epsilon_0 L}$

2. A sonometer wire of length 1.5 m is made of steel. The tension in it produces an elastic strain of 1%. What is the fundamental frequency of steel if density and elasticity of steel are 7.7×10^3 kg/m^3 and 2.2×10^{11} N/m^2 respectively ?

(1) 200.5 Hz

(2) 770 Hz

(3) 188.5 Hz

(4) 178.2 Hz

3. A projectile is given an initial velocity of $\left(\hat{i} + 2\hat{j}\right)$ m/s, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If g = 10 m/s^2, the equation of its trajectory is :

(1) $4y = 2x - 5x^2$

(2) $4y = 2x - 25x^2$

(3) $y = x - 5x^2$

(4) $y = 2x - 5x^2$

4. A uniform cylinder of length L and mass M having cross - sectional area A is suspended, with its length vertical, from a fixed point by a massless spring, such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_0 of the spring when it is in equilibrium is :

(1) $\frac{Mg}{k}\left(1 - \frac{LA\sigma}{2M}\right)$

(2) $\frac{Mg}{k}\left(1 + \frac{LA\sigma}{M}\right)$

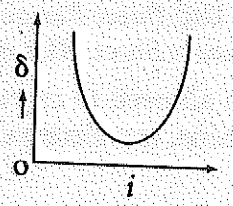
(3) $\frac{Mg}{k}$

(4) $\frac{Mg}{k}\left(1 - \frac{LA\sigma}{M}\right)$

(Here k is spring constant)

5. The graph between angle of deviation (δ) and angle of incidence (i) for a triangular prism is represented by :

(1)



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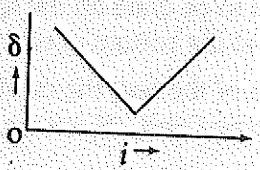

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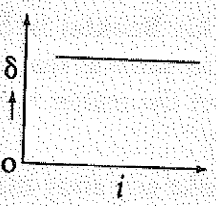
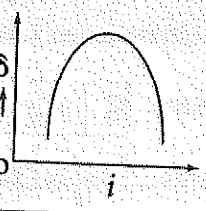


(4)



SPACE FOR ROUGH WORK

6. Diameter of a plano - convex lens is 6 cm and thickness at the centre is 3 mm. If speed of light in material of lens is 2×10^8 m/s, the focal length of the lens is :

(1) 30 cm

(2) 10 cm

(3) 15 cm

(4) 20 cm

7. The supply voltage to a room is 120 V. The resistance of the lead wires is 6 Ω. A 60 W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb ?

(1) 13.3 Volt

(2) 10.04 Volt

(3) zero Volt

(4) 2.9 Volt

8. A beam of unpolarised light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of the emergent light is :

(1) $I_0/4$

(2) $I_0/8$

(3) I_0

(4) $I_0/2$

9. The amplitude of a damped oscillator decreases to 0.9 times its original magnitude in 5s. In another 10s it will decrease to α times its original magnitude, where α equals :

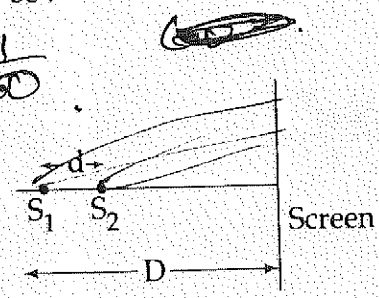
(1) 0.729

(2) 0.6

(3) 0.7

(4) 0.81

10. Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown. The fringes obtained on the screen will be :



(1) semi - circles

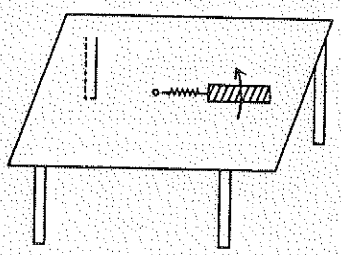
(2) concentric circles

(3) points

(4) straight lines

SPACE FOR ROUGH WORK

11. A metallic rod of length 'l' is tied to a string of length 2l and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is :



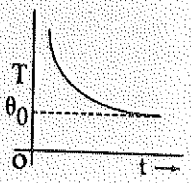
(1) $\frac{4B\omega l^2}{2}$

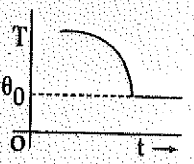
(2) $\frac{5B\omega l^2}{2}$

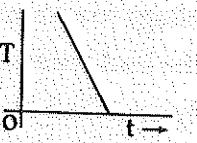
(3) $\frac{2B\omega l^2}{2}$

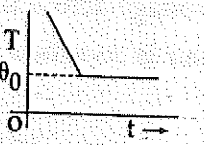
(4) $\frac{3B\omega l^2}{2}$

12. If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0, the graph between the temperature T of the metal and time t will be closest to :

(1) 

(2) 

(3) 

(4) 

13. *This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

Statement - I : Higher the range, greater is the resistance of ammeter.

Statement - II : To increase the range of ammeter, additional shunt needs to be used across it.

(1) Statement - I is true, Statement - II is false.

(2) Statement - I is false, Statement - II is true.

(3) Statement - I is true, Statement - II is true, Statement -II is the **correct** explanation of Statement - I.

(4) Statement - I is true, Statement - II is true, Statement - II is **not** the correct explanation of Statement - I.

SPACE FOR ROUGH WORK

14. Two charges, each equal to q, are kept at $x = -a$ and $x = a$ on the x - axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement ($y << a$) along the y - axis, the net force acting on the particle is proportional to :

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

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

(3) y

(4) $-y$

15. *This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

Statement - I : A point particle of mass m moving with speed v collides with stationary point particle of mass M. If the maximum energy loss possible is given as $f\left(\frac{1}{2}mv^2\right)$ then $f = \left(\frac{m}{M+m}\right)$.

Statement - II : Maximum energy loss occurs when the particles get stuck together as a result of the collision.

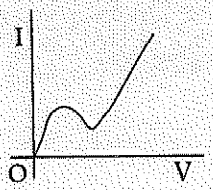
(1) Statement - I is true, Statement - II is false.

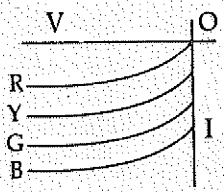
(2) Statement - I is false, Statement - II is true.

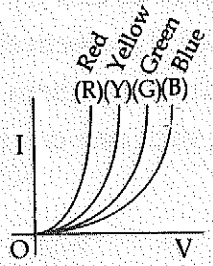
(3) Statement - I is true, Statement - II is true, Statement - II is a **correct** explanation of Statement - I.

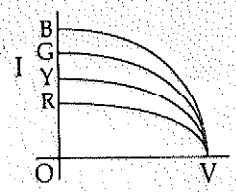
(4) Statement - I is true, Statement - II is true, Statement - II is **not** a correct explanation of Statement - I.

16. The I - V characteristic of an LED is :

(1)


(2)


(3)


(4)


SPACE FOR ROUGH WORK

17. Assume that a drop of liquid evaporates by decrease in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible ? The surface tension is T, density of liquid is ρ and L is its latent heat of vaporization.

(1) $T/\rho L$

(2) $2T/\rho L$

(3) $\rho L/T$

(4) $\sqrt{T/\rho L}$

18. Two capacitors C_1 and C_2 are charged to 120 V and 200 V respectively. It is found that by connecting them together the potential on each one can be made zero. Then :

(1) $3C_1 + 5C_2 = 0$

(2) $9C_1 = 4C_2$

(3) $5C_1 = 3C_2$

(4) $3C_1 = 5C_2$

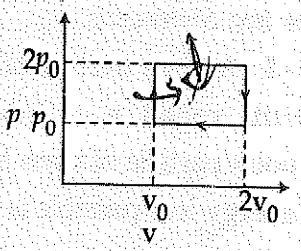
19. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of 2R ?

(1) $\frac{GmM}{2R}$

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

(3) $\frac{5GmM}{6R}$

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

20. 

The above p-v diagram represents the thermodynamic cycle of an engine, operating with an ideal monoatomic gas. The amount of heat, extracted from the source in a single cycle is :

(1) $\left(\frac{11}{2}\right)p_0 v_0$

(2) $4p_0v_0$

(3) p_0v_0

(4) $\left(\frac{13}{2}\right)p_0 v_0$

SPACE FOR ROUGH WORK

21. A circular loop of radius 0.3 cm lies parallel to a much bigger circular loop of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with bigger loop is :

(1) 3.3×10^{-11} weber

(2) 6.6×10^{-9} weber

(3) 9.1×10^{-11} weber

(4) 6×10^{-11} weber

22. A diode detector is used to detect an amplitude modulated wave of 60% modulation by using a condenser of capacity 250 pico farad in parallel with a load resistance 100 kilo ohm. Find the maximum modulated frequency which could be detected by it.

(1) 5.31 MHz

(2) 5.31 kHz

(3) 10.62 MHz

(4) 10.62 kHz

23. An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and the cylinder have equal cross sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency :

(1) $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma P_0}{MV_0}}$

(2) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma P_0}}$

(3) $\frac{1}{2\pi}\frac{A\gamma P_0}{V_0 M}$

(4) $\frac{1}{2\pi}\frac{V_0 M P_0}{A^2\gamma}$

SPACE FOR ROUGH WORK

24. A hoop of radius r and mass m rotating with an angular velocity ω_0 is placed on a rough horizontal surface. The initial velocity of the centre of the hoop is zero. What will be the velocity of the centre of the hoop when it ceases to slip ?

(1) $\frac{r\omega_0}{2}$

(2) $r\omega_0$

(3) $\frac{r\omega_0}{4}$

(4) $\frac{r\omega_0}{3}$

25. Two short bar magnets of length 1 cm each have magnetic moments 1.20 Am^2 and 1.00 Am^2 respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid - point O of the line joining their centres is close to

(Horizontal component of earth's magnetic induction is 3.6×10^{-5} Wb/m^2)

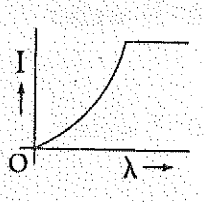
(1) 3.50×10^{-4} Wb/m^2

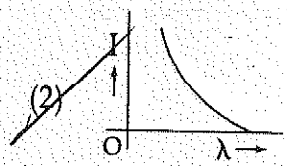
(2) 5.80×10^{-4} Wb/m^2

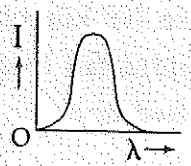
(3) 3.6×10^{-5} Wb/m^2

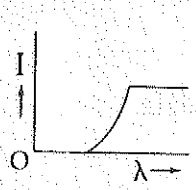
(4) 2.56×10^{-4} Wb/m^2

26. The anode voltage of a photocell is kept fixed. The wavelength λ of the light falling on the cathode is gradually changed. The plate current I of the photocell varies as follows :

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

27. Let $[\epsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then :

(1) $[\epsilon_0]=[M^{-1}L^2T^{-1}A^{-2}]$

(2) $[\epsilon_0]=[M^{-1}L^2T^{-1}A]$

(3) $[\epsilon_0]=[M^{-1}L^{-3}T^2A]$

(4) $[\epsilon_0]=[M^{-1}L^{-3}T^4A^2]$

28. In a hydrogen like atom electron makes transition from an energy level with quantum number n to another with quantum number (n−1). If n>>1, the frequency of radiation emitted is proportional to :

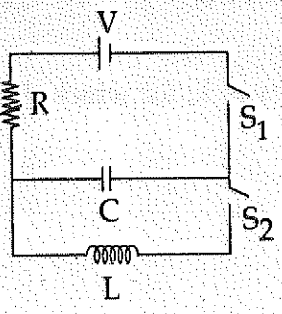
(1) $\frac{1}{n^{3/2}}$

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

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

(4) $\frac{1}{n^2}$

29. In an LCR circuit as shown below both switches are open initially. Now switch S_1 is closed, S_2 kept open. (q is charge on the capacitor and $\tau = RC$ is Capacitive time constant). Which of the following statement is correct ?



(1) At $t=2\tau$, $q=CV(1-e^{-2})$

(2) At $t=\frac{\tau}{2}$, $q=CV(1-e^{-1})$

(3) Work done by the battery is half of the energy dissipated in the resistor

(4) At $t=\tau$, $q=CV/2$

30. The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is :

(1) 9 V/m

(2) 12 V/m

(3) 3 V/m

(4) 6 V/m

SPACE FOR ROUGH WORK

PART B – MATHEMATICS

31. The real number k for which the equation, $2x^3+3x+k=0$ has two distinct real roots in [0, 1]

(1) lies between -1 and 0.

(2) does not exist.

(3) lies between 1 and 2.

(4) lies between 2 and 3.

32. The number of values of k, for which the system of equations :

$(k+1)x+8y=4k$

$kx+(k+3)y=3k-1$

has no solution, is :

(1) 2

(2) 3

(3) infinite

(4) 1

33. If $P=\begin{bmatrix}1 & \alpha & 3\\ 1 & 3 & 3\\ 2 & 4 & 4\end{bmatrix}$ is the adjoint of a 3×3 matrix A and $|A| = 4$, then α is equal to :

(1) 5

(2) 0

(3) 4

(4) 11

34. Let T_n be the number of all possible triangles formed by joining vertices of an n-sided regular polygon. If $T_{n+1}-T_n=10$, then the value of n is :

(1) 10

(2) 8

(3) 7

(4) 5

35. At present, a firm is manufacturing 2000 items. It is estimated that the rate of change of production P w.r.t. additional number of workers x is given by $\frac{dP}{dx}=100-12\sqrt{x}$. If the firm employs 25 more workers, then the new level of production of items is :

(1) 3500

(2) 4500

(3) 2500

(4) 3000

36. ABCD is a trapezium such that AB and CD are parallel and $BC\perp CD$. If $\angle ADB=\theta$, $BC=p$ and $CD=q$, then AB is equal to :

(1) $\frac{p^2+q^2}{p^2\cos\theta+q^2\sin\theta}$

(2) $\frac{(p^2+q^2)\sin\theta}{(p\cos\theta+q\sin\theta)^2}$

(3) $\frac{(p^2+q^2)\sin\theta}{p\cos\theta+q\sin\theta}$

(4) $\frac{p^2+q^2\cos\theta}{p\cos\theta+q\sin\theta}$

37. All the students of a class performed poorly in Mathematics. The teacher decided to give grace marks of 10 to each of the students. Which of the following statistical measures will not change even after the grace marks were given ?

(1) mode

(2) variance

(3) mean

(4) median

SPACE FOR ROUGH WORK

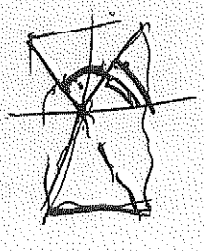
38. A ray of light along $x + \sqrt{3}y = \sqrt{3}$ gets reflected upon reaching x-axis, the equation of the reflected ray is :

(1) $y = \sqrt{3}x - \sqrt{3}$

(2) $\sqrt{3}y = x - 1$

(3) $y = x + \sqrt{3}$

(4) $\sqrt{3}y = x - \sqrt{3}$



39. The area (in square units) bounded by the curves $y = \sqrt{x}$, $2y - x + 3 = 0$, x-axis, and lying in the first quadrant is :

(1) 18

(2) $\frac{27}{4}$

(3) 9

(4) 36

40. If z is a complex number of unit modulus and argument θ, then $\arg\left(\frac{1+z}{1+\bar{z}}\right)$ equals :

(1) θ

(2) $\pi - \theta$

(3) $-\theta$

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

41. If $\int f(x)\,dx = \Psi(x)$, then $\int x^5 f(x^3)\,dx$ is equal to :

(1) $\frac{1}{3}x^3\Psi(x^3) - \int x^2\Psi(x^3)dx + C$

(2) $\frac{1}{3}\left[x^3\Psi(x^3) - \int x^3\Psi(x^3)dx\right] + C$

(3) $\frac{1}{3}\left[x^3\Psi(x^3) - \int x^2\Psi(x^3)dx\right] + C$

(4) $\frac{1}{3}x^3\Psi(x^3) - 3\int x^3\Psi(x^3)dx + C$

42. Let A and B be two sets containing 2 elements and 4 elements respectively. The number of subsets of $A \times B$ having 3 or more elements is :

(1) 219

(2) 211

(3) 256

(4) 220

43. If the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar, then k can have :

(1) exactly two values.

(2) exactly three values.

(3) any value.

(4) exactly one value.

SPACE FOR ROUGH WORK

44. The x-coordinate of the incentre of the triangle that has the coordinates of mid points of its sides as (0, 1) (1, 1) and (1, 0) is :

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

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

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

(4) $2 - \sqrt{2}$

45. Consider :

Statement - I : $(p \wedge \sim q) \wedge (\sim p \wedge q)$ is a fallacy.

Statement - II : $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$ is a tautology.

(1) Statement - I is true; Statement - II is false.

(2) Statement - I is false; Statement - II is true.

(3) Statement - I is true; Statement - II is true; Statement - II is a **correct** explanation for Statement - I.

(4) Statement - I is true; Statement - II is true; Statement - II is **not** a correct explanation for Statement - I.

46. If the equations $x^2 + 2x + 3 = 0$ and $ax^2 + bx + c = 0$, a, b, c $\in$ R, have a common root, then a : b : c is :

(1) 1 : 3 : 2

(2) 3 : 1 : 2

(3) 1 : 2 : 3

(4) 3 : 2 : 1

47. The sum of first 20 terms of the sequence 0.7, 0.77, 0.777, ..., is :

(1) $\frac{7}{81}\left(179 + 10^{-20}\right)$

(2) $\frac{7}{9}\left(99 + 10^{-20}\right)$

(3) $\frac{7}{81}\left(179 - 10^{-20}\right)$

(4) $\frac{7}{9}\left(99 - 10^{-20}\right)$

48. The term independent of x in expansion of $\left(\frac{x+1}{x^{2/3} - x^{1/3} + 1} - \frac{x-1}{x - x^{1/2}}\right)^{10}$ is :

(1) 210

(2) 310

(3) 4

(4) 120

49. If the vectors $\overrightarrow{AB} = 3\hat{i} + 4\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 4\hat{k}$ are the sides of a triangle ABC, then the length of the median through A is :

(1) $\sqrt{33}$

(2) $\sqrt{45}$

(3) $\sqrt{18}$

(4) $\sqrt{72}$

SPACE FOR ROUGH WORK

50. If x, y, z are in A.P. and $\tan^{-1}x$, $\tan^{-1}y$ and $\tan^{-1}z$ are also in A.P., then :

(1) $6x = 3y = 2z$

(2) $6x = 4y = 3z$

(3) $x = y = z$

(4) $2x = 3y = 6z$

51. The intercepts on x- axis made by tangents to the curve, $y = \int_0^x |t|\,dt$, $x \in R$, which are parallel to the line $y = 2x$, are equal to :

(1) ± 3

(2) ± 4

(3) ± 1

(4) ± 2

52. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is :

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

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

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

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

53. The circle passing through $(1, -2)$ and touching the axis of x at $(3, 0)$ also passes through the point :

(1) $(5, -2)$

(2) $(-2, 5)$

(3) $(-5, 2)$

(4) $(2, -5)$

54. The equation of the circle passing through the foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$, and having centre at $(0, 3)$ is :

(1) $x^2 + y^2 - 6y - 5 = 0$

(2) $x^2 + y^2 - 6y + 5 = 0$

(3) $x^2 + y^2 - 6y - 7 = 0$

(4) $x^2 + y^2 - 6y + 7 = 0$

55. If $y = \sec(\tan^{-1}x)$, then $\frac{dy}{dx}$ at $x = 1$ is equal to :

(1) 1

(2) $\sqrt{2}$

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

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

56. The expression $\frac{\tan A}{1 - \cot A} + \frac{\cot A}{1 - \tan A}$ can be written as :

(1) $\tan A + \cot A$

(2) $\sec A + \operatorname{cosec} A$

(3) $\sin A \cos A + 1$

(4) $\sec A \operatorname{cosec} A + 1$

SPACE FOR ROUGH WORK

57. Given : A circle, $2x^2+2y^2=5$ and a parabola, $y^2=4\sqrt{5}\,x$.

Statement - I : An equation of a common tangent to these curves is $y=x+\sqrt{5}$.

Statement - II : If the line, $y=mx+\frac{\sqrt{5}}{m}\ (m\neq 0)$ is their common tangent, then m satisfies $m^4-3m^2+2=0$.

(1) Statement - I is true; Statement - II is false.

(2) Statement - I is false; Statement - II is true.

(3) Statement - I is true; Statement - II is true; Statement - II is a **correct** explanation for Statement - I.

(4) Statement - I is true; Statement - II is true; Statement - II is **not** a correct explanation for Statement - I.

58. A multiple choice examination has 5 questions. Each question has three alternative answers of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is :

(1) $\frac{11}{3^5}$

(2) $\frac{10}{3^5}$

(3) $\frac{17}{3^5}$

(4) $\frac{13}{3^5}$

59. **Statement - I :**

The value of the integral $\int_{\pi/6}^{\pi/3}\frac{dx}{1+\sqrt{\tan x}}$ is equal to $\frac{\pi}{6}$.

Statement - II :

$\int_a^b f(x)dx=\int_a^b f\,(a+b-x)dx$.

(1) Statement - I is true; Statement - II is false.

(2) Statement - I is false ; Statement - II is true.

(3) Statement - I is true ; Statement - II is true; Statement - II is a **correct** explanation for Statement - I.

(4) Statement - I is true; Statement - II is true; Statement - II is **not** a correct explanation for Statement - I.

60. $\lim\limits_{x\to 0}\frac{(1-\cos 2x)(3+\cos x)}{x\tan 4x}$ is equal to :

(1) 1

(2) 2

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

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

SPACE FOR ROUGH WORK

PART C – CHEMISTRY

61. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar ?

(1) Ba < Ca < Se < S < Ar

(2) Ca < Ba < S < Se < Ar

(3) Ca < S < Ba < Se < Ar

(4) S < Se < Ca < Ba < Ar

62. A gaseous hydrocarbon gives upon combustion 0.72 g. of water and 3.08 g. of CO_2. The empirical formula of the hydrocarbon is :

(1) C_6H_5

(2) C_7H_8

(3) C_2H_4

(4) C_3H_4

63. The rate of a reaction doubles when its temperature changes from 300 K to 310 K. Activation energy of such a reaction will be :

(R = 8.314 JK^{-1} mol^{-1} and log 2 = 0.301)

(1) 58.5 kJ mol^{-1}

(2) 60.5 kJ mol^{-1}

(3) 53.6 kJ mol^{-1}

(4) 48.6 kJ mol^{-1}

64. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was :

(1) Ammonia

(2) Phosgene

(3) Methylisocyanate

(4) Methylamine

65. An organic compound A upon reacting with NH_3 gives B. On heating, B gives C. C in presence of KOH reacts with Br_2 to give $CH_3CH_2NH_2$. A is :

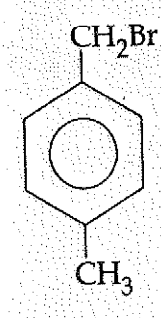
(1) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-COOH$

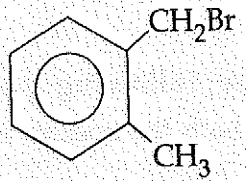
(2) CH_3CH_2COOH

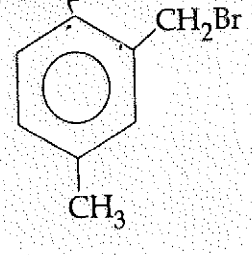
(3) CH_3COOH

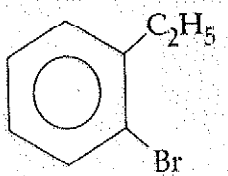
(4) $CH_3CH_2CH_2COOH$

66. Compound (A), C_8H_9Br, gives a white precipitate when warmed with alcoholic $AgNO_3$. Oxidation of (A) gives an acid (B), $C_8H_6O_4$. (B) easily forms anhydride on heating. Identify the compound (A).

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

67. A compound with molecular mass 180 is acylated with CH_3COCl to get a compound with molecular mass 390. The number of amino groups present per molecule of the former compound is :

(1) 4

(2) 6

(3) 2

(4) 5

68. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

(1) O_2

(2) S_2

(3) C_2

(4) N_2

69. In which of the following pairs of molecules/ions, both the species are not likely to exist ?

(1) H_2^{2+}, He_2

(2) H_2^-, He_2^{2+}

(3) H_2^+, He_2^{2-}

(4) H_2^-, He_2^{2-}

70. Which of the following complex species is not expected to exhibit optical isomerism ?

(1) $\left[Co(NH_3)_3\ Cl_3\right]$

(2) $\left[Co(en)(NH_3)_2\ Cl_2\right]^+$

(3) $\left[Co(en)_3\right]^{3+}$

(4) $\left[Co(en)_2\ Cl_2\right]^+$

71. The coagulating power of electrolytes having ions Na^+, Al^{3+} and Ba^{2+} for arsenic sulphide sol increases in the order :

(1) $Ba^{2+} < Na^+ < Al^{3+}$

(2) $Al^{3+} < Na^+ < Ba^{2+}$

(3) $Al^{3+} < Ba^{2+} < Na^+$

(4) $Na^+ < Ba^{2+} < Al^{3+}$

72. Consider the following reaction :

$$x MnO_4^- + y C_2O_4^{2-} + zH^+ \rightarrow$$

$$x Mn^{2+} + 2y CO_2 + \frac{z}{2} H_2O$$

The values of x, y and z in the reaction are, respectively :

(1) 2, 5 and 16

(2) 5, 2 and 8

(3) 5, 2 and 16

(4) 2, 5 and 8

SPACE FOR ROUGH WORK

73. Which of the following exists as covalent crystals in the solid state ?

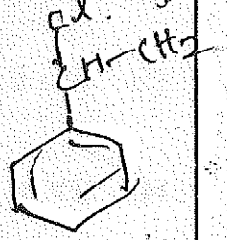
(1) Sulphur

(2) Phosphorus

(3) Iodine

(4) Silicon

74. A solution of (−)−1−chloro−1−phenylethane in toluene racemises slowly in the presence of a small amount of $SbCl_5$, due to the formation of :



(1) carbocation

(2) free radical

(3) carbanion

(4) carbene

75. An unknown alcohol is treated with the "Lucas reagent" to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism :

(1) secondary alcohol by S_N2

(2) tertiary alcohol by S_N2

(3) secondary alcohol by S_N1

(4) tertiary alcohol by S_N1

76. How many litres of water must be added to 1 litre of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2 ?

(1) 2.0 L

(2) 9.0 L

(3) 0.1 L

(4) 0.9 L

77. The molarity of a solution obtained by mixing 750 mL of 0.5(M)HCl with 250 mL of 2(M)HCl will be :

(1) 1.75 M

(2) 0.975 M

(3) 0.875 M

(4) 1.00 M

78. A piston filled with 0.04 mol of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208J of heat. The values of q and w for the process will be :

(R = 8.314 J/mol K) (ln 7.5 = 2.01)

(1) q = −208 J, w = +208 J

(2) q = +208 J, w = +208 J

(3) q = +208 J, w = −208 J

(4) q = −208 J, w = −208 J

SPACE FOR ROUGH WORK

79. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M, is present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be :

(1) 6.05%

(2) 5.08%

(3) 7.01%

(4) 4.08%

80. For gaseous state, if most probable speed is denoted by C^*, average speed by $\overline{C}$ and mean square speed by C, then for a large number of molecules the ratios of these speeds are :

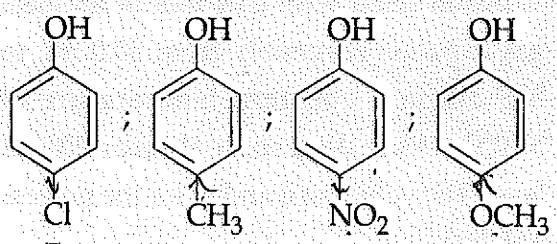
(1) $C^* : \overline{C} : C = 1 : 1.128 : 1.225$

(2) $C^* : \overline{C} : C = 1 : 1.225 : 1.128$

(3) $C^* : \overline{C} : C = 1.225 : 1.128 : 1$

(4) $C^* : \overline{C} : C = 1.128 : 1.225 : 1$

81. Arrange the following compounds in order of decreasing acidity :



(I) (II) (III) (IV)

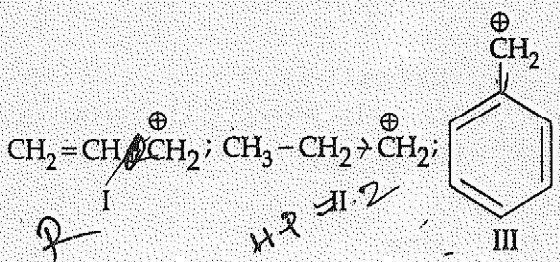
(1) III > I > II > IV

(2) IV > III > I > II

(3) II > IV > I > III

(4) I > II > III > IV

82. The order of stability of the following carbocations :



I II III

is :

(1) I > II > III

(2) III > I > II

(3) III > II > I

(4) II > III > I

83. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

(1) −10.2 eV

(2) +2.55 eV

(3) −2.55 eV

(4) −5.1 eV

SPACE FOR ROUGH WORK

84. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest $E^0_{M^{3+}/M^{2+}}$ value ?

(1) Fe(Z = 26)

(2) Co(Z = 27)

(3) Cr(Z = 24)

(4) Mn(Z = 25)

85. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of :

(1) $Li_2 < Li_2^- < Li_2^+$

(2) $Li_2^- < Li_2 < Li_2^+$

(3) $Li_2 < Li_2^+ < Li_2^-$

(4) $Li_2^- < Li_2^+ < Li_2$

86. Energy of an electron is given by $E = -2.178 \times 10^{-18} J \left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom from level n = 1 to n = 2 will be :

(h = 6.62×10^{-34} Js and c = 3.0×10^8 ms^{-1})

(1) 6.500×10^{-7} m

(2) 8.500×10^{-7} m

(3) 1.214×10^{-7} m

(4) 2.816×10^{-7} m

87. Synthesis of each molecule of glucose in photosynthesis involves :

(1) 8 molecules of ATP

(2) 6 molecules of ATP

(3) 18 molecules of ATP

(4) 10 molecules of ATP

SPACE FOR ROUGH WORK

88. Which of the following is the wrong statement ?

(1) Ozone is violet-black in solid state.

(2) Ozone is diamagnetic gas.

(3) ONCl and ONO^- are not isoelectronic.

(4) O_3 molecule is bent.

89. Which of the following arrangements does **not** represent the correct order of the property stated against it ?

(1) $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+}$: stability in aqueous solution

(2) Sc < Ti < Cr < Mn : number of oxidation states

(3) $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$: paramagnetic behaviour

(4) $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$: ionic size

90. Given

$E^0_{Cr^{3+}/Cr} = -0.74\ V$; $E^0_{MnO_4^-/Mn^{2+}} = 1.51\ V$

$E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\ V$; $E^0_{Cl/Cl^-} = 1.36\ V$

Based on the data given above, strongest oxidising agent will be :

(1) Mn^{2+}

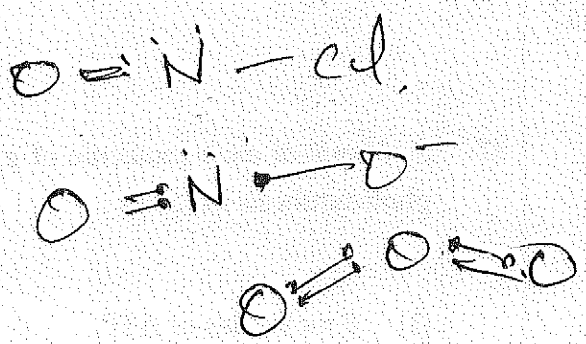
(2) MnO_4^-

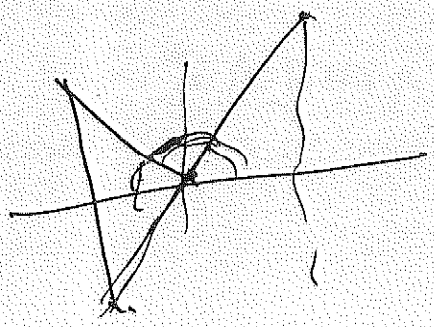
(3) Cl^-

(4) Cr^{3+}

-o0o-

SPACE FOR ROUGH WORK





$$2000 \qquad y +$$

$$2000 = 100x - \frac{2}{3}x^{3/2} + C.$$

$$=.$$

$$\begin{vmatrix} 1-k & -1 & 1+k \\ 2 & 3 & 4 \\ 1 & +1 & 5 \end{vmatrix}.$$

$$(1-k)(15-16) + 1(10-4) + 1+k(8-3)$$

$$-1+k+6+5+5k=0$$

$$6k = '$$

$$2y - y^2 + 3 = 0$$

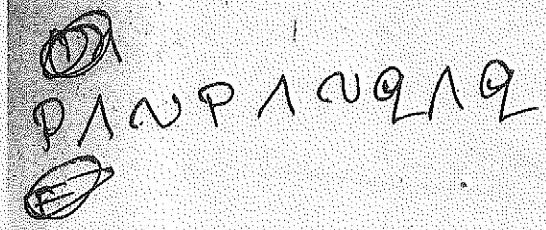
$$y^2 - 2y - 3 = 0$$

$$y-3 \quad y+1.$$

$$\sqrt{3} \quad y=3 \quad y=-1$$

$$9-1+9+1\int 2y+3 \; y^2+3y$$

SPACE FOR ROUGH WORK



P	Q	~Q	~P	P→Q	~Q→~P
T	T	F	F	T	T
T	F	T	F	F	F
F	T	F	T	T	T
F	F	T	T	T	T

SPACE FOR ROUGH WORK

$$\frac{2}{1+\frac{x^2}{4}}$$

$$\frac{2y}{1+y^2} = \frac{2y}{1+y^2} + \frac{2z}{1+z^2}$$

$$\frac{4y}{1+\left(\frac{x+2y}{4}\right)^2} = \frac{2x}{1+x^2} + \frac{2z}{1+z^2}$$

$$\frac{4(x+z)}{4+x^2+y^2} =$$

$$\frac{\left(1-\frac{\cos 2x}{2}\right)\left(3+2\cos^2\frac{x}{2}-1\right)}{4x^2}$$

$$\frac{\left(1-1+2\sin^2 x\right)\left(3+1-2\sin^2\frac{x}{2}\right)}{4x^2}$$

$$\frac{2\sin^2 x\left(4-2\sin^2\frac{x}{2}\right)}{4x^2}$$

$$\frac{8\sin^2 x}{4x^2} - \frac{4\sin^2 x \sin^2\frac{x}{2}}{4x^2}$$

Read the following instructions carefully :

1. The candidates should fill in the required particulars on the Test Booklet and Answer Sheet (*Side-1*) with ***Blue/Black Ball Point Pen.***
2. For writing/marking particulars on *Side-2* of the Answer Sheet, use ***Blue/Black Ball Point Pen only.***
3. The candidates should not write their Roll Numbers anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
4. Out of the four options given for each question, only one option is the correct answer.
5. For each ***incorrect response, one-fourth*** (¼) of the total marks allotted to the question would be deducted from the total score. *No deduction* from the total score, however, will be made *if no response* is indicated for an item in the Answer Sheet.
6. Handle the Test Booklet and Answer Sheet with care, *as under no circumstances (except for discrepancy in Test Booklet Code and Answer Sheet Code), another set will be provided.*
7. The candidates are not allowed to do any rough work or writing work on the Answer Sheet. All calculations/writing work are to be done in the space provided for this purpose in the Test Booklet itself, marked 'Space for Rough Work'. This space is given at the bottom of each page and in 3 pages (Pages 21 - 23) at the end of the booklet.
8. On completion of the test, the candidates must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them.**
9. Each candidate must show on demand his/her Admit Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, should leave his/her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet again. Cases where a candidate has not signed the Attendance Sheet a second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case. **The candidates are also required to put their left hand THUMB impression in the space provided in the Attendance Sheet.**
12. Use of Electronic/Manual Calculator and any Electronic Item like mobile phone, pager etc. is prohibited.
13. The candidates are governed by all Rules and Regulations of the JAB/Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the JAB/Board.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. **Candidates are not allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, electronic device or any other material except the Admit Card inside the examination hall/room.**

SEAL