MATHEMATICS

1. Consider $A=\begin{pmatrix}2 & 1\\ 4 & 1\end{pmatrix}, B=\begin{pmatrix}3 & 4\\ 2 & 3\end{pmatrix}$ and $C=\begin{pmatrix}3 & -4\\ -2 & 3\end{pmatrix}$. Then the value of the sum

$$tr(A)+tr\left(\frac{ABC}{2}\right)+tr\left(\frac{A(BC)^2}{4}\right)+tr\left(\frac{A(BC)^3}{8}\right)+.......\infty \text{ is}$$

1) 6 2) 9 3) 12 4) 15

2. $\sum_{r=1}^{n}\sin^{-1}\left(\frac{\sqrt{r}-\sqrt{r-1}}{\sqrt{r(r+1)}}\right)$ is equal to

1) $\tan^{-1}(\sqrt{n})-\frac{\pi}{4}$ 2) $\tan^{-1}(\sqrt{n+1})-\frac{\pi}{4}$

3) $\tan^{-1}(\sqrt{n})$ 4) $\tan^{-1}(\sqrt{n+1})$

3. If the standard deviation of 0, 1, 2, 3, …, 9 is K, then the standard deviation of 10, 11, 12, 13, ….19 is

1) K 2) $K+10$ 3) $K+\sqrt{10}$ 4) $10K$

4. $(p\wedge \sim q)\wedge(\sim p\wedge q)$ is

1) A tautology 2) A contradiction

3) Both a tautology and a contradiction

4) Neither a tautology nor a contradiction

5. The coefficient of $a^8b^4c^9d^9$ in $\{ab(c+d)+cd(a+b)\}^{10}$ is

1) $\frac{(10)!}{8!4!9!9!}$ 2) 10! 3) 2520 4) 5!

6. $\lim_{x\to1}\left[\tan\left(\frac{\pi}{4}+\log x\right)\right]^{\frac{1}{\log x}}$ is

1) 2 2) e 3) e^{-1} 4) e^2

7. Value of $\frac{\int_0^n [x]dx}{\int_0^n \{x\}dx}$ where [x] and {x} are integral and fractional parts of x and $n \in N$, is equal to

1) n 2) n – 1 3) $\frac{1}{n-1}$ 4) $\frac{1}{n}$

8. Locus of a point $P(x, y)$ satisfying the equation

$\sqrt{x^2+y^2+24y+144}=17-\sqrt{x^2+y^2-10x+25}$ is

1) a line segment 2) hyperbola

3) part of a circle with finite radius 4) ellipse

9. If $\int f(x)\,dx = y(x)$, then $\int x^5 f(x^3)\,dx$ is equal to

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

3) $\frac{1}{3}x^3y(x^3)-\int x^2y(x^3)dx+C$ 4) $\frac{1}{3}\left(x^3y(x^3)-\int x^3y(x^3)dx\right)+C$

10. If a, b and c are three numbers (not necessarily different) chosen randomly and with replacement from the set $\{1,2,3,4,5\}$, then the probability that $(ab+c)$ is even, is

1) $\frac{35}{125}$ 2) $\frac{59}{125}$ 3) $\frac{64}{125}$ 4) $\frac{75}{125}$

11. 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 true; Statement-II is a correct explanation for Statement-I.

2) Statement-I is true; Statement-II is true; Statement-II is not a correct explanation for Statement-I.

3) Statement-I is true; Statement-II is false.

4) Statement-I is false; Statement-II is true.

12. The area bounded by the curves of $y=\sqrt{5-x^2}$ *and* $y=|x-1|$ *is*

1) $\left(\frac{5\pi}{2}-4\right)$ *sq.units* 2) $\left(\frac{5\pi+2}{4}\right)$ *sq.units*

3) $\left(\frac{5\pi-2}{4}\right)$ *sq.units* 4) $\left(\frac{5\pi-2}{2}\right)$ *sq.units*

13. The line which passes through the origin and intersects the two lines

$\frac{x-1}{2}=\frac{y+3}{4}=\frac{z-5}{3},\ \frac{x-4}{2}=\frac{y+3}{3}=\frac{z-14}{4}$ is

1) $\frac{x}{1}=\frac{y}{-3}=\frac{z}{5}$ 2) $\frac{x}{-1}=\frac{y}{3}=\frac{z}{5}$ 3) $\frac{x}{1}=\frac{y}{3}=\frac{z}{5}$ 4) $\frac{x}{1}=\frac{y}{4}=\frac{z}{3}$

14. A complex number z is said to be unimodular if $|Z|=1$. Suppose z_1 *and* z_2 are complex numbers such that $\frac{z_1-2z_2}{2-z_1\bar{z}_2}$ is unimodular and z_2 is not unimodular. Then the point z_1 lies on a

1) straight line parallel to y- axis.
2) circle of radius 2.
3) circle of radius $\sqrt{2}$.
4) straight line parallel to x-axis.

15. Let $f:R\to R$ be function such that $f(2-x)=f(2+x)$ *and* $f(4-x)=f(4+x)$, for all $x\in R$ *and* $\int_0^2 f(x)dx=5$.Then the value of $\int_{10}^{50} f(x)dx$ is

1)125 2) 80 3) 100 4) 200

16. Let 10 vertical poles standing at equal distances on a straight line, subtend the same angle of elevation at a point O on this line and all the poles are on the same side of O. if the height of the longest pole is 'h' and the distance of the foot of the smallest pole from O is 'a', then the distance between two consecutive poles, is

1) $\frac{h\cos\alpha-a\sin\alpha}{9\sin\alpha}$ 2) $\frac{h\sin\alpha-a\cos\alpha}{9\sin\alpha}$ 3) $\frac{h\cos\alpha-a\sin\alpha}{9\cos\alpha}$ 4) $\frac{h\sin\alpha-a\cos\alpha}{9\cos\alpha}$

17. $\sum_{n=1}^{5}\frac{1}{n(n+1)(n+2)(n+3)}=\frac{k}{3}$, then k is equal to :

1) $\frac{1}{6}$ 2) $\frac{17}{105}$ 3) $\frac{55}{336}$ 4) $\frac{19}{112}$

18. Let $A=\{x_1,x_2,....,x_7\}$ *and* $B=\{y_1,y_2,y_3\}$ be two sets containing seven and three distinct elements respectively. Then the total number of functions $f:A\to B$ that are onto, if there exists three elements x in A such that $f(x)=y_2$, is equal to

1) $14.{}^7C_3$ 2) $16.{}^7C_3$ 3) $14.{}^7C_2$ 4) $12.{}^7C_2$

19. If the shortest distance between the lines
$\frac{x-1}{\alpha}=\frac{y+1}{-1}=\frac{z}{1},(\alpha\neq-1)$ *and* $x+y+z+1=0=2x-y+z+3$ *is* $\frac{1}{\sqrt{3}}$, then a value of α is

1) $\frac{32}{19}$ 2) $\frac{19}{32}$ 3) $-\frac{16}{19}$ 4) $-\frac{19}{16}$

20. The integral $\int\frac{dx}{(x+1)^{3/4}(x-2)^{5/4}}$ is equal to

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

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

21. The number of ordered pairs (m,n) where $m,n\in\{1,2,...........,50\}$ such that 6^n+9^m is a multiple of 5

22. Let α and β be the roots of $x^2-6x-2=0$, with $\alpha>\beta$. If $a_n=\alpha^n-\beta^n$ for $n\geq 1$, then the value of $\frac{a_{10}-2a_8}{2a_9}$ is

23. If $3^{rd}, 6^{th}$ & last term of HP is $\frac{1}{3},\frac{1}{5},\frac{3}{203}$. Find number of terms.

24. If the function $f(x)=x^3-6kx^2+5x$ satisfies the conditions of Lagrange's mean value theorem for the interval [1,2] and the tangent to the curve $y=f(x)$ at $x=\frac{7}{4}$ is parallel to the chord that joins the points of intersection of the curve with the ordinates x = 1 and x = 2.Then the value of k is

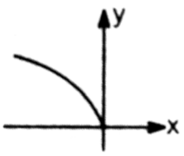
25. Let $f(x)$ be a polynomial of degree four having extreme values at x=1 and x = 2. If $\lim_{x\to 0}\left[1+\frac{f(x)}{x^2}\right]=3$,Then f(2) is equal to :

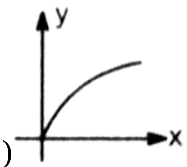
PHYSICS

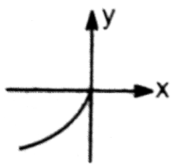
26. In a vernier calipers, *n* divisions of its main scale match with (*n* + 1) divisions on its vernier scale. Each division of the main scale is a units. Using the vernier principle, calculate its least count.

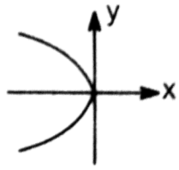
1) $\frac{a}{n}$ 2) $\frac{a}{n+1}$ 3) $\frac{n}{2}$ 4) $n+1$

27. The instantaneous velocity of a particle moving in *xy*-plane is $\vec{V}=(ay)\hat{i}+(V_0)\hat{j}$, where *y* is the instantaneous *y* co-ordinate of the particle and V_0 is a positive constant and *a* is a negative constant. If the particle starts from origin then its trajectory is:

1) 

2) 

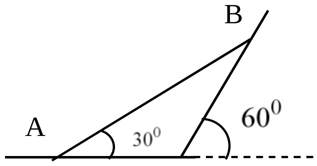
3) 

4) 

28. A gas mixture contains of 2 moles of oxygen and 4 moles of argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

1) $4RT$ 2) $15RT$ 3) $9RT$ 4) $11RT$

29 In the figure shown, the instantaneous speed of end A of the rod of length L is v to the left .The angular speed of the rod at that instant must be



1) $v/2L$ 2) v/L 3) $\frac{\sqrt{3}v}{2L}$ 4) $\frac{2v}{L}$

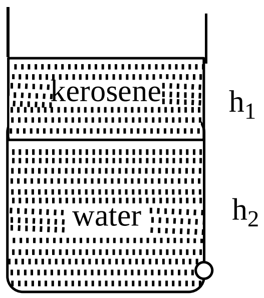
30. Long range radio transmission is possible when the radio waves are reflected from the ionosphere. For this to happen the frequency of the radio waves must be in the range:

1) 80-150MHz 2) 8-25 MHz 3) 1-3 MHz 4) 150-500 kHz

31. A particle of mass m moves in a one–dimension, potential energy $U(x) = -ax^2 + bx^4$, where 'a' and 'b' are positive constants. The angular frequency of small oscillations about the minima of the potential energy is equal to

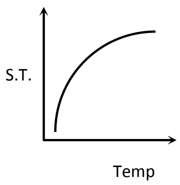
1) $\pi\sqrt{\frac{a}{2b}}$ 2) $2\sqrt{\frac{a}{m}}$ 3) $\sqrt{\frac{2a}{m}}$ 4) $\sqrt{\frac{a}{2m}}$

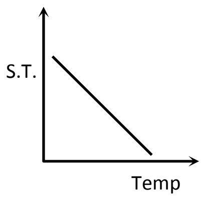
32. A wide vessel with a small orifice near the base is filled with kerosene (density ρ_1) and water (density ρ_2) to heights h_1 and h_2 respectively. If the initial outflow velocity of water through the orifice is v, then v^2 is equal to

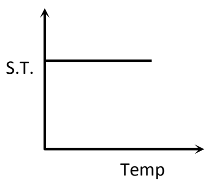


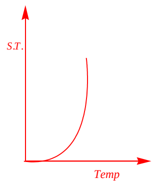
1) $2g(h_1 + h_2)$ 2) $2g\left(h_1 + \frac{h_2\rho_2}{\rho_1}\right)$ 3) $2g\left(h_2 + \frac{h_1\rho_1}{\rho_2}\right)$ 4) $2g\left(\frac{\rho_1}{\rho_2}\right)(h_1 + h_2)$

33. Which graph represents the variation of surface tension with temperature over small temperature ranges for water

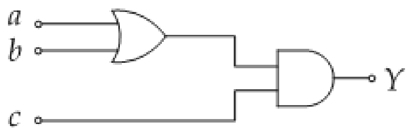
1) 

2) 

3) 

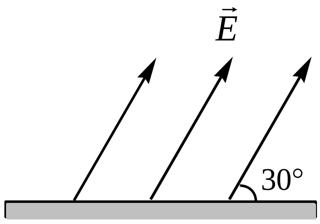
4) 

34. To get an output of 1 from the circuit shown in figure the input must be :



(1) a=0, b=1, c=0 (2) a=1, b=0, c=0 (3) a=1, b=0, c=1 (4) a=0, b=0, c=1

35. In a region, an electric field of intensity 15 N/C making an angle of 30° with the horizontal plane is present. A ball having charge of 2C, mass 3 kg and coefficient of restitution with ground 0.5 is projected at an angle of 30° with the horizontal in the direction of electric field with speed 20 m/s. Find the horizontal distance travelled by ball between the instances of first and second collision. ($g = 10\ ms^{-2}$)



1) $20\sqrt{3}\,m$ 2) $30\sqrt{3}\,m$ 3) $50\sqrt{3}\,m$ 4) $70\sqrt{3}\,m$

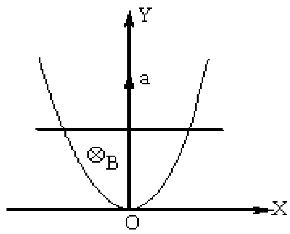
36. A particle of charge q and mass m moves in a circular orbits of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on

1) ω and q 2) ω, q and m 3) q and m 4) ω and m

37. Dimensions of $\dfrac{magnetic\ flux}{electric\ flux}$ are

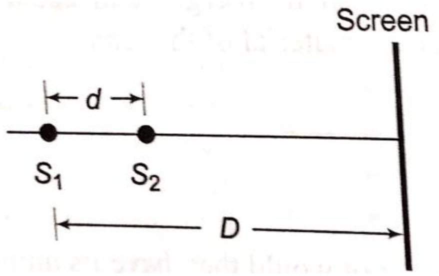
1) M^0LT^{-1} 2) $M^0L^{-1}T$ 3) $M^0L^3T^2A^{-2}$ 4) $M^0L^0T^0$

38. A wire in the shape of a parabola $y = kx^2$ is in a uniform magnetic field B perpendicular to the plane XY. A straight conductor translates without initial velocity and at a constant acceleration 'a' from the apex of the parabola as shown in given figure. The e.m.f induced in the conductor as a function of the co-ordinate y is



1) $By\sqrt{\dfrac{4a}{k}}$ 2) $By\sqrt{\dfrac{2a}{k}}$ 3) $By\sqrt{\dfrac{8a}{k}}$ 4) $By\sqrt{\dfrac{a}{k}}$

39. 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) points 2) straight lines 3) semi-circle 4) concentric circles

40. What is the ratio of de – Broglie wave lengths of electron in the second & third Bohr's orbits in a hydrogen atom?

1) 2/3 2) 3/2 3) 4/3 4) ¾

41. If the frequency of k_α X-ray emitted from the element with atomic number 31 is f, then the frequency of k_α X-ray emitted from the element with atomic number 51 would be (According to Moosley's law)

1) $\frac{5f}{3}$ 2) $\frac{51f}{31}$ 3) $\frac{9f}{25}$ 4) $\frac{25f}{9}$

42. A radioactive element disintegrates for a time interval equal to its mean life. The fraction that has disintegrated is

1) $\frac{1}{e}$ 2) $1-\frac{1}{e}$ 3) $\frac{0.693}{e}$ 4) $0.693\left(1-\frac{1}{e}\right)$

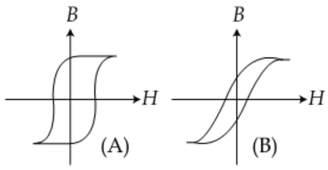
43. A particle of mass m starts to move with acceleration a = A cos t. The De - Broglie wavelength associated with this particle at time t = (π/2) s will be

1) $\frac{h}{mA}$ 2) $\frac{2h}{mA}$ 3) $\sqrt{\frac{h}{mA}}$ 4) infinite

44. A pendulum with time period of 1s is losing energy due to damping. At certain time its energy is 45 J. If after completing 15 oscillations, its energy has become 15J, its damping constant $\left(in\ s^{-1}\right)$ is

1) $\frac{1}{30}in3$ 2) $\frac{1}{15}in3$ 3) 2 4) $\frac{1}{2}$

45. Hysteresis loops for two magnetic materials A and B are given below :



These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use :

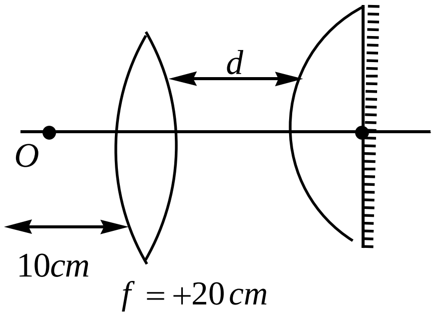
1) A for electric generators and transformers

2) A for electromagnets and B for electric generators.

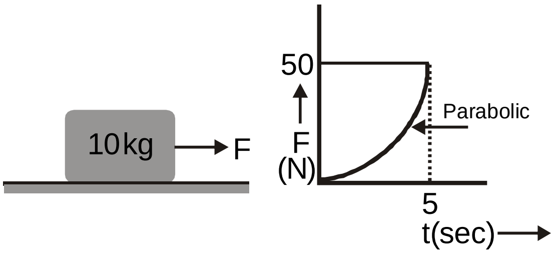
3) A for transformers and B for electric generators.

4) B for electromagnets and transformers.

46. A convex lens of focal length 20cm and another plano-convex lens of focal length 40cm are placed coaxially (see figure). The plano convex lens is slivered on plane surface. What should be the distance d (in cm) so that final image of the object 'O' is formed on 'O' itself

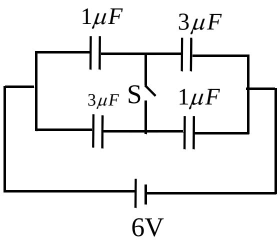


47. A force F is applied to the initially stationary block. The variation of force with time is shown in the figure. The speed of block at t = 5 sec is (in m/s)

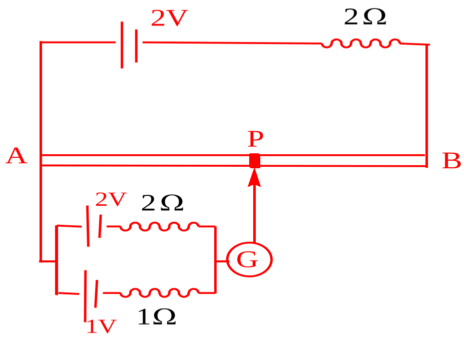


48. The potential energy (in joule) of a body mass 2kg moving in the $x-y$ plane is given by $U=6x+8y$ Where the position coordinate x and y are measured in metre. If the body is at rest at point (6m, 4m) at time $t=0$, it will cross the $y-axis$ at time t equal to (in sec)

49. In the circuit when switch 'S' is closed the amount of charging passing the switch is $x\mu C$ then the value of x



50. A battery of emf 2V is connected across a long uniform wire AB of length 1m and resistance per unit length $2\Omega m^{-1}$. Two cells of emf $\varepsilon_1=1V$ and $\varepsilon_2=2V$ are connected as shown in the figure. If the galvanometer shows no deflection at point P, the distance of point P from point A is equal to (in cm)



CHEMISTRY

51. The hydrides of the first elements in groups 15-17 namely NH_3, H_2O and HF respectively show abnormally high values for melting and boiling points. This is due to

1) small size of N, O and F

2) the ability to form extensive intermolecular H-bonding

3) the ability to form extensive intramolecular H-bonding

4) effective van der Waals' interaction

52. On dissolving moderate amount of sodium meta in liquid NH_3 at low temperature, which one of the following does not occur?

1) Blue coloured solution is obtained 2) Na^+ ions are formed in the solution

3) Liquid NH_3 solution becomes good conductor of electricity

4) Liquid NH_3 solution remains diamagnetic

53. The correct order of pseudohalide, polyhalide and interhalogen are

1) BrI_2^-, OCN^-, IF_5 2) IF_5, BrI_2^-, OCN^- 3) OCN^-, IF_5, BrI_2^- 4) OCN^-, BrI_2^-, IF_5

54. The magnetic moment of a transition metal of 3d- series is 6.92 BM. Its electronic configuration would be

1) $3d^4 4s^2$ 2) $3d^5 4s^1$ 3) $3d^8 4s^1$ 4) $3d^5 4s^0$

55. The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is

1) $L_4 < L_3 < L_2 < L_1$ 2) $L_1 < L_3 < L_2 < L_4$ 3) $L_3 < L_2 < L_4 < L_1$ 4) $L_1 < L_2 < L_4 < L_3$

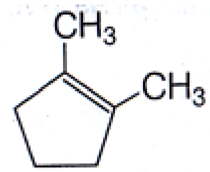
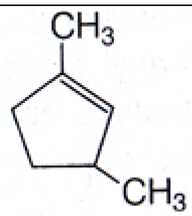
56. Pollutants released from iron and steel industry are

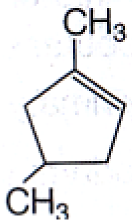
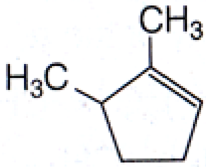
1) CO_2, NO_2, H_2S 2) CO, CO_2, SO_2 3) CO_2, SO_3, NO_2 4) CO_2, NO, SO_3

57. The compound that does not give a blue colour in Lassaigne's test is

1) aniline 2) glycine 3) hydrazine 4) urea

58. Which compound would give 5-keto-2-mythyl hexanal upon ozonolysis?

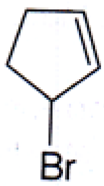
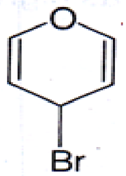
1) 
2) 

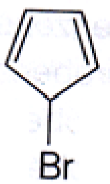
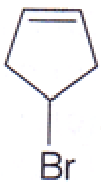
3) 
4) 

59 The correct sequence of reactions to be performed to convert benzene into m-bromoaniline is

1) nitration, reduction, bromination
2) bromination, nitration, reduction
3) nitration, bromination, reduction
4) reduction, nitration, bromination

60. The increasing order of reactivity of the following bromides in S_N1 reaction is

I) 
II) 

III) 
IV) 

1) $III > I > II > IV$
2) $III > II > I > IV$
3) $II > III > I > IV$
4) $II > I > IV > III$

61. I. 1, 2- dihydroxy benzene

II. 1, 3-dihydroxy benzene

III. 1, 4-dihydroxy benzene

IV. Hydroxy benzene

The increasing order of boiling points of above mentioned alcohols is

1) $I < II < III < IV$
2) $I < II < IV < III$
3) $IV < I < II < III$
4) $IV < II < I < III$

62. Which of the following should be most volatile ?

I) $CH_3CH_2CH_2NH_2$
II) $(CH_3)_3N$

CH_3CH_2 \> NH
CH_3 /

III) IV) $CH_3CH_2CH_3$

1) II 2) IV 3) I 4) III

63. The polymer used for optical lenses is

1) polypropylene 2) polyvinyl chloride 3) polythene 4) polymethyl methacrulate\

64. Which of the following is a fat soluble vitamin?

1) Vitamin A 2) Riboflavin 3) Pyridoxine 4) Thiamine

65. A substance on treatment with dil. H_2SO_4 liberates a colourless gas which produces (i) turbidity with baryta water and (ii) turns acidified dichromate solution green. The reaction indicates the presence of

1) CO_3^{2-} 2) S^{2-} 3) SO_3^{2-} 4) NO_2^-

66. The standard reduction potential values of the three metallic cations X, Y and Z are 0.52, -3.03 and -1.18 V respectively. The order of reducing power of the corresponding metals is

1) $Y > Z > X$ 2) $X > Y > Z$ 3) $Z > Y > X$ 4) $Z > X > Y$

67. Let v_1 be the frequency of the series limit of the Lyman series, v_2 be the frequency of the first line of the Lyman series, and v_3 be the frequency of the series limit of the Balmer series, then

1) $v_3 = \frac{1}{2}(v_1 - v_3)$ 2) $v_2 - v_1 = v_3$ 3) $v_1 - v_2 = v_3$ 4) $v_1 + v_2 = v_3$

68. Both geometrical and optical isomerisms are shown by

1) $\left[Co(en)_2Cl_2\right]^+$ 2) $\left[Co(NH_3)_5Cl\right]^{2+}$ 3) $\left[Co(NH_3)_4Cl_2\right]^+$ 4) $\left[Cr(ox)_3Cl_2\right]^{3-}$

69. Which of the following xenon-oxo compounds may not be obtained by hydrolysis of xenon fluorides?

1) XeO_2F_2 2) $XeOF_4$ 3) XeO_3 4) XeO_4

70. Reagent used to convert allyl alcohol to acrolein is

1) MnO_2 2) H_2O_2 3) OSO_4 4) $KMnO_4$

71. A mixture contains $Na_2C_2O_4$ and KHC_2O_4 in 1:1 molar ratio. Mixture is neutralized by 100 mL of 0.01 M KOH. What volume of 0.01 M $KMnO_4$? Thus the same mixture is oxidized by (in mL)

72. At what temperature, the rms velocity of SO_2 be same as that of O_2 at 303 K?

73. A first order reaction is half – completed in 45 min. How long does it need for 99.9% of the reaction to be completed in (in Hours)

74. At 675 K, $H_2(g)$ and $CO_2(g)$ react to form $CO(g)$ and $H_2O(g)$ K_p for the reaction is .16. If a mixture of 0.25 mole of $H_2(g)$ and 0.25 mol of CO_2 is heated at 675 K, mole % of $CO(g)$ in equilibrium mixture is

75. The enthalpy of combustion of $H_2(g)$, to give $H_2O(g)$ is 249kJ mol^{-1} and bond enthalpies of H-H and $O=O$ are 433kJ mol^{-1} and 492 kJ mol^{-1} respectively. The bond enthalpy of $O-H$ is (in kJ mol^{-1})

SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

Sec: SR MPC | Jee Main | Date: 20-08-20
Time: 09:00 AM to12:00 Noon | GT-16 | Max.Marks:360

KEY SHEET

MATHS

1	**1**	2	**3**	3	**1**	4	**2**	5	**3**
6	**4**	7	**2**	8	**1**	9	**3**	10	**2**
11	**2**	12	**3**	13	**1**	14	**2**	15	**3**
16	**1**	17	**3**	18	**1**	19	**1**	20	**2**
21	**1250**	22	**3**	23	**100**	24	**0.729**	25	**0**

PHYSICS

26	**2**	27	**1**	28	**4**	29	**2**	30	**2**
31	**2**	32	**3**	33	**2**	34	**2**	35	**4**
36	**3**	37	**2**	38	**3**	39	**4**	40	**1**
41	**4**	42	**2**	43	**1**	44	**3**	45	**4**
46	**20**	47	**8.33**	48	**2**	49	**6**	50	**0**

CHEMISTRY

51	**2**	52	**1**	53	**4**	54	**2**	55	**2**
56	**2**	57	**3**	58	**2**	59	**3**	60	**4**
61	**3**	62	**2**	63	**4**	64	**1**	65	**3**
66	**1**	67	**3**	68	**1**	69	**4**	70	**1**
71	**80**	72	**606**	73	**7.5**	74	**40**	75	**464**

SOLUTIONS

MATHEMATICS

1. $BC=\begin{pmatrix}3&4\\2&3\end{pmatrix}\begin{pmatrix}3&-4\\-2&3\end{pmatrix}=\begin{pmatrix}1&0\\0&1\end{pmatrix}=I$

$traA+tra\frac{A}{2}+tra\frac{A}{4}+.....$

$traA\left(1+\frac{1}{2}+\frac{1}{4}+.....\right)=6$

2. $\sin^{-1}\left(\frac{\sqrt{r}-\sqrt{r-1}}{\sqrt{r(r+1)}}\right)=\tan^{-1}\left(\frac{\sqrt{r}-\sqrt{r-1}}{1+\sqrt{r}\sqrt{r-1}}\right)$

$=\tan^{-1}\sqrt{r}-\tan^{-1}\sqrt{r-1}$

$\Rightarrow G.E=\sum_{r=1}^{n}\left(\tan^{-1}\sqrt{r}-\tan^{-1}\sqrt{r-1}\right)$

$\tan^{-1}\sqrt{1}-\tan^{-1}(0)+\tan^{-1}\sqrt{2}-\tan^{-1}\sqrt{1}+....+\tan^{-1}\sqrt{n}-\tan^{-1}\sqrt{n-1}$

$=\tan^{-1}\sqrt{n}$

3. **It is fundamental concept** $(\text{S.D of } x=\text{ S.D of }(x+10))$

4. $(p\wedge\sim q)\wedge(\sim p\wedge q)\equiv(p\wedge\sim p)\wedge(\sim q\wedge q)\equiv c\wedge c\equiv c$

(By using associative laws and commutative laws)

$\therefore(p\wedge\sim q)\wedge(\sim p\wedge q)$ **is a contradiction.**

5. $(abc+abd+acd+bcd)^{10}=a^{10}b^{10}c^{10}d^{10}\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}\right)^{10}$

$\therefore$ **coefficient of** $a^8b^4c^9d^9$

=coefficient of $a^{-2}b^{-6}c^{-1}d^{-1}$ **in**

$\left(\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}\right)^{10}=\frac{10!}{2!6!1!1!}$

$=\frac{10\times9\times8\times7}{2}=2520$

6. 1^{∞} **form**

$\therefore$ **limit** $= e^{\lim_{x\to1}\left[\tan\left(\frac{\pi}{4}+\log x\right)-1\right]\times\frac{1}{\log x}}$

$= e^{\lim_{x\to1}\frac{\left[\sec^2\left(\frac{\pi}{4}+\log x\right)\right]\frac{1}{x}}{\frac{1}{x}}}$

$=e^{\sec^2\frac{\pi}{4}}=e^2$ **(using L′ Hospital Rule)**

7. $\int_0^n[x]dx=\int_0^1[x]dx+\int_1^2[x]dx+........+\int_{n-1}^n[x]dx$

$=\int_0^1 0.dx+\int_1^2 1.dx+........+\int_{n-1}^n(n-1).dx$

= 0 + 1 + 2 + ….. + (n – 1) = $\frac{(n-1)n}{2}$

$\int_0^n\{x\}dx=n\int_0^1\{x\}dx=n\int_0^1 xdx=\frac{n}{2}$

$\therefore$ **Required value =** $\dfrac{\frac{(n-1)n}{2}}{\frac{n}{2}} = n-1$

8. **The given equation denotes that PA+PB=13**
Point P lies on line segment AB

9.

$$\int f(x)dx = \psi(x)$$

$$I = \int x^5 f(x^3)dx$$

$$\text{put } x^3 = t \quad \Rightarrow \quad x^2dx = \frac{dt}{3}$$

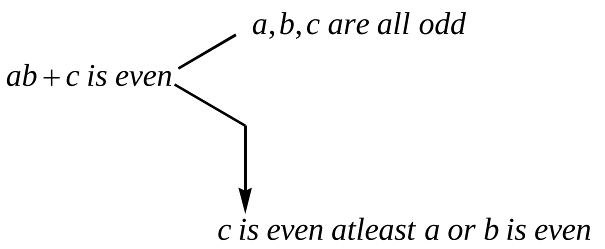
$$= \frac{1}{3}\int tf(t)dt$$

$$= \frac{1}{3}\left[t\psi(t) - \int \psi(t)dt\right]$$

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

$$= \frac{1}{3}x^3\psi(x^3) - \int x^2\psi(x^3)dx + c$$

10. **P(number chosen is odd) = 3/5**
P(number chosen is even)=2/5



E: $(ab+c)$ **is even note that even** E **can occurs in two cases**

E_1 **:all the three numbers a,b and 'c' are odd** $P(E_1) = \left(\frac{3}{5}\right)^3 = \frac{27}{125}$

E_2 **: 'c' is even and at least one of a or b is even** $P(E_2) = \frac{2}{5}\left(1 - \frac{9}{25}\right) = \frac{2}{5}.\frac{16}{25} = \frac{32}{125}$

$P(E) = P(E_1 \text{ or } E_2)$

$= P(E_1) + P(E_2)$

$= \frac{59}{125}$

11.

Let common tangent

$y = mx + \frac{\sqrt{5}}{m}$

$$\frac{\frac{\sqrt{5}}{m}}{\sqrt{1+m^2}} = \sqrt{\frac{5}{2}}$$

$m\sqrt{1+m^2} = \sqrt{2}$

$m^2(1+m^2) = 2$

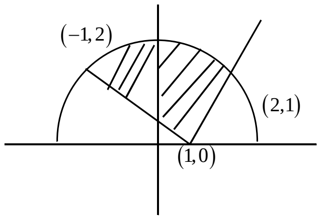
$m^4 + m^2 - 2 = 0$

$(m^2+2)(m^2-1) = 0$

$m = \pm 1$

$y = \pm(x + \sqrt{5})$, both statements are correct as m = ± 1 satisfies the given equation of statement-2.

12.



Area = $\int_{-1}^{2}\left(\sqrt{5-x^2} - |x-1|\right)dx$

$= \int_{-1}^{2}\sqrt{5-x^2}\,dx + \int_{-1}^{1}(x-1)\,dx - \int_{1}^{2}(x-1)\,dx$

13. **Let the line be** $\frac{x}{a} = \frac{y}{b} = \frac{z}{c}$

This intersects the given line

$$\begin{vmatrix} 1 & -3 & 5 \\ a & b & c \\ 2 & 4 & 3 \end{vmatrix} = 0 \text{ and } \begin{vmatrix} 4 & -3 & 14 \\ a & b & c \\ 2 & 3 & 4 \end{vmatrix} = 0$$

14. $\left|\frac{z_1 - z z_2}{2 - z_2\bar{z}_2}\right| = 1 \Rightarrow (|z_2|-1)(|z_1|-2) = 0$

$\Rightarrow |z_1| = 2$

15. **Replacing x with 2+ x**

$f(-x) = f(4+x) = f(4-x) \Rightarrow f(x) = f(x+4)$

Period of f (x) is 4

$\int_{10}^{50} f(x)\,dx = 10\int_{10}^{14} f(x)\,dx = 10(5+5) = 100$

16. $\frac{h_1}{a_1} = \frac{h_2}{a_2} = \frac{h_{10}}{a_{10}} = \tan\alpha$

$h_{10} = h = a_{10}\tan\alpha$

$a_1 = a \Rightarrow h_1 = a\tan\alpha$

$h = (a + ad)\tan\alpha$

$h = a\tan\alpha + 9d\ \tan\alpha$

$d=\dfrac{h\cos\alpha-a\sin\alpha}{9\sin\alpha}$

17. $T_r=\dfrac{1}{3}\left[\dfrac{1}{n(n+1)(n+2)}-\dfrac{1}{(n+1)(n+2)n+3}\right]$

$\sum_{r=1}^{5}=\dfrac{1}{3}\left[\dfrac{1}{6}-\dfrac{1}{6.7.8}\right]=\dfrac{k}{3}$

$\therefore k=\dfrac{55}{336}$

18. **Number of onto functions =** $7_{c_3}.\left(2^4-2\right)$

$=7_{c_3}.14$

19. **Any plane is** $(x+y+z+1)+\lambda(2x-y+z+3)=0$

$\Rightarrow\alpha=-\dfrac{2\lambda}{2\lambda+1}$

$S.D=\dfrac{1}{\sqrt{3}}\Rightarrow\lambda=0,-\dfrac{32}{102}\Rightarrow\alpha=0\ or\ \dfrac{32}{19}$**.**

20. $\dfrac{x-2}{x+1}=t$

$I=\int\dfrac{dt}{3t^{5/4}}=-\dfrac{4}{3t^{1/4}}+c$**.**

21. $6^n\rightarrow$**Always ends with 6**

$9^m\rightarrow$ **always ends with 1 or 9**

m is odd it ends with 9

$\therefore 50\times25=1250$

22. **The roots of** $x^2-6x-2=0$ **are** α **and** β

So $\alpha+\beta=6\ and\ \alpha\beta=-2$

Then $a_n-2a_{n-2}=\alpha^n-\beta^n-2\left(\alpha^{n-2}-\beta^{n-2}\right)$

$=\left(\alpha^n-2\alpha^{n-2}\right)-\left(\beta^n-2\beta^{n-2}\right)$

$=\alpha^{n-2}\left(\alpha^2-2\right)-\beta^{n-2}\left(\beta^2-2\right)$

Since α **and** β **are roots of** $x^2-6x-2=0$

So $\alpha^2-6\alpha-2=0\ or\ \alpha^2-2=6\alpha$

And $\beta^2-6\beta-2=0\ or\ \beta^2-2=6\beta$

Put $\alpha^2-2=6\alpha$

And $\beta^2-2=6\beta$

From equation (1)

$a_n-2a_{n-2}=\alpha^{n-2}.6\alpha-\beta^{n-2}.6\beta$

$=6\left(\alpha^{n-1}-\beta^{n-1}\right)$

$=6a_{n-1}$

Hence $a_n-2a_{n-1}=6a_{n-1}$

For $n=10,$ **we have** $a_{10}-2a_8=6a_9$

or $\dfrac{a_{10}-2a_8}{2a_9}=3$

23. **As** $3^{rd}, 6^{th}$ **& last term of HP are** $\frac{1}{3}, \frac{1}{5} \& \frac{3}{205}$ **respectively,**

So 3rd ,6th & last term of AP are $3, 5 \& \frac{203}{3}$ **respectively.**

Let a & d be first term & common difference of A.P.

$T_3 \Rightarrow a + 2d = 3$.............(1)

$T_6 \Rightarrow a + 5d = 5$.............(2)

$T_n \Rightarrow a + (n-1)d = \frac{203}{3}$.............(3)

On, solving equation (1) &(2)

$d = \frac{2}{3} \& a = \frac{5}{3}$

Put value of a & d in equation (3)

$\frac{5}{3} + (n-1)\frac{2}{3} = \frac{203}{3}$

$\therefore$ **number of terms is 100.**

24. $f(b) = f(2) = 8 - 24k + 10 = 18 - 24k$

$f(a) = f(1) = 1 - 6k + 5 = 6 - 6k$

$f'(x) = 3x^2 - 12kx + 5$

From Lagrange's mean value theorem

$f'(x) = \frac{f(b) - f(a)}{b - a} = \frac{18 - 24k - 6 + 6k}{2 - 1}$

$\therefore f'(x) = 12 - 18k$

At $x = \frac{7}{4}$ $3 \times \frac{49}{16} - 12k \times \frac{7}{4} + 5 = 12 - 18k$

$\Rightarrow 3k = \frac{147}{16} - 7 \Rightarrow 3k = \frac{35}{16} \Rightarrow k = \frac{35}{48}$

25. $x^2 + f(x) = ax^4 + bx^3 + 3x^2$

$f(x) = ax^4 + bx^3 + 2x^2$

$f'(x) = 4ax^3 + 3b^2x + 4x$ *also* $f'(x) = 0$ *at* $x = 1, 2$

$\Rightarrow a = \frac{1}{2}, b = -2 \Rightarrow f(2) = 0$

PHYSICS

26.

$1\,VSD = \left(\frac{n}{n+1}\right)a, 1\,MSD = a$

$LC = 1MSD - 1VSD = a\left(\frac{1}{n+1}\right)$

27.

$\vec{v} = (ay)\hat{i} + (V_0)\hat{j}$

$\Rightarrow V_x = ay \quad and \quad V_y = V_0$

$\Rightarrow \dfrac{dx}{dt} = ay \quad and \quad \dfrac{dy}{dt} = V_0$

$\Rightarrow \dfrac{dy}{dx} = \dfrac{V_0}{ay} \Rightarrow \int aydy = \int V_0 dx$

$\Rightarrow \dfrac{1}{2}ay^2 = V_0 x + c$

$\Rightarrow \dfrac{1}{2}ay^2 = V_0 x, \quad (\because (0,\ 0)\ satisfies)$

$\Rightarrow y = \pm\sqrt{\underbrace{\dfrac{2V_0}{a}}_{negative} x}$

$\Rightarrow y = \sqrt{\dfrac{2V_0 x}{a}}, \quad (\because V_y = V_0 > 0)$

28. Internal energy of n moles of an ideal gas at temperature T is given by

$U = n\left(\dfrac{f}{2}RT\right)$

where, $f =$ degrees of freedom

= 5 for O_2 and 3 for Ar

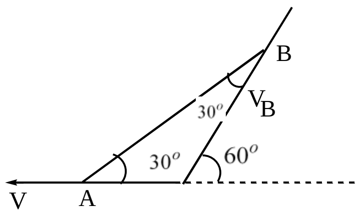
Hence, $U = U_{O_2} + U_{Ar}$

$= 2\left(\dfrac{5}{2}RT\right) + 4\left(\dfrac{3}{2}RT\right)$

= 11RT

29.

Component of velocities of A and B along AB should be same



$\therefore V_A \cos 30^o = V_B \cos 30^o$

$\therefore \quad V_B = V_A = V$

$$\omega = \frac{\text{Re}lative\ velocity \perp to\ AB}{AB} = \frac{v_A \sin 30^o + v_B \sin 30^o}{l} = \frac{v}{l} \qquad (as v_A = v_B = v)$$

30.

31.

$U = -ax^2 + bx^4$

$F = -\dfrac{\partial U}{\partial x} = -\left[-2ax + 4bx^3\right] = 0$

$\therefore x = 0$ (or) $x = \pm\sqrt{\frac{a}{2b}}$

$\frac{\partial^2 U}{\partial x^2} = -2a + 12bx^2$ is +ve at $x = \pm\sqrt{\frac{a}{2b}}$

$U_{\min imum}$ $at\ x = \pm\sqrt{\frac{a}{2b}}$

$\omega = \sqrt{\frac{\frac{\partial^2 U}{\partial x^2}}{m}} = 2\sqrt{\frac{a}{m}}$

32.

$\frac{1}{2}\rho_2 v^2 = h_1\rho_1 g + h_2\rho_2 g \Rightarrow \upsilon^2 = 2g\left(\frac{h_1\rho_1}{\rho_2} + h_2\right).$

33.

$T_c = T_o(1-\alpha t)$ i.e. surface tension decreases with increase in temperature

34.

35. qE = 30 N, vertical component of electric force = 30 sin 30° = 15N and horizontal component of electric force = 30° cos 30° = $15\sqrt{3}$N

$a_y = \frac{mg - 15}{m} = 5\ m/s^2,\ a_x = \frac{15\sqrt{3}}{3} = 5\sqrt{3}\ m/s^2$

$T_1 = \frac{2u_y}{a_y} = \frac{2x20\ \sin 30°}{5} = 4\ s$

$T_2 = eT_1 = 2s$

Horizontal velocity at the instance of first collision = (20 cos 30°) + $a_x T_1$.

= $\left(10\sqrt{3}\right) + \left(5\sqrt{3}\right)4 = 30\sqrt{3}$ m/s

Horizontal distance travelled between the instances of first and second collision.

= $\left(30\sqrt{3}\right)T_2 + \frac{1}{2}a_x T_2^2 = 70\sqrt{3}\,m$

36. Ratio of magnetic moment and angular momentum is given by

$\frac{M}{L} = \frac{q}{2m}$

Which is a function of q and m only. This can be derived as follows

$M = iA = (qf).(\pi r)^2$

$= (q)\left(\frac{\omega}{2\pi}\right)\left(\pi r^2\right) = \frac{q\omega r^2}{2}$

and $L = I\omega = \left(mr^2\omega\right)$

$\therefore \frac{M}{L} = \frac{q\frac{\omega r^2}{2}}{mr^2\omega} = \frac{q}{2m}$

37. Conceptual

38.

$$d\phi = BdA, \quad dA = 2xdy, \quad x = \sqrt{\frac{y}{K}}$$

$$|E| = \frac{d\phi}{dt} = -B2\sqrt{\frac{y}{k}}\frac{dy}{dt}, \quad \frac{dy}{dt} = \sqrt{2ay}$$

39. A fringe is a locus of points having constant path difference from the two coherent sources S_1 and S_2. It will be concentric circle.

40. $(2\pi r_2) = 2\lambda_2$ now $r \alpha n^2$

$$(2\pi r_3) = 3\lambda_3$$

$$\frac{r_2}{r_3} = \left(\frac{2}{3}\right)^2$$

$$\frac{\lambda_2}{\lambda_3} = \frac{2}{3}$$

41.

$$\sqrt{f} = a(z-b) \ and \ b = 1 \text{ for k series } \therefore f \alpha (z-1)^2$$

$$\frac{f}{f^1} = \left(\frac{30}{50}\right)^2 = \frac{9}{25} \Rightarrow f^1 = \frac{25f}{9}$$

42.

$$N = N_0 e^{-\lambda t} = N_0 e^{-\lambda \times \frac{1}{\lambda}} = \frac{N_0}{e} \Rightarrow \frac{N_0 - N}{N_0} = 1 - \frac{N}{N_0} = 1 - \frac{1}{e}$$

43.

a = A cost t, $\omega = 1$

v = A sin t at t = $\pi/2$; v = A

$\therefore \lambda = h/mA$

44

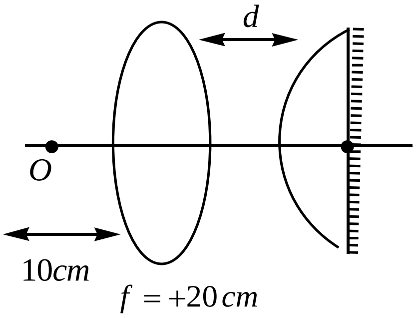
45

46. The silvered lens can be replaced by a mirror of focal length given as (DIAGRAM)

$$\frac{1}{F_M} = \frac{1}{f_m} - \frac{2}{f_1}$$

for lens $\upsilon = \frac{uf}{u+f}$

$$\upsilon = \frac{-10 \times 20}{-10 + 20} = -20$$



So this position has to be centre of curvature of mirror in order for the ray to retrace its path so d=40-20=20cm.

47. The equation of parabola is $x^2 = 4ay$

Here, $t^2 = 4aF$

When t = 5 sec, F = 50 N (see graph)

$\therefore 5^2 = 4a \times 50 \Rightarrow a = \frac{25}{200} = \frac{1}{8}$

$\therefore t^2 = 4 \times \frac{1}{8}F = \frac{F}{2} \Rightarrow F = 2t^2$

Acceleration is $f = \frac{F}{m} = \frac{2t^2}{m} = \frac{2t^2}{10} = \frac{t^2}{5}$

$\frac{dv}{dt} = \frac{t^2}{5}$ or $\int_0^v dv = \int_0^5 \frac{t^2}{5} dt$

$\therefore v = \frac{1}{5}\left[\frac{t^3}{3}\right]_0^5 = \frac{125}{15} = 8.33\,m/s$

48.

Given $U = 6x + 8y$ joule and mass $m = 2kg.$ force along $x - axis$ is

$$F_x = -\frac{dU}{dx} = -\frac{d}{dx}(6x + 8y) = -6 \text{ Newton}$$

Force along $y - axis$ is $F_y = -\frac{dU}{dy} = -\frac{d}{dx}(6x + 8y) = -8$ newton

Therefore, the x and y components of acceleration are

$$a_x = \frac{F_x}{m} = \frac{-6}{2} = -3ms^{-2} \quad \text{And } a_y = \frac{F_y}{m} = \frac{-8}{2} = -4ms^{-2}$$

$\therefore$ Resultant acceleration

$$a = \sqrt{a_x^2 + a_y^2} = \sqrt{(-3)^2 + (-4)^2} = 5ms^{-2}$$

The x and y coordinates of the body at time t are

$$x = x_0 + \frac{1}{2}a_x t^2 = 6 - \frac{1}{2} \times 3 \times t^2 \quad = \left(6 - \frac{3}{2}t^2\right) metre$$

And $y = y_0 + \frac{1}{2}a_y t^2 = -\frac{1}{2} \times 4 \times t^2 \quad = (4 - 2t^2) metre$

The body will cross the $y - axis$ when $x = 0,$ i.e. at time

t given by $\left(6 - \frac{3}{2}t^2\right) = 0 \, or \, t = 2s.$

49.

After closing the switch the charge on $1\mu F$ is $3\mu F$ and $3\mu C$ is $9\mu C$

Hence charge passing through the switch $= -3 + 9 = 6\mu C$

50. $I = \frac{2}{(2+2)} = \left(\frac{1}{2}\right)A$

$\therefore V_A - V_P = XI = \frac{X}{2}$ …..(i)

Also, $2 - 2I_1 + I - I_1 = 0 \quad I_1 = 1A$

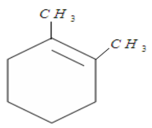
$V_A - V_P = I_1 - 1 = 1 - 1 = 0$ …..(ii)

Using eqn (i) and (ii), x = 0

Point A and P are at same potential.

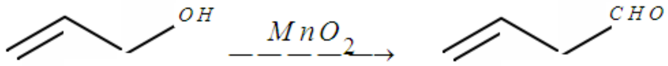
CHEMISTRY

51. Intermolecular hydrogen bonding increases M.P &B.P
52. The alkali metals dissolve in liquid ammonia giving deep blue solution which are conducting in nature
53. Psendohalide - OCN^{-}
Polyhalide - BrI_2
Interhalogen - IF_5
54. Magnetic moment $=\sqrt{n(n+2)}$
N = unpoired electrons
55. Ligand field strength α energy of light absorbed
$$\alpha \frac{1}{wavelength\, of\ light\ absorbed}$$
Blue < yellow < green < red (increasing order of wave length)
56. Major pollutants are CO, CO_2 and SO_2 hydrazine
57. does not contain carbon
58.



59. nitration- bromination- reduction
60. depend on stability of carbocation
61. Depending on intermolecular hydrogen bonding.
62. Compared to amines hydrocarbons are more volatile.
63. PMMA(polymethyl methacrylate) is used as a substitute of glass. Hence used to prepare optical censes.
64. A,D,E & K are Fat soluble
65. SO_3^{2-} gives SO_2 with del H_2SO_4 Which gives turbidity with $Ba(OH)_2$ and turns acidified dichromate solution green
66. Greater the reduction potential, less is the reducing power.
Reducing power $Y > Z > X$.
67. $\nu_1 = R, \nu_2 = \frac{3R}{4}, \nu_3 = \frac{R}{4}$
68. $[M(aa)_2 b_2]$ exhibits geometrical and optical isomerism.
69. XeO_4 can not produced by hydrolysis of xenon fluoride.

70.



71. $KHC_2O_4 \equiv KOH$
100 ml of 0.01M KOH
= 100 ml of 0.01 M KHC_2O_4
= 1 milli mol KHC_2O_4
$\therefore$ $Na_2C_2O_4$ = 1 milli mol
Total $C_2O_4^{2-}$ = 2 milli mol
= 4 milli eq min

Le^{+} volume of $KMnO_4 = V\, ml$

$V \times 0.01 \times 5 = 4 \qquad \Rightarrow \qquad V = 80\, ml$

72. $\dfrac{Urms(SO_2)}{Urms(O_2)} = \sqrt{\dfrac{T(SO_2)}{M(SO_2)} \times \dfrac{M(O_2)}{T(O_2)}}$

$T(SO_2) = 606\, K$

73. $t_{99.9}\% = \dfrac{2.303 \times 45}{0.693} \log 10^3$

$= 448 \min \approx 7\dfrac{1}{2} h$

74.

75. $\Delta H_r = [\varepsilon$ Bond energies of Reac - ε Bond energies of products]