SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC
Time: 3 Hours

JEE MAINS MODEL

Date: 27-03-2020

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

MATHS

SYLLABUS : Algebra of Matrices (up to adjoint of matrices), Determinants & Pair of straight lines & Limits and continuity

1. The values of x, so that $\begin{bmatrix}1 & x & 1\end{bmatrix}\begin{bmatrix}1 & 3 & 2\\ 0 & 5 & 1\\ 0 & 3 & 2\end{bmatrix}\begin{bmatrix}1\\ 1\\ x\end{bmatrix}=0$ **is /are**

1) ± 2 2) 0 3) $\frac{-7\pm\sqrt{35}}{2}$ 4) $\frac{-9\pm\sqrt{53}}{2}$

2. Matrix X satisfying the equation $2X-Y=\begin{bmatrix}3 & -3 & 0\\ 3 & 3 & 2\end{bmatrix}$, $2Y+X=\begin{bmatrix}4 & 1 & 5\\ -1 & 4 & -4\end{bmatrix}$ is

1 $2\begin{bmatrix}-2 & -1 & 0\\ -1 & 2 & 1\end{bmatrix}$ 2) $2\begin{bmatrix}-2 & 1 & 1\\ -1 & 2 & 0\end{bmatrix}$ 3) $\begin{bmatrix}2 & -1 & 1\\ 1 & 2 & 0\end{bmatrix}$ 4) $\begin{bmatrix}3 & 1 & 2\\ 1 & 2 & 0\end{bmatrix}$

3. If $A=\begin{bmatrix}a & p\\ b & q\\ c & r\end{bmatrix}$**,then** $\det\left(AA^T\right)$ **is equal to**

1) 0 2) 7 3) 2 4) 3

4. If $E(\theta)=\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}$**, then** $E(\alpha).E(\beta)$ **is equal to**

1) $E(\alpha-\beta)$ 2) $E(\alpha+\beta)$ 3) $E(\alpha)$ 4) $E(\beta)$

5. If $A=\begin{bmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{bmatrix}$ **and A (adj A) =** λI **, then the value of** λ **is**

1) 1 2) 2 3) 3 4) 4

6. If $A=\begin{bmatrix}\alpha & \beta\\ \gamma & -\alpha\end{bmatrix}$ **is such that** $A^2=I$ **, then**

1) $1+\alpha^2+\beta\gamma=0$ 2) $1-\alpha^2+\beta\gamma=0$ 3) $1-\alpha^2-\beta\gamma=0$ 4) $1+\alpha^2-\beta\gamma=0$

7. If $A=\begin{bmatrix}0 & 1\\ 1 & 1\end{bmatrix}$ **and** $B=\begin{bmatrix}0 & -1\\ 1 & 0\end{bmatrix}$**, then which of the following is correct?**

1) $(A+B).(A-B)-A^2-B^2$ 2) $(A+B).(A-B)=A^2-B^2$
3) $(A+B).(A-B)=1$ 4) None of these

8. **If** $A=\begin{bmatrix} 0 & -\tan\frac{\alpha}{2} \\ \tan\frac{\alpha}{2} & 0 \end{bmatrix}$ **and I is the identity matrix of order2,** $(I-A)\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$ **is equal to**

1) A   2) 1   3) $1+A$ 4) None of these

9. **If** $2X+3Y=\begin{bmatrix} 2 & 3 \\ 4 & 0 \end{bmatrix}$ **and** $3x+2y=\begin{bmatrix} 2 & -2 \\ -1 & 5 \end{bmatrix}$**, then the value of** x **and** y **is**

1) $\begin{bmatrix} -5 & 0 \\ -1 & 4 \end{bmatrix}$ and $\begin{bmatrix} 2 & 0 \\ -1 & -1 \end{bmatrix}$ 2) $\begin{bmatrix} \frac{5}{2} & 0 \\ 1 & 0 \end{bmatrix}$ and $\begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}$

3) $\begin{bmatrix} 4 & 1 \\ \frac{3}{2} & 2 \end{bmatrix}$ and $\begin{bmatrix} 1 & 1 \\ 1 & \frac{5}{2} \end{bmatrix}$ 4) $\begin{bmatrix} \frac{2}{5} & \frac{-12}{5} \\ \frac{-11}{5} & 3 \end{bmatrix}$ and $\begin{bmatrix} \frac{2}{5} & \frac{13}{5} \\ \frac{14}{5} & -2 \end{bmatrix}$

10. **If** $A=\begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$**, if** $Q_1=\frac{1}{2}\left(A+A^{'}\right)$ **and** $Q_2=\frac{1}{2}\left(A-A^{'}\right)$**, then** Q_1,Q_2 **is equal to**

1) l_3 2) 0_3 3) A   4) A^2

11. **If** $2x^2-5xy+2y^2=0$ **represents two sides of a triangle whose centroid is** $(1,1)$ **then the equation of the third side is**

1) $x+y-3=0$ 2) $x-y-3=0$ 3) $x+y+3=0$ 4) $x-y+3=0$

12. **If the pair of lines which joins the origin to the point of intersection of** $ax^2+2hxy+by^2+2gx=0$, $a_1x^2+2h_1xy+b_1y^2+2g_1x=0$ **are at right angles then**

1) $\frac{g}{g_1}=\frac{a_1+b_1}{a+b}$ 2) $\frac{g}{g_1}=\frac{a+b}{a_1+b_1}$ 3) $\frac{h}{h_1}=\frac{a+b}{a_1+b_1}$ 4) $\frac{h}{h_1}=\frac{a_1+b_1}{a+b}$

13. **If a and b are positive numbers** $(a<b)$**, then the range of values of** K**, for which a real** λ **be found such that the equation** $ax^2+2\lambda xy+by^2+2k(x+y+1)=0$ **represents a pair of straight lines is**

1) $a<K^2<b$ 2) $a\le K^2\le b$

3) $K^2\le a$ or $K^2\ge b$ 4) $K\le 2a$ or $K\ge 2b$

14. **Two of the lines represented by** $ax^3+3bx^2y+3cxy^2+dy^3=0$ **will be perpendicular if**

1) $a^2+ac+db+d^2=0$ 2) $a^2+3(ac+bd)d^2=0$

3) $a^2-3(ac+bd)+d^2=0$ 4) $a^2-ac-bd+d^2=0$

15. **If the line** $y=\sqrt{3}x$ **cuts the curve** $x^3+y^3+3xy+5x^2+3y^2+4x+5y-1=0$ **at the point** A,B,C **then** $OA.OB.OC$ **is**

1) $\frac{4}{13}\left(3\sqrt{3}+1\right)$ 2) $\frac{2}{\sqrt{3}}+7$ 3) $3\sqrt{3}+1$ 4) $\frac{4}{13}\left(3\sqrt{3}-1\right)$

16. **Area enclosed by the pair of lines** $S=ax^2+2hxy+by^2+2gx+2fy+c=0$ **and** $S^1=ax^2+2hxy+by^2-2gx-2fy+c=0$

1) $\frac{|c|}{\sqrt{h^2-ab}}$ 2) $\frac{2|c|}{\sqrt{h^2-ab}}$ 3) $\frac{3|c|}{\sqrt{h^2-ab}}$ 4) $\frac{4|c|}{\sqrt{h^2-ab}}$

17. **The lines through origin which make angles of 45^0 with the line $lx+my+n=0$ are**

1) $\left(l^2-m^2\right)\left(x^2-y^2\right)+4lmxy=0$
2) $\left(l^2+m^2\right)\left(x^2-y^2\right)+4lmxy=0$
3) $\left(l^2-m^2\right)\left(x^2+y^2\right)+4lmxy=0$
4) $\left(l^2-m^2\right)\left(x^2+y^2\right)-4lmxy=0$

18. **The equation of image of pair of lines $y=|x-1|$ in $y-axis$ is**

1) $x^2-y^2+5=0$ 2) $x^2+y^2+2x+1=0$
3) $x^2-y^2+2x+1=0$ 4) $x^2-y^2-2x-1=0$

19. $\underset{x\to\infty}{Lt}\dfrac{\sin\left(\dfrac{3}{4^x}\right)}{\tan\left(\dfrac{4}{3^x}\right)}=$

1) 0 2) 1 3) 2 4) 3

20. $\underset{n\to\infty}{Lt}\prod_{r=3}^{n}\left(\dfrac{r^3-8}{r^3+8}\right)=$

1) $\dfrac{1}{7}$ 2) $\dfrac{2}{7}$ 3) $\dfrac{3}{4}$ 4) $\dfrac{7}{2}$

SECTION-II
(Numerical Value Answer Type)

21. **If** $\begin{vmatrix} b+c & c & b \\ c & c+a & a \\ b & a & a+b \end{vmatrix}=kabc$**, then the value of k is ______**

22. **If** $\begin{vmatrix} x+y+2z & x & y \\ z & y+z+2x & y \\ z & x & z+x+2y \end{vmatrix}=k\left(x+y+z\right)^3$**, then the value of k is ______**

23. **If** $\Delta=\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$ **and** $\Delta_1=\begin{vmatrix} 1 & 1 & 1 \\ yz & zx & xy \\ x & y & z \end{vmatrix}$**, then the value of $\Delta+\Delta_1$ is ______**

24. **If P_1, P_2 denote the length of the perpendiculars from the point $(2,3)$ on the lines given by the equation $15x^2+31xy+14y^2=0$ if $P_1<P_2$ then** $\dfrac{1}{5}\left(13P_1^2+\dfrac{74}{31}P_2^2\right)=$ ____

25. **If the angle between the pair of straight lines $y^2Sin^2\theta-xySin^2\theta+x^2\left(Cos^2\theta-1\right)=0$ is ϕ then the value of** $5Sin^2\varphi+15Sin\varphi-20Cos^2\varphi=$ ____

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PHYSICS

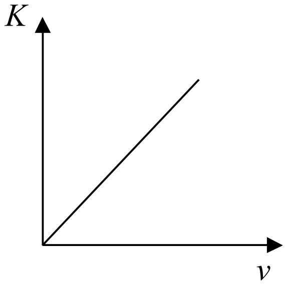
SYLLABUS: Impulse and Momentum,Work, Energy

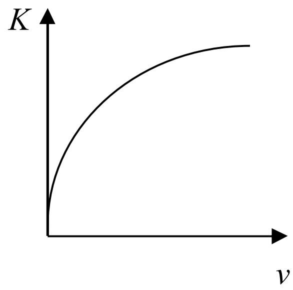
26. Choose the correct alternative among the following:
1) When a conservative force does positive work on a body, the potential energy of the body increases
2) Work done by a body against friction always results in a loss of its kinetic energy
3) The rate of change of total momentum of a many particle system is proportional to the sum of the internal forces on the system
4) In an elastic collision kinetic energy of the colliding bodies before collision is equal to kinetic during collision

27. A spring of spring constant k is stretched by a length x from its natural length and released. What about its potential energy:
1) Remain stored in spring in any form
2) Converted into heat
3) Transfer to air molecules
4) None of the above

28. Alight and a heavy body have equal momenta. Which one has greater K.E.?
1) The light body
2) The heavy body
3) The K.E. are equal
4) data is incomplete

29. The graph of kinetic energy (K) of a body versus velocity (v) is represented as:

1)


2)


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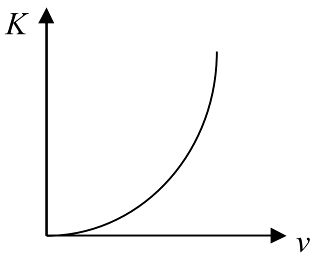
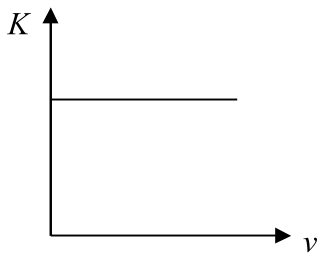
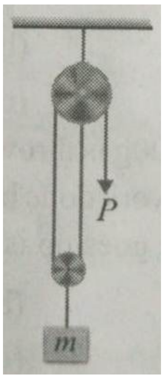


4)


30. The only force acting on a 2kg body as it moves along the positive x axis has component $F_x = -6x$ N, where x is in metre. The velocity of the body at $x = 3m$ is 8 m/s. the velocity of the body at $x = 4m$ is:
1) 10m/s
2) 9 m/s
3) 7.4 m/s
4) 6.6 m/s

31. A toy gun has a spring of force constant k. After charging the spring by compressing it through a distance x, the toy releases off shot of mass m vertically upwards. Then the shot will travel a vertical height of
1) $\frac{2mg}{kx}$
2) $\frac{kx^2}{mg}$
3) $\frac{kx}{mg}$
4) $\frac{kx^2}{2mg}$

32. The body of mass m is pulling, vertically up with constant speed, by applying force P. the free end of the string is pulled by l meter, the increase in potential energy of the block is:



1) $\frac{mgl}{2}$ 2) mgl 3) $2mgl$ 4) $\frac{mgl}{4}$

33. A block of mass M is through over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F. the kinetic energy of the block increases by 20 J in 1 s:

1) The tension of the string is Mg
2) The tension in the string is F.
3) The work done by the tension on the block is 20 J in the above 1 s.
4) The work done by the force of gravity is – 20 J in the above 1 s.

34. A force acts on a 30g particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in metres and t is in seconds. The work done during the first 4 seconds is

1) 5.28 J 2) 450 J 3) 490 J 4) 530 J

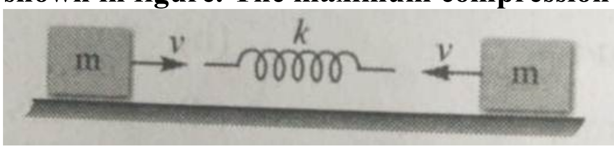
35. A particle of mass 100g is thrown vertically upwards with a speed of 5m/s. The work done by the force of gravity during the time particle goes up is

1) -1.25 J 2) 5.17 kJ 3) 0.5 J 4) -0.5 J

36. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100m. it slides down a smooth surface to the ground, them climb up another hill of height 30m and finally slides down to a horizontal base at a height of 20mabove the ground. the velocity attained by the ball is

1) $10 m/s$ 2) $10\sqrt{30} m/s$ 3) $40 m/s$ 4) $20 m/s$

37. Two blocks, each of mass m moving with speed v **collide with the spring of force constant** k **as shown in figure. The maximum compression of the spring is:**



1) $\sqrt{\frac{mv^2}{k}}$ 2) $\sqrt{\frac{2mv^2}{k}}$ 3) $\sqrt{\frac{mv^2}{2k}}$ 4) Zero

38. Calculate the work done, if a wire is loaded by 'Mg' weight and the increase in length is 'l':

1) Mgl 2) $\frac{Mgl}{2}$ 3) $2Mg\,l$ 4) Zero

39. A 60g bullet is fired through a stack of fibre board sheers 200mm thick. If the bullet approaches the stack with a velocity of 600m/s, and emerges out with a velocity of 300 m/s, the average resistance offered to the bullet is:

1) 40.5 kN 2) 2 k N 3) 20.25 kN 4) 10 kN

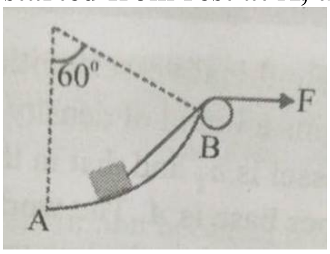
40. A particle in a conservative force field has a potential energy given by $U = \left(\frac{20xy}{z}\right)$. The force exerted on it is

1) $\left(\frac{20y}{z}\right)\hat{i}+\left(\frac{20x}{z}\right)\hat{j}+\left(\frac{20xy}{z^2}\right)\hat{k}$
2) $-\left(\frac{20y}{z}\right)\hat{i}-\left(\frac{20x}{z}\right)\hat{j}+\left(\frac{20xy}{z^2}\right)\hat{k}$
3) $-\left(\frac{20y}{z}\right)\hat{i}-\left(\frac{20x}{z}\right)\hat{j}-\left(\frac{20xy}{z^2}\right)\hat{k}$
4) $\left(\frac{20y}{z}\right)\hat{i}+\left(\frac{20x}{z}\right)\hat{j}-\left(\frac{20xy}{z^2}\right)\hat{k}$

41. A locomotive of mass m starts moving so that its velocity varies according to law $v = a\sqrt{s}$, where a is a constant, and s is the distance covered. The total work done performed by all the forces which are acting on the locomotive during first t seconds after the beginning of motion is:

1) ma^2t 2) $\frac{ma^4t}{2}$ 3) $\frac{ma^4t^2}{8}$ 4) None of these

42. A 10 kg block is pulled in the vertical plane along a frictionless surface in the form of an arc of a circle of radius 10m. the applied force is of 200N as shown in figure. If the block had started from rest at A, the velocity at B would be:



1) 1.7 m/s 2) 17 m/s 3) 27 m/s 4) 34 m/s

43. A ball of mass 'm' is thrown at an angle is 'θ' with the horizontal with an initial velocity 'u'. The change in its momentum during its flight in a time interval of 't' is

1) mgt 2) $mgt\cos\theta$ 3) $mgt\sin\theta$ 4) $\frac{1}{2}mgt$

44. An impulse "I" given to a body change its velocity from "v_1 to v_2". The increase in the kinetic energy of the body is given by

1) $I(v_1+v_2)$ 2) $I(v_1+v_2)/2$ 3) $I(v_1-v_2)$ 4) $I(v_1-v_2)/2$

45. An impulse is supplied to a moving object with the force at an angle 120^0 with the velocityand the change in momentum vector is

1) 120^0 2) 0^0 3) 60^0 4) 240^0

SECTION- II
(Numerical Value Answer Type)

46. A force $F = 6\bar{i}+2\bar{j}+3\vec{k}$ acts on a particle and produces a displacement of $\vec{s} = 2\vec{i}-3\vec{j}-x\vec{k}$. If the work done is zero, the value of x is: ____

47. A body of mass 0.5kg travels in a straight line with velocity $v = 5x^{3/2}$. The work done by the net force during the displacement from $x=0$ to $x=2m$ is (J) _____

48. Figure gives the acceleration of $a,$ 2.0 kg body as it moves from res along $x-axis$ while a variable force acts on it from $x=0$ m rest to $x=9m$. The work done by the force on the body when it reaches $x=7m$ is given by (J) ______

49. At $t=0$ a 1.0 kg ball is thrown from the top of a tall tower with velocity $\vec{v} = \left(8\hat{i}+9\hat{j}\right)m/s$. The change in the potential energy of the ball – earth system between $t=0$ to $t=5\,s$: $\left(g=10m/s^2\right)$ (J) ______

50. A body is acted on by a force given by $F=(10+2t)\,N$. The impulse received by the body during the first four seconds is (Ns) ______

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CHEMISTRY

SYLLABUS :Chemical Bonding & Stoichiometry

51. Given that g-atomic mass of H is 1.008 g. Calculate the mass of one H-atom in g.
1) $1.67\times10^{-24}g$ 2) $1.90\times10^{-24}g$
3) $1.76\times10^{-24}g$ 4) $60g$

52. Hydrated barium iodide molecule contains *x* molecules of water $\left(BaI_2.xH_2O\right)$. A sample of it weighing $10.407g$ when heated strongly gives off water completely and anhydrous residue left weighs $9.520g$. Find the value of x.
1) 2 2) 3 3) 6 4) 4

53. Two samples of lead oxide were separately reduced to metallic lead by heating on a current of hydrogen the weight of lead from one oxide was half the weight of lead obtained from the other oxide, the data illustrates
1) Law of reciprocal proportions
2) Law of constant proportions
3) Law of multiple proportions
4) Law of equivalent proportions

54. 50 ml of an aqueous solution of Glucose contains 6.02×10^{22} molecules. The concentration of solution is
1) 0.1 M 2) 1.0 M 3) 0.2 M 4) 2.0 M

55. The molality of 15% $\left(mass/Vol\right)$ solution of H_2SO_4 of density $1.1\,g/cm^3$ is approximately
1) 1.2 2) 1.4 3) 1.8 4) 1.6

56. Two elements X (atomic mass =75) and Y (atomic mass =16) combine to give a compound having 75.8% of X. The formula of the compound is
1) XY 2) X_2Y 3) X_2Y_2 4) X_2Y_3

57. The reaction $2C+O_2\rightarrow2CO$ is carried out by taking 24g carbon and $96g\ O_2$. Which one is limiting reagent
1) C 2) O_2 3) CO_2 4) NO_2

58. What volume of hydrogen gas at 273 K and 1 atm. pressure will be consumed in obtaining 21.6 g of elemental boron (at mass =10.8). From the reduction of boron trichloride with hydrogen
1) 44.5 L 2) 22.4 L 3) 89.6 L 4) 67.2 L

59. Which reaction involves neither oxidation nor reduction?
1) $CrO_4^{2-}\rightarrow Cr_2O_7^{2-}$ 2) $Cr\rightarrow CrCl_3$ 3) $Na\rightarrow Na^+$ 4) $2S_2O_3^{2-}\rightarrow S_2O_6^{2-}$

60. How many gram of $KMnO_4$ are contained in 4 litre of 0.05N solution? The $KMnO_4$ is to be used as an oxidant in acid medium
1) 1.58 g 2) 15.8 g 3) 6.32 g 4) 31.6 g

61. 0.455g sample of Plaster of Paris $\left(CaSO_4.\frac{1}{2}H_2O\right)$. When treated with excess of $Ba\left(NO_3\right)_2$ gave 0.617 g anhydrous $BaSO_4$, Calculate the % $CaSO_4$ in the sample
1) 79.15 % 2) 76.49% 3) 70.65% 4) 97.15%

62. Calculate the amount of MgS formed when $2g$ of Mg reacts with $2g$ of S

1) 4.5 g 2) 3.5 g 3) 2.5 g 4) 0.5 g

63. Addition of Zinc powder to $CuSO_4$ solution precipitates copper due to

1) reduction of Cu^{2+}
2) reduction of SO_4^{2-}
3) reduction of Zn
4) hydrolysis of $CuSO_4$

64. Same amount of metal carbines with 0.1 g of oxygen and 1g of a halogen. Hence the equivalent mass of halogen is

1) 9 2) 35.5 3) 80 4) 127

65. An oxide of sulphur contains 50% of sulphur. What will be its empirical formula?

1) SO 2) SO_2 3) SO_3 4) S_2O_3

66. A solution contains one mole of alcohol and four moles of water. What are the fractions of water and alcohol?

1) 1/4, 4/1 2) 4/1, 1/4 3) 4/5, 1/5 4) 1/5, 4/5

67. Li_2O is one of the most efficient absorbents for CO_2 in space crafts in terms of absorbing capacity per unit mass. If the reaction is $Li_2O + CO_2 \rightarrow Li_2CO_3$. What if the absorption efficiency of pure Li_2O in litre CO_2 (STP) per kg

1) 746.66 *L/kg* 2) 7466.6 *L/kg* 3) 74.66 *L/kg* 4) None of these

68. What is the charge involved when 0.1 mol of $C_6H_5NO_2$ is reduced to C_6H_5NHOH

1) 0.3 F 2) 0.4 F 3) 0.6 F 4) 0.8 F

69. A gaseous hydro carbon gives upon combustion 0.72g of water and 3.08 g of CO_2. The empirical formula of the hydrocarbon is

1) C_3H_4 2) C_6H_5 3) C_7H_8 4) C_2H_4

70. The volume strength of 1.15 N H_2SO_4 solution is

1) 4.8 2) 8.4 3) 3.0 4) 8.0

SECTION- II

(Numerical Value Answer Type)

71. The density of a gaseous element is 5 times that of oxygen under similar condition. If the molecule of the element is Triatomic. What will be its atomic mass?

72. What volume of 75% alcohol by mass $\left(d = 0.8\,g/cm^3\right)$ must be used to prepare 150 cc of 30% alcohol by mass $\left(d = 0.9\,g/cm^3\right)$?

73. Given that the abundances of isotopes $\overset{54}{Fe}$ $\overset{56}{Fe}$ and $\overset{57}{Fe}$ are 50%, 90% and 5% respectively the atomic mass of Fe is

74. A saturated solution is prepared at 70^0C containing 32.0 g $CuSO_4\ .5H_2O$ per 100 g solution. A 335 g sample of this solution is then cooled to 0^0C so that $CuSO_4.5H_2O$ crystallizes out. If the concentration of saturated solution at 0^0C is 12.5 g $CuSO_4.5H_2O$ per 100 g solution. How much $CuSO_4.5H_2O$ is crystallized.

75. How many grams $KMnO_4$ are contained in 4 litres of 0.05 N solution the $KMnO_4$ is to be used as an oxidant in acid medium

SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC
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Date: 27-03-2020

KEY SHEET

MATHS

1) **4**	2) **3**	3) **1**	4) **2**	5) **1**	6) **3**	7) **2**	8) **3**	9) **4**	10) **2**
11) **1**	12) **2**	13) **4**	14) **2**	15) **4**	16) **2**	17) **1**	18) **3**	19) **1**	20) **2**
21) **4**	22) **2**	23) **0**	24) **35**	25) **20**					

PHYSICS

26) **2**	27) **3**	28) **1**	29) **3**	30) **4**	31) **4**	32) **1**	33) **2**	34) **1**	35) **1**
36) **3**	37) **2**	38) **2**	39) **1**	40) **2**	41) **3**	42) **2**	43) **1**	44) **2**	45) **2**
46) **2**	47) **50**	48) **30**	49) **800**	50) **56**					

CHEMISTRY

51) **1**	52) **1**	53) **3**	54) **4**	55) **4**	56) **4**	57) **1**	58) **4**	59) **1**	60) **3**
61) **1**	62) **2**	63) **1**	64) **3**	65) **2**	66) **3**	67) **1**	68) **2**	69) **3**	70) **2**
71) **53.33**	72) **67.5**	73) **55.95**	74) **74.47**	75) **6.32**					

HINTS & SOLUTIONS
MATHS - A

1. Take $\begin{bmatrix}1 & x & 1\end{bmatrix}\begin{bmatrix}1 & 3 & 2\\0 & 5 & 1\\0 & 3 & 2\end{bmatrix}\begin{bmatrix}1\\1\\x\end{bmatrix}=0$

$\begin{bmatrix}1 & 5x+6 & x+4\end{bmatrix}\begin{bmatrix}1\\1\\x\end{bmatrix}=0$

$1+5x+6+x^2+4x=0$

$x^2+9x+7=0$

$x=\frac{-9\pm\sqrt{53}}{2}$

2. **Given** $2x-y=\begin{bmatrix}3 & -3 & 0\\3 & 3 & 2\end{bmatrix}$

$2x-y=\begin{bmatrix}4 & 1 & 5\\-1 & 4 & 4\end{bmatrix}$

Multiply 2 with $4\times -2y=\begin{bmatrix}6 & -6 & 0\\6 & 6 & 4\end{bmatrix}$

$5X=\begin{bmatrix}10 & -5 & 5\\5 & 10 & 0\end{bmatrix}$

$X=\begin{bmatrix}2 & -1 & 1\\1 & 2 & 0\end{bmatrix}$

3. Since, $A=\begin{bmatrix}a & p\\b & q\\c & r\end{bmatrix}$, and $A^T=\begin{bmatrix}a & b & c\\p & q & r\end{bmatrix}$

$AA^T=\begin{bmatrix}a & p\\b & q\\c & r\end{bmatrix}\begin{bmatrix}a & b & c\\p & q & r\end{bmatrix}$

$=\begin{bmatrix}a^2+p^2 & ab+pq & ac+pr\\ab+qp & b^2+q^2 & bc+qr\\ac+pr & bc+qr & c^2+r^2\end{bmatrix}$

4. Since, $E(\theta)=\begin{bmatrix}\cos\theta & \sin\theta\\-\sin\theta & \cos\theta\end{bmatrix}$

$E(\alpha)=\begin{bmatrix}\cos\alpha & \sin\alpha\\-\sin\alpha & \cos\alpha\end{bmatrix}$

and $E(\beta)=\begin{bmatrix}\cos\beta & \sin\beta\\-\sin\beta & \cos\beta\end{bmatrix}$

$E(\alpha).E(\beta)=\begin{bmatrix}\cos\alpha & \sin\alpha\\-\sin\alpha & \cos\alpha\end{bmatrix}\begin{bmatrix}\cos\beta & \sin\beta\\-\sin\beta & \cos\beta\end{bmatrix}$

$=\begin{bmatrix}\cos\alpha\cos\beta-\sin\alpha\sin\beta & \cos\alpha\sin\beta+\sin\alpha\cos\beta\\-\sin\alpha\cos\beta-\cos\alpha\sin\beta & -\sin\alpha\sin\beta+\cos\alpha\cos\beta\end{bmatrix}$

$=\begin{bmatrix}\cos(\alpha+\beta) & \sin(\alpha+\beta)\\-\sin(\alpha+\beta) & \cos(\alpha+\beta)\end{bmatrix}$

$\therefore E(\alpha).E(\beta)=E(\alpha+\beta)$

5. Since, $A=\begin{bmatrix}\cos\theta & \sin\theta\\-\sin\theta & \cos\theta\end{bmatrix}$

Adj (A) = $\begin{bmatrix}\cos\theta & -\sin\theta\\\sin\theta & \cos\theta\end{bmatrix}$

$\therefore A.(adjA)=\begin{bmatrix}\cos\theta & \sin\theta\\-\sin\theta & \cos\theta\end{bmatrix}\begin{bmatrix}\cos\theta & -\sin\theta\\\sin\theta & \cos\theta\end{bmatrix}$

$=\begin{bmatrix}\cos^2\theta+\sin^2\theta & -\sin\theta\cos\theta+\sin\theta\cos\theta\\-\sin\theta\cos\theta+\sin\theta\cos\theta & \sin^2\theta+\cos^2\theta\end{bmatrix}$

$=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

$\Rightarrow A.(adjA)=1$

But $\Rightarrow A.(adjA)=\lambda 1$

$\Rightarrow \lambda=1$

6. $AA=1$

$\Rightarrow\begin{bmatrix}\alpha & \beta\\\gamma & -\alpha\end{bmatrix}\begin{bmatrix}\alpha & \beta\\\gamma & -\alpha\end{bmatrix}=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

$\Rightarrow\begin{bmatrix}\alpha^2+\beta\gamma & \alpha\beta-\alpha\beta\\\alpha\gamma-\gamma\alpha & \gamma\beta+\alpha^2\end{bmatrix}=\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$

On comparing the corresponding elements, we have

$\alpha^2+\beta\gamma=1\Rightarrow\alpha^2+\beta\gamma-1=0$

$\Rightarrow 1-\alpha^2-\beta\gamma=1$

7. $A+B=\begin{bmatrix}0 & 1\\1 & 1\end{bmatrix}+\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}=\begin{bmatrix}0 & 0\\2 & 1\end{bmatrix}$

$A-B=\begin{bmatrix}0 & 1\\1 & 1\end{bmatrix}-\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}=\begin{bmatrix}0 & 2\\0 & 1\end{bmatrix}$

$A^2=A.A=\begin{bmatrix}0 & 1\\1 & 1\end{bmatrix}\begin{bmatrix}0 & 1\\1 & 1\end{bmatrix}=\begin{bmatrix}0+1 & 0+1\\0+1 & 1+1\end{bmatrix}=\begin{bmatrix}1 & 1\\1 & 2\end{bmatrix}$

and

$B^2=B.B=\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}=\begin{bmatrix}0-1 & 0+0\\0+0 & -1+0\end{bmatrix}=\begin{bmatrix}-1 & 0\\0 & -1\end{bmatrix}$

$\therefore A^2 - B^2 = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} - \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$

and

$(A+B)(A-B) = \begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} 0 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0+0 & 0+0 \\ 0+0 & 4+1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 5 \end{bmatrix}$

hence, $(A+B)(A-B) \neq A^2 - B^2$

8. $\cos\alpha = \dfrac{1-\tan^2\left(\frac{\alpha}{2}\right)}{1+\tan^2\left(\frac{\alpha}{2}\right)} = \dfrac{1-t^2}{1+t^2}$

$\sin\alpha = \dfrac{2\tan\left(\frac{\alpha}{2}\right)}{1+\tan^2\left(\frac{\alpha}{2}\right)} = \dfrac{2t}{1+t^2}$

$= \begin{bmatrix} \dfrac{1-t^2+2t^2}{1+t^2} & \dfrac{-2t+t(1-t^2)}{1+t^2} \\ \dfrac{-t(1-t^2)+2t}{1+t^2} & \dfrac{2t^2+1-t^2}{1+t^2} \end{bmatrix}$

$= \begin{bmatrix} \dfrac{1+t^2}{1+t^2} & \dfrac{-t(1+t^2)}{1+t^2} \\ \dfrac{t(1+t^2)}{1+t^2} & \dfrac{1+t^2}{1+t^2} \end{bmatrix} = \begin{bmatrix} 1 & -t \\ t & 1 \end{bmatrix}$

$= \begin{bmatrix} 0+1 & -t+0 \\ t+0 & 0+1 \end{bmatrix} = \begin{bmatrix} 1 & -t \\ t & 1 \end{bmatrix}$

On putting the value of t in both equations, we get

$$\begin{bmatrix} 1 & -\tan\left(\frac{\alpha}{2}\right) \\ \tan\left(\frac{\alpha}{2}\right) & 1 \end{bmatrix} = \begin{bmatrix} 1 & -\tan\left(\frac{\alpha}{2}\right) \\ \tan\left(\frac{\alpha}{2}\right) & 1 \end{bmatrix}$$

$\therefore (I-A)\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} = I + A$

9. $2x+3y = \begin{bmatrix} 2 & 3 \\ 4 & 0 \end{bmatrix}$

$3x+2y = \begin{bmatrix} 2 & -2 \\ -1 & 5 \end{bmatrix}$

On multiplying Eq. (i) by 2, Eq. (ii) by 3 and then subtracting, we get

$\Rightarrow 4x+6y-9x-6y = \begin{bmatrix} 4 & 6 \\ 8 & 0 \end{bmatrix} - \begin{bmatrix} 6 & -6 \\ -3 & 15 \end{bmatrix}$

$= \begin{bmatrix} \frac{2}{5} & \frac{-12}{5} \\ \frac{-11}{5} & 3 \end{bmatrix}$

$= \begin{bmatrix} 2-\frac{4}{5} & 3+\frac{24}{5} \\ 4+\frac{22}{5} & 0-6 \end{bmatrix} = \begin{bmatrix} \frac{6}{5} & \frac{39}{5} \\ \frac{42}{5} & -6 \end{bmatrix}$

$\therefore Y = \frac{1}{3}\begin{bmatrix} \frac{6}{5} & \frac{39}{5} \\ \frac{42}{5} & -6 \end{bmatrix} = \begin{bmatrix} \frac{2}{5} & \frac{13}{5} \\ \frac{14}{5} & -2 \end{bmatrix}$

10. $A = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$

$A = \frac{1}{2}(A+A') + \frac{1}{2}(A-A')$

$Q_1 = \frac{1}{2} = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix} + \begin{bmatrix} 0 & -a & -b \\ a & 0 & -c \\ b & c & 0 \end{bmatrix}$

$Q_2 = \frac{1}{2}(A-A') = \begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$

$Q_1Q_2 = Q_3$

11. $2x^2+5xy+2y^2 = (2x-y)(x-2y)$

G divides $\overline{OD}$ in 2:1

$\Rightarrow D = \left(\frac{3}{2}, \frac{3}{2}\right)$

Slope of $OD = 1 = m$

$OD \perp^r AB \Rightarrow$ equation of AB is

$y - \frac{3}{2} = \frac{-1}{1}\left(x - \frac{3}{2}\right)$

$\Rightarrow x+y=3$

$\Rightarrow x+y-3=0$

12. Eliminate $'x'$ in two equations

$\Rightarrow (ag_1 - a_1g)x^2 + (2hg_1 - 2h_1g)xy + (bg_1 - b_1g)y^2 = 0$

and $a+b=0$

$\left(Coeff\ of\ x^2 + Coeff\ of\ y^2 = 0\right)$

13. We have $h=\lambda$, $g=K$, $c=2K$, $f=K$

Apply $\Delta = 0$, we get a quadratic equation in λ for real $\lambda \Rightarrow b^2 - 4ac \ge 0$

14. Let $m_1 m_2 m_3 = \frac{-a}{d}$ and $y = \frac{a}{d}x$ in the given equation

15. $Tan\theta = \sqrt{3}$, the line is $\frac{x - x_1}{Cos\theta} = \frac{y - y_1}{Sin\theta} = r$

$\Rightarrow \frac{x-0}{\frac{1}{2}} = \frac{y-0}{\frac{\sqrt{3}}{2}} = r$ any point on the

Line is $\left(\frac{r}{2}, \frac{\sqrt{3}}{2}r\right)$, where '$r$' is the distance from $(0,0)$

Substituting in the curve

$r^3\left(\frac{1+3\sqrt{3}}{8}\right) + r^2(....) + r(......) - 1 = 0$

It is a cubic equation in 'r'

$\therefore (OA)(OB)(OC) = \frac{1}{\left(1+3\sqrt{3}\right)}(8) = \frac{4}{13}\left(3\sqrt{3}-1\right)$

16. $S = \left(l_1x + m_1y + n_1\right)\left(l_2x + m_2y + n_2\right)$

$S^1 = \left(-l_1x - m_1y + n_1\right)\left(-l_2x - m_2y + n_2\right)$

Above four lines form a parallelogram

$Area = \left|\frac{(c_1 - c_2)(d_1 - d_2)}{a_1b_2 - a_2b_1}\right|$

17. $\overleftrightarrow{OP}$ and $\overleftrightarrow{OQ}$ be the bisectors of the angles between OA and OB

Equations of OB and OA are

$lx + my = 0$ and $mx - ly = 0$

and $(lx + my)(mx - ly) = 0$

$\Rightarrow lmx^2 - \left(l^2 - m^2\right)my - lmy^2 = 0$

Combined equation of OP and OQ is

$\frac{x^2 - y^2}{2lm} = \frac{xy}{-\frac{1}{2}\left(l^2 - m^2\right)}$

$\Rightarrow \left(l^2 - m^2\right)\left(x^2 - y^2\right) + 4lmxy = 0$

18. $y = |x-1| \Rightarrow y^2 = (x-1)^2$

Replace x by $-x \Rightarrow y^2 = (-x-1)^2$

$\Rightarrow x^2 - y^2 + 2x + 1 = 0$

19.

$$\underset{x\to\infty}{Lt}\frac{\sin\left(\frac{3}{4x}\right)}{\tan\left(\frac{4}{3x}\right)} = \underset{x\to\infty}{Lt}\frac{\left(\frac{3}{4^x}\right)}{\left(\frac{4}{3^x}\right)} = \frac{3}{4}.\underset{x\to\infty}{Lt}\left(\frac{3}{4}\right)^x = \frac{3}{4}.(0) = 0$$

20.

$$\underset{n\to\infty}{Lt}\prod_{r=3}^{n}\left(\frac{r^3-8}{r^3+8}\right) = \underset{n\to\infty}{Lt}\prod_{r=3}^{n}\left[\frac{(r-2)\left(r^2+2r+4\right)}{(r+2)\left(r^2-2r+4\right)}\right]$$

$$\underset{n\to\infty}{Lt}\prod_{r=3}^{n}\left(\frac{r-2}{r+2}\right).\prod_{r=3}^{n}\left(\frac{r^2+2r+4}{r^2-2r+4}\right)$$

$$\underset{n\to\infty}{Lt}\prod_{r=3}^{n}\left(\frac{r-2}{r+2}\right).\prod_{r=3}^{n}\left[\frac{(r+1)^2+3}{(r-1)^2+3}\right]$$

$$= \underset{n\to\infty}{Lt}\frac{1.2.3.4}{(n-1)n(n+1)(n+2)}\frac{\left(n^2+3\right)\left(n^2+2n+4\right)}{7.12}$$

$$\underset{n\to\infty}{Lt}\frac{2}{7}\frac{\left(1+\frac{3}{n^2}\right)\left(1+\frac{2}{n}+\frac{4}{n^2}\right)}{\left(1-\frac{1}{n}\right)\left(1+\frac{1}{n}\right)\left(1+\frac{2}{n}\right)} = \frac{2}{7}$$

NUMERICAL VALUE HINTS & SOLUTIONS

21. We have $\begin{vmatrix} b+c & c & b \\ c & c+a & a \\ b & a & a+b \end{vmatrix}$

$= \begin{vmatrix} 0 & -2a & -2a \\ c & c+a & a \\ b & a & a+b \end{vmatrix}$

$= -2a\begin{vmatrix} 0 & 1 & 1 \\ c & c+a & a \\ b & a & a+b \end{vmatrix}$

$= (-2a)(-bc - bc)$

22.

$$\begin{vmatrix} x+y+2z & x & y \\ z & y+z+2x & y \\ z & x & z+x+2y \end{vmatrix} = \begin{vmatrix} 2(x+y+z) & x & y \\ 2(x+y+z) & y+z+2x & y \\ 2(x+y+z) & x & z+x+2y \end{vmatrix}$$

$$= 2(x+y+z)\begin{vmatrix} 1 & x & y \\ 1 & y+z+x & 0 \\ 0 & 0 & z+x+y \end{vmatrix}$$

$$=2(x+y+z)(x+y+z)(x+y+z)\begin{vmatrix}1 & x & y\\0 & 1 & 0\\0 & 0 & 1\end{vmatrix}$$

$$=2(x+y+z)^3\left[(1)(1-0)\right]=2\left(x+y+z^3\right)$$

$$=k(x+y+z)^3$$

$$\therefore k=2$$

23. We have, $\Delta_1=\begin{vmatrix}1 & 1 & 1\\yz & zx & xy\\x & y & z\end{vmatrix}$

$$=\frac{xyz}{xyz}\begin{vmatrix}x & 1 & x^2\\y & 1 & y^2\\z & 1 & z^2\end{vmatrix}$$

$$=(-1)\begin{vmatrix}1 & x & x^2\\1 & y & y^2\\1 & z & z^2\end{vmatrix}=-\Delta\Rightarrow\Delta_1+\Delta=0$$

24. $15x^2+31xy+14y^2=0$

$$\Rightarrow 15x^2+21xy+10xy+14y^2=0$$

$$\Rightarrow 3x(5x+7y)+2y(5x+7y)=0$$

$$\Rightarrow (5x+7y)(3x+2y)=0$$

$$\Rightarrow 5x+7y=0,\Rightarrow 3x+2y=0$$

$$P_1=\frac{6+6}{\sqrt{9+4}}=\frac{12}{\sqrt{13}};\ P_2=\frac{10+21}{\sqrt{25+49}}=\frac{31}{\sqrt{74}}$$

$$\frac{1}{5}\left(13P_1^2+\frac{74}{31}P_2^2\right)=\frac{1}{5}\left(13\times\frac{144}{13}+\frac{74}{31}\times\frac{31\times31}{74}\right)$$

$$=\frac{1}{5}(175)=35$$

25 $a+b=Sin^2\theta+Cos^2\theta-1=0\Rightarrow\phi=90$

PHYSICS

26. **(2)**

27. Potential energy of the spring will transfer to the kinetic energy of air molecules.

28. As $K=\frac{P^2}{2m};\quad K\alpha\frac{1}{m}$.

29. We know that $K=\frac{1}{2}mv^2$

$\Rightarrow$ It represent a parabola about $y-axis$

30. $W=K_f-K_i$.

or $\int_3^4(-6x)dx=\frac{1}{2}\times 2\left(v_f^2-8^2\right)$

or $\left|\frac{-6x^2}{2}\right|_3^4=v_f^2-64$

or $-3\left|4^2-3^2\right|=v_f^2-64$

$\therefore v_f=6.6\,m/s$

31. $\frac{1}{2}kx^2=mgh$

or $h=\frac{kx^2}{2mg}$

32. In the device when free end of the string is pulled by l, the block will rise by $\frac{l}{2}$. So increase in potential energy $U=mgl/2$.

33. The tension in the string, T = F.

Also $W_{gravity}+W_{tension}=\Delta K$

$\therefore\ W_{tension}=\Delta K-W_{gravity}$

34. $v=\frac{dx}{dt}=\frac{d\left(3t-4t^2+t^3\right)}{dt}=3-8t+3t^2$

$t=0$, $3m/s$

$t=4$, $v_f=3-8\times4+3\times4^2=19m/s$

Now, $W=\frac{1}{2}m\left(v_f^2-v_i^2\right)$

$$=\frac{1}{2}\times30\times10^{-3}\left[19^2-3^2\right]=5.28J$$

35. $W=\frac{1}{2}m\left(v_f^2-v_i^2\right)$

$$=\frac{1}{2}\times100\times10^{-3}\left(0^2-5^2\right)$$

$$=-1.25J$$

36. $mg(100-20)=\frac{1}{2}mv^2$

$\therefore v=40m/s$

37. $\frac{1}{2}kx^2=2\times\frac{1}{2}mv^2$

38. $W=\frac{Mg\times l}{2}=\frac{Mgl}{2}$

39. $Fx=\frac{1}{2}m\left(v_f^2-v_i^2\right)$

or

$$F\times200\times10^{-3}=\frac{1}{2}\times60\times10^{-3}\left(300^2-600^2\right)$$

$\therefore\ F=40.5\times10^3\,N$

40. Given, $U=20xyz^{-1}$

$$F_x = -\frac{\partial U}{\partial x} = -\frac{20x}{z}$$

$$F_y = -\frac{\partial U}{\partial y} = -\frac{20y}{z}$$

and $F_z = -\frac{\partial U}{\partial z} = -\frac{20xy}{z^2}$

$$\therefore \vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$$

41. See examples

42. $W_{gravity} + W_F = \Delta K$

$$-10\times g\left(10-10\cos 60^0\right)+200\times 10\sin 60^0$$

$$=\frac{1}{2}\times 10\times v_f^2 - 0$$

$$v_f = 17\,m/s$$

43. $J = Ft = \Delta P$

44. $\Delta KE = \frac{1}{2}m\left(v_2^2 - v_1^2\right)$, $J = \Delta p = m\left(v-u\right)$

45. Both the impulse and change in momentum are in same direction.

46. $\vec{F}.\vec{S} = 0$

or $\left(6\hat{i}+2\hat{j}+3\hat{k}\right).\left(2\hat{i}-3\hat{j}-x\hat{k}\right)=0$

or $6\times 2-2\times 3-3x=0$

$\therefore x = 2$

47. At $x=0, v_i = 5\left(0\right)^{\frac{3}{2}} = 0$

and $x=2m$, $v_f = 5\left(2\right)^{\frac{3}{2}} = 5\sqrt{8}\ m/s$

$W = \Delta K$

$$=\frac{1}{2}m\left(v_f^2 - v_i^2\right)$$

$$=\frac{1}{2}0.5\left[\left(5\sqrt{8}\right)^2 - 0^2\right]$$

= 50 J

48. $W = area\ of\ \vec{F} - x$

$$= m\left[area\ of\ \vec{a} - x\right]$$

$$=2\left[\frac{1}{2}\left(5+3\right)\times 6 - \frac{1}{2}\left(2+1\right)\times 6\right] = 30\ j$$

49. $v_i = \left(8\hat{i}+9\hat{j}\right)m/s$

and $\vec{v}_f = 8\hat{i}+\left(9-g\times 5\right)\hat{j} = \left(8\hat{i}-41\hat{j}\right)m/s$

so $v_i = \sqrt{8^2+9^2} = \sqrt{147}$

and $v_f = \sqrt{8^2+41^2} = \sqrt{1745}$

$$\Delta U = -\Delta K = \frac{1}{2}\times 1\times\left[145-1745\right]$$

$$=-800J$$

$$=\left(\frac{-20y}{z}\right)\hat{i} - \left(\frac{20x}{z}\right)\hat{j} + \frac{20xy}{z^2}\hat{k}$$

50. $J = \int F.dt$

CHEMISTRY

51. One g atom = mass of N_A atoms

$$1.008\,g = 6.022\times 10^{23}\ \text{H-atoms}$$

$$Mass\ of\ one\ H-atom = \frac{1.008}{6.022\times 10^{23}} = 1.67\times 10^{-24}\,g$$

52. Mass of water escaped = 10.407-9.520= 0.887 g $BaI_2.xH_2O$

$BaI_2\left(9.520g\right)$ $\quad xH_2O\left(0.887\,g\right)$

$$\frac{moles\ of\ H_2O}{moles\ of\ BaI_2} = x$$

$$=\frac{0.887/18}{9.520/391} = x = x = 2$$

53. Law of multiple proportions

54. $Mole\ of\ Glu\cos e = \frac{6.02\times 10^{22}}{6.02\times 10^{23}} = 0.1$

$$M_{glu\cos e} = \frac{0.1\times 100}{50} = 2$$

55. $m = \dfrac{15}{98\times\dfrac{\left(100\times 1.1-15\right)}{1000}} = 1.6$

56. g-atoms of $X = \frac{75.8}{75}$ and

g-atom of $Y = \frac{24.2}{16}$

57. Limiting reagent is one which is completely consumed in reaction

58. $2BCl_3 + 3H_2 \rightarrow 2B + 6HCl$

$$2\times 10.8g\ Boron = 3\times 22.4\,LH_2$$

$$21.6\,g\ Boron = \frac{3\times 22.4\times 21.6}{2\times 10.8}$$

$$=67.2L\,H_2$$

59. Oxidation number remains unchanged.

60. Meq. Of $KMnO_4$

$$=4\times 1000\times 0.5 = \frac{\omega}{31.6}\times 1000$$

$$\omega = 6.32\,g$$

61.

$$CaSO_{4(aq)} + Ba\left(NO_3\right)_2 \rightarrow BaSO_4\downarrow + Ca\left(NO_3\right)_2$$

$1 mole$ $1 mole$

136 g 233 g

Mass of $CaSO_4$ required to get 0.617 g $BaSO_4$

$$=\frac{136}{233}\times 0.617=0.360\,g\ CaSO_4$$

% Purity of $CaSO_4$ sample

$$\frac{0.360}{0.455}\times 100=79.15\%$$

62 $Mg+S\rightarrow Mg\ S$

1 mole 1 mole

Mass ratio = 24 g 32 g

When $2g\,S\ (2/32\,mole)$ reacts with Mg. It acts as limiting reagent while Mg is excess reagent. Thus amount produced will be decided by moles of *S* not by moles of Mg, thus

$1\,mole\,S=1\,mole\,MgS$

$$Moles\,of\ Mg\ S\ formed=\frac{2}{32}$$

And mass of

$Mg\,S$ formed$=\frac{2}{32}\times 56=3.5g$

63. Reduction of Cu^{2+}

64. Eq. metal = eq. of O_2 = eq. of halogen

Eq. of $O_2=\frac{0.1}{E}=\frac{0.1}{\frac{32}{4}}=\frac{0.1}{8}$

Eq. of halogen$=\frac{1}{E}=\frac{0.1}{8}$

$E=80$

65. Conceptual

66. $\frac{1}{1+4}=\frac{1}{5}\ \therefore x_{H_20}$=4/5

67. Li_2O reacts with CO_2 as

$Li_2O+CO_2\rightarrow Li_2CO_3$ (Mass of $Li_2O=30g$)

1 mole of Li_2O reacts with 22.4 L CO_2 at NTP

$1000\,g\,Li_2O$ absorbs $\frac{22.4\times 1000}{30}$

=746.66 litre CO_2

$\therefore$ Absorption efficiency is 746.66 L/kg

68. $C_6H_5NO_2+4e^-\rightarrow C_6H_5\ NHOH$

$4\times 6+5+x-4=0$ $24+7+x-2=0$

$x=-25$ $x=-29$

$n=-25-(-29)=4$

1 mole = $4F$ (or) 0.1 mole = 0.4F

69. $=C_XH_Y+x+\frac{Y}{4}O_2\rightarrow XCO_2+\frac{4}{2}H_2O$

3.08 g 0.72 g

0.07 moles 0.04 moles

$$\frac{X}{Y/2}=\frac{0.07}{0.04}=\frac{X}{Y}=\frac{7}{8}$$

70. $2H_2O_2\rightarrow 2H_2O+O_2$

68 g 22.4 *l* (at STP)

Mass of H_2O_2 in 1.5 N solution =

E. wt. of $H_2O_2\times 1.5N$

$=17\times 1.5=25.5\,g$

= Volume strength of $1.5N\ H_2O_2$ solution

$$\frac{22.4l\times 25.5g}{68.0}=8.4l$$

NUMERICAL HINTS

71. Molecular mass of oxygen $=32$

V.D of oxygen $=\frac{32}{2}=16$

V.D of gaseous element $16\times 5=80$

Molecular mass of gaseous element $=80\times 2=160$

As molecule id Triatomic, Its atomic mass

$$=\frac{molar\ mass}{Atomicity}$$

$$=\frac{160}{3}=53.33$$

Ans: 53.33

72. $\frac{75}{100}\times V\times 0.8=\frac{30}{100}\times 150\times 0.9$

$V=67.5\,m\,L$

73. $Fe=\frac{5}{100}\times 54+\frac{90}{100}\times 56+\frac{5}{100}\times 57$

$=55.95\,amu$

74. Mass of $CuSO_4.5H_2O$ in 335 g solution

$$\frac{32\times 335}{100}=107.20\,g$$

Mass of water = 335-107.20 =227.80 g

At 0^0C mass of $CuSO_4.5H_2O$ in 100 g of solution = 12.5 g

Mass of water= 100-12.5 g =87.5 g

$87.5\,H_2o\rightarrow 12.5$

$227.80\rightarrow ?$

$\frac{12.5 \times 227.8}{87.5} = 32.73\,g$

Amount of $CuSO_4.5H_2O$ crystallised

=107.20-32.73 = 74.47

75. Wt. of $KMnO_4 = 4 \times 1000 \times 0.5 = \frac{w}{31.6} \times 1000$

$w = 6.32\,g$