MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SECTION:: Outing Senior | **JEE MAINS UNIT TEST-08** | **Date: 29-06-2020**

Time: 3 Hours | **Max. Marks: 300 M**

JEE MAIN MODEL

MATHEMATICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 01 – 20)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 21 – 25)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

PHYSICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 26 – 45)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 46 – 50)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

CHEMISTRY

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 51 – 70)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 71 – 75)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (B) 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.

MATHEMATICS

SYLLABUS: ***Quadratic Equations, Logarithmic, Permutations & Combinations, Binomial theorem, Probability, Statistics, Mathematical Reasoning***

1. **Let α and β be two real roots the $(k+1)\tan^2 x-\sqrt{2}\lambda\tan x=(1-k)$, where $k(\neq -1)$ and λ are real numbers. If $\tan^2(\alpha+\beta)=50$, then a value of λ is**

A) $10\sqrt{2}$ B) $5\sqrt{2}$ C) 10 D) 5

2. **Let α and β be the roots of the equation $x^2-x-1=0$, if $p_k=\alpha^k+\beta^5; k\geq 1$, then which of the following statements is not true?**

A) $p_5=p_2p_3$ B) $p_1+p_2+p_3+p_4+p_5=26$

C) $p_3=p_5-p_4$ D) $p_5=11$

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

A) 6 B) -6 C) 3 D) -3

4. **The number of integral solutions of $2\left(x^2+\frac{1}{x^2}\right)-7\left(x+\frac{1}{x}\right)+9=0$ when $x\neq 0$ is**

A) 1 B) 2 C) 4 D) 0

5. **Let (x_0,y_0) be the solution of the following equations $(2x)^{\ln 2}=(3y)^{\ln 3}; 3^{\ln x}=2^{\ln y}$ then x_0 is**

A) $\frac{1}{6}$ B) $\frac{1}{3}$ C) $\frac{1}{2}$ D) 6

6. **Total number of 6 digit numbers in which only and all the 5 digits 1,3,5,7 and 9 appear, is**

A) 5^6 B) $\frac{1}{2}(6!)$ C) 6! D) $\frac{5}{2}(6!)$

7. **If the four letter words (need not be meaningful) are to be formed using the letters from the word "MEDITERRANEAN" such that the first letter in R and the fourth letter is E then the total number of all such words is**

A) 110 B) 59 C) $\frac{11!}{(2!)^3}$ D) 56

8. **The number of ways in which an examiner can assign 30 marks to 8 questions, giving not less than 2 marks to any question is**

A) ${}^{30}C_7$ B) ${}^{21}C_8$ C) ${}^{21}C_7$ D) ${}^{30}C_8$

9. **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 exist exactly three elements in A, such that $f(x)=y_2$, is equal to**

A) $14.{}^7C_2$ B) $16.{}^7C_3$ C) $12.{}^7C_2$ D) $14.{}^7C_3$

10. **The coefficient of x^7 in the expression $(1+x)^{10}+x(1+x)^9+x^2(1+x)^8+....+x^{10}$ is**

A) 210 B) 330 C) 420 D) 120

11. **The sum of the rational terms in the expansion of $\left(\sqrt{2}+\sqrt[5]{3}\right)^{10}$ is**

A) 41 B) 42 C) 32 D) 39

12. **The term independent of $x\left(x>0, x\neq 1\right)$ in the expansion of $\left(\frac{x+1}{x^{2/3}-x^{1/3}+1}-\frac{x-1}{x-\sqrt{x}}\right)^{10}$ is**

A) 105 B) 210 C) 315 D) 420

13. **If x is numerically so small so that x^2 and higher powers of x can be neglected, then $\left(1+\frac{2x}{3}\right)^{3/2}(32+5x)^{-1/5}$ is approximately equal to**

A) $\frac{32+31x}{64}$ B) $\frac{31+32x}{64}$ C) $\frac{31-32x}{64}$ D) $\frac{1-2x}{64}$

14. **In a workshop there are five machines and the probability of any of them to be out of service on a day is $\frac{1}{4}$. If the probability that atmost two machines will be out of service on the same day is $\left(\frac{3}{4}\right)^3 k$ then k is equal to**

A) $\frac{17}{2}$ B) $\frac{17}{4}$ C) $\frac{17}{8}$ D) 4

15. **In a box, there are 20 cards, out of which 10 are labeled as A and the remaining 10 are labeled as B. Cards are drawn at random, one after the other and with replacement, till a second A – card is obtained. The probability that the second A-card appear before the third B-card is.**

A) $\frac{13}{16}$ B) $\frac{15}{16}$ C) $\frac{9}{16}$ D) $\frac{11}{16}$

16. **A random variable X has the following probability distribution**

$X:$	1	2	3	4	5
$P(X):$	k^2	$2k$	k	$2k$	$5k^2$

then $p(x>2)$ is equal to

A) $\frac{23}{36}$ B) $\frac{7}{12}$ C) $\frac{1}{36}$ D) $\frac{1}{6}$

17. **An unbiased coin is tossed 5 times. Suppose that a variable X is assigned the value k when k consecutive heads are obtained for k = 3,4,5 otherwise x takes the value -1. Then the expected value of x is**

A) $\frac{3}{16}$ B) $\frac{1}{8}$ C) $\frac{3}{16}$ D) $\frac{1}{8}$

18. **Let A and B be two events such that $P\left(\overline{A\cup B}\right)=\frac{1}{6}; P(A\cap B)=\frac{1}{4}$ and $P\left(\bar{A}\right)=\frac{1}{4}$ where $\bar{A}$ stands for the complement of the event A. Then the events A and B are**

A) independent but not equally likely B) independent and equally likely

C) mutually exclusive and independent D) equally likely but not independent

19. The mean and standard deviation (s.d) of 10 observations are 20 and 2 respectively. Each of these 10 observations is multiplied by p and then reduced by q, where $p \neq 0,$ and $q \neq 0.$ If the new mean and new s.d. becomes half of their original values, then q is equal to

A) -20 B) 10 C) -10 D) -5

20. Which of the following statement is a tautology?

A) $\sim(p \vee \sim q) \rightarrow p \wedge q$ B) $\sim(p \wedge \sim q) \rightarrow p \vee q$

C) $\sim(p \vee \sim q) \rightarrow p \vee q$ D) $p \vee (\sim q) \rightarrow p \wedge q$

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. 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 in all other cases.

21. The number of 4 letter words (with or without meaning) that can be formed from the eleven letters of the word 'EXAMINATION' is _____

22. The least positive value of 'a' for which the equation, $2x^2 + (a-10)x + \frac{33}{2} = 2a$ has real roots is

23. If the mean and variance of eight numbers 3,7,9,12,13,,20,x, and y be 10 and 25 respectively, then x.y is equal to _____

24. If the sum of the coefficient of all even powers of x in the product $(1+x+x^2+....+x^{2n})(1-x+x^2-x^3....+x^{2n})$ is 61, then n is equal to _____

25. If $C_r = {}^{25}C_r$ and $C_0 + {}^5C_1 + {}^9C_2 + ... + {}^{(101)}C_{25} = 2^{25}.k$ then k is equal to _____

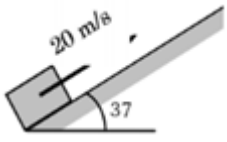
SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) 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.

PHYSICS

SYLLABUS: **SHM,Units and Dimensions,Kinematics, NLM, Friction,Circular motion,Work power energy**

26. A box of mass m =10 kg is projected up an inclined plane from its foot with a speed of 20 m/s as shown in the figure. The coefficient of friction μ between the box and the plane is 0.5. Find the distance traveled by the box on the plane before it stops first time.



A) 10m B) 5m C) 15m D) 20m

27. A stone of mass 1 kg tied to a light string of length $l = \frac{10}{3}m$ is whirling in a circular path in vertical plane. If the ratio of the maximum to minimum tension in the string is 4, find the speed of the stone at the lowest and highest points

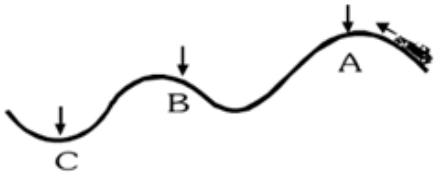
A) $10\,ms^{-1}, 15.2\,ms^{-1}$ B) $15.2\,ms^{-1}, 10\,ms^{-1}$ C) $5.2\,ms^{-1}, 10\,ms^{-1}$ D) $1\,ms^{-1}, 15.2\,ms^{-1}$

28. When a conservative force does positive work on a body, then

A) its potential energy must increase B) its potential energy must decrease

C) its kinetic energy must increase D) its total energy must decrease

29. A car is moving along a hilly road as shown (side view). The coefficient of static friction between the tyres and pavement is constant and the car maintains a steady speed. If, at one of the points shown the driver applies the brakes as hard as possible without making the tyres slip, the magnitude of the frictional force immediately after the brakes are applied will be maximum if the car was at



A) point A B) point B

C) point C D) friction force same for positions A, B and C

30. A student measured the diameter of a wire using a screw gauge with the least count 0.001 cm. The measured value should be recorded as

A) 5.3200 cm B) 5.3 cm C) 5.32 cm D) 5.320 cm

31. In a Searle's experiment, the diameter of the wire as measured by a screw gauge of least count 0.001 cm is 0.050 cm. The length, measured by a scale of least count of 0.1 cm, is 110.0 cm. When a weight of 50 N is suspended from the wire, the extension is measured to be 0.125 cm by a micrometer of least count 0.001 cm. Find the maximum error in the measurement of Young's modulus of the material of wire from these data.

A) $1.09\times10^{10}\ \mathrm{N/m^2}$ B) $2.24\times10^{10}\ \mathrm{N/m^2}$ C) $2.24\times10^{11}\ \mathrm{N/m^2}$ D) $1.09\times10^{11}\ \mathrm{N/m^2}$

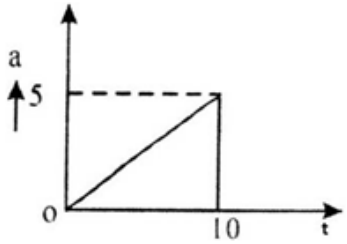
32. The respective number of significant figures for numbers 23.023, 0.0003 and 2.1×10^{-3} are

A) 5,1,2 B) 5,5,2 C) 5,1,5 D) 4,4,2

33. The trajectory of a projectile in a vertical plane is $y = ax - bx^2$, where a, b are constants, and x and y are respectively the horizontal and vertical distances of the projectile from the point of projection. The maximum height attained is ___ and the angle of projection from the horizontal is ____.

A) $\frac{a^2}{4b}, \theta = \tan^{-1} a$ B) $\frac{a^2}{4b}, \theta = \tan^{-1} b$ C) $\frac{a}{4b^2}, \theta = \tan^{-1} a$ D) $\frac{a^2}{4b^2}, \theta = \tan^{-1} b$

34. A particle is moving in a straight line with initial velocity of10 $\mathrm{ms^{-1}}$. A graph of acceleration → time of the particle is given in the figure. Find velocity at t = 10 s.

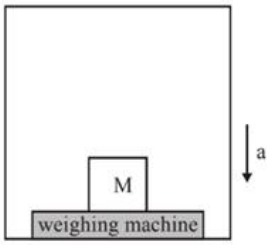


A) 25 $\mathrm{ms^{-1}}$ B) 35 $\mathrm{ms^{-1}}$ C) 45 $\mathrm{ms^{-1}}$ D) 15 $\mathrm{ms^{-1}}$

35. Acceleration of a particle moving along the x-axis is defined by the law $a = -4x$, where a is in m/s^2 and x is in meters. At the instant $t = 0$, the particle passes the origin with the a velocity of 2 m/s moving in the positive x-direction. If its position x as function of time t is given by $\sin(Kt)$ then K value is

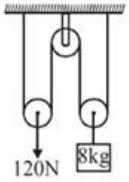
A) 1 B) 3 C) 2 D) 0.5

36. With what acceleration 'a' shown the elevator descends so that the block of mass M exerts a force of $\frac{Mg}{10}$ on the weighing machine? [g= acceleration due to gravity]



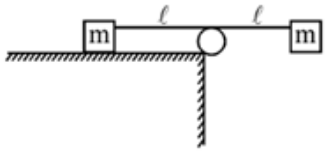
A) 0.3g B) 0.1g C) 0.9g D) 0.6g

37. If the string is pulled down with a force of 120N as shown in the figure, then the acceleration of 8 kg block would be



A) $10\,\mathrm{m/s^2}$ B) $5\,\mathrm{m/s^2}$ C) $0\,\mathrm{m/s^2}$ D) $4\,\mathrm{m/s^2}$

38. As shown in figure, the left block rests on a table at distance l from the edge while the right block is kept at the same level so that thread is unstretched and does not sag and then released. What will happen first?



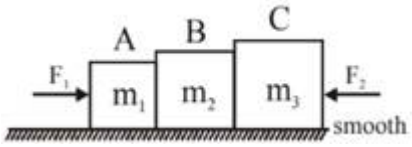
A) Left block reach the edge of the table B) Right block hit the table
C) Both (A) and (B) happens at the same time D) Can't say anything

39. For shown situation let

$N_1 =$ **Normal reaction between A & B**

$N_2 =$ **Normal reaction between B & C**

Which of the following statement (s) is/are correct?



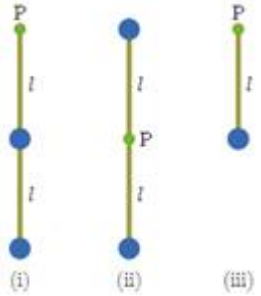
A) If $F_1 > F_2$ then $N_1 \neq N_2$ and $F_2 < \sqrt{N_1 N_2} < F_1$ B) If $F_1 < F_2$ then $N_2 > N_1$

C) If $F_1 = F_2$ then $N_1 = N_2$ D) All are correct

40. A point mass is subjected to two simultaneous sinusoidal displacements in x-direction, $x_1(t) = A\sin(\omega t)$ and $x_2(t) = A\sin\left(\omega t + \frac{2\pi}{3}\right)$. Adding a third sinusoidal displacement $x_3(t) = B\sin(\omega t + \phi)$ brings the mass to complete rest. The value of B and ϕ are,

A) $\sqrt{2}A, 3\pi/4$ B) $\sqrt{2}A, 3\pi/4$ C) $A, 4\pi/3$ D) $A, \pi/3$

41. Three physical pendulums consisting of identical uniform spheres of the same mass m that are rigidy connected by identical rods of length l and negligible mass. Each pendulum is vertical and can pivot about suspension point P. The increasing order of their time periods is?

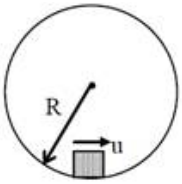


A) (iii), (i), (ii) B) (i), (iii), (ii) C) (ii), (i), (iii) D) (ii), (iii), (i)

42. Length of a uniform chain is L and coefficient of static fiction is μ between the chain and the table top. Calculate the maximum length of the chain which can hang from the table without sliding.

A) $\frac{\mu L}{1+\mu}$ B) $\frac{L}{1+\mu}$ C) $\frac{\mu L}{1-\mu}$ D) $\frac{L}{1-\mu}$

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



A) $g\sqrt{10}$ B) g C) $g\sqrt{2}$ D) $3g$

44. A car is travelling along a circular curve that has a radius of 8m. If its speed is 8 m/s and is increasing uniformly at $8m/s^2$, the magnitude of its acceleration at this instant is

A) $8\,\mathrm{m/s^2}$ B) $8\sqrt{2}\,\mathrm{m/s^2}$ C) $\frac{8}{\sqrt{2}}\,\mathrm{m/s^2}$ D) $16\,\mathrm{m/s^2}$

45. A particle performs circular motion of radius 1m from rest. The tangential acceleration of the particle at any time t is given by $a_1 = tms^{-2}$. The radial acceleration of the particle at t = 2 sec is

A) $1ms^{-2}$ B) $2ms^{-2}$ C) $0.5ms^{-2}$ D) $4ms^{-2}$

SECTION- II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 in all other cases.

46. A force which varies with position coordinate x according to equation $F_x = (4x \times 2)N$. Here x is the meters. Calculate work done by this force in carrying a particle from position $x_1 = 1m$ to $x_2 = 2m$.

47. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2\ s^{-1}$. The measurement of A has on error of 1.25%. If the error in the measurement of time is 1.5C % the percentage error in the value of $E(t)$ at $t = 5s$ is …..

48. A boat, which has a speed of 5 km/hr in still water, crosses a river of width 1 km along the shortest possible path is 15 minutes. The velocity of the river water (in km/hr) is.

49. A block of mass 2 kg rests on a rough inclined plane making an angle of 30^0 with the horizontal. The coefficient of static friction between the block and the plane is 0.7. The frictional force on the block is

50. The period of a particle executing shm is 2π. The total energy of the particle is 0.0786J. After a time $\pi/4s$ the displacement is 0.2m. Calculate the mass of the particle (in kg)

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) 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.

CHEMISTRY

SYLLABUS: **Transition Elements (3d series), Qualitative Analysis, f Block, Metallurgy, IA & IIA Group Elements Group-13, 15, 16, 17 Elements, Hydrogen & Its compounds**

51. The correct order of hydration enthalpies of alkali metal ions is

A) $Li^+ > Na^+ > K^+ > Cs^+ > Rb^+$ B) $Na^+ > Li^+ > K^+ > Rb^+ > Cs^+$

C) $Na^+ > Li^+ > K^+ > Cs^+ > Rb^+$ D) $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

52. What is reason of temporary hardness of water?

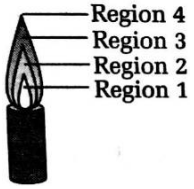
A) Na_2SO_4 B) $CaCl_2$ C) $NaCl$ D) $Ca(HCO_3)_2$

53. The isotopes of hydrogen are

A) deuterium and tritium only B) protium and deuterium only

C) protium, deuterium and tritium D) tritium and protium only

54. The hottest region of Bunsen flame shown in the figure given below is



A) region 2 B) region 3 C) region 4 D) region 1

55. The correct sequence of thermal stability of the following carbonates is

A) $BaCO_3 < CaCO_3 < SrCO_3 < MgCO_3$ B) $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

C) $MgCO_3 < SrCO_3 < CaCO_3 < BaCO_3$ D) $BaCO_3 < SrCO_3 < CaCO_3 < MrCO_3$

56. The structures of beryllium chloride in the solid state and vapour phase, respectively are

A) dimeric and dimeric B) chain and chain C) dimeric and chain D) chain and dimeric

57. Diborate (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively.

A) B_2O_3 and H_3BO_3 B) B_2O_3 and $[BH_4]^-$ C) H_3BO_3 and B_2O_3 D) HBO_2 and H_3BO_3

58. The relative stability of +1 oxidation state of group 13 elements follows the order

A) $Al < Ga < Tl < In$ B) $Al < Ga < In < Tl$ C) $Tl < In < Ga < Al$ D) $Ga < Al < In < Tl$

59. The number of 2-centre-2-electron and 3-centre-2-electron bonds in

A) 4 and 2 B) 2 and 4 C) 2 and 2 D) 2 and 1

60. Moderate electrical conductivity is shown by

A) silica B) graphite C) diamond D) None of these

61. The correct statement among the following is

A) $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$.

B) $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$.

C) $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$.

D) $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$.

62. The correct order of the oxidation states of nitrogen in NO, NO_2, NO_2 and N_2O_3 is

A) $NO_2 < NO < N_2O_3 < N_2O$ B) $N_2O < NO < N_2O_3 < NO_2$

C) $O_2 < N_2O_3 < NO < N_2O$ D) $N_2O < N_2O_3 < NO < NO_2$

63. The correct order of acidic strength is

A) $Cl_2O_7 > SO_2 > P_4O_{10}$ B) $CO_2 > N_2O_5 > SO_3$

C) $Na_2O > MgO > Al_2O_3$ D) $K_2O > CaO > MgO$

64. The number of P-O-P bonds in cyclic metaposphoric acid is

A) zero B) two C) three D) four

65. The highest possible oxidation states of uranium and plutonium, respectively, are

A) 7 and 6 B) 6 and 7 C) 6 and 4 D) 4 and 6

66. Consider the hydrated ions of Ti^{2+}, V^{2+}, Ti^{3+} and Sc^{3+}. The correct order of their spin-only magnetic moment is

A) $Sc^{3+} < Ti^{3+} < Ti^{2+} < V^{2+}$ B) $Sc^{3+} < Ti^{3+} < V^{2+} < Ti^{2+}$

C) $Ti^{3+} < Ti^{2+} < Sc^{3+} < V^{2+}$ D) $V^{2+} < Ti^{2+} < Ti^{3+} < Sc^{3+}$

67. The element that usually does not show variable oxidation states is

A) Sc B) Cu C) Ti D) V

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

A) $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$: paramagnetic behavior

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

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

D) $Sc < Ti < Cr < Mn$: number of oxidation states

69. When MnO_2 is fused with KOH, a coloured compound is formed, the product and its colour is

A) K_2MnO_4, purple green B) K_2MnO_4, purple C) Mn_2O_3, brown D) Mn_3O_4, black

70. In the dichromate dianion

A) 4 Cr-O bonds are equivalent B) 6 Cr-O bonds are equivalent

C) all Cr-O bonds are equivalent D) all Cr-O bonds are non-equivalent

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 in all other cases.

71. **How many unpaired electrons are present in** Ni^{2+} **?**

72. **Reaction of** Br_2 **with** Na_2CO_3 **in aqueous solution gives sodium bromide and sodium bromated with evolution of** CO_2 **gas. The number of sodium bromide molecules involved in the balanced chemical equation is _____**

73. **In neutral or faintly alkaline solution, 8 moles of permanganate anion quantitative oxidize thiosulphate anions to produce X moles of a sulphur containing product. The magnitude of X is _____**

74. **In dilute aqueous** H_2SO_4 **the complex diaquadioxalatoferrate (II) is oxidized by** MnO_4^-**. For this reaction, the ratio of the rate of change of** $\left[H^+\right]$ **to the rate of change of** $\left[MnO_4^-\right]$ **is _____**

75. **Consider the following list of reagents, acidified** $K_2Cr_2O_7$**, alkaline** $KMnO_4, CuSO_4, H_2O_2, Cl_2, O_3, FeCl_3, HNO_3$ **and** $Na_2S_2O_3$**. The total number of reagents that can oxidize aqueous iodide to iodine is _____**

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MELUHA INTERNATIONAL SCHOOL
HYDERABAD

SECTION:: Outgoing Senior | **JEE MAINS UNIT TEST-08** | **Date: 29-06-2020**
Time: 3 Hours | **Max. Marks: 300 M**

KEY SHEET

MATHEMATICS

1) **C**	2) **A**	3) **C**	4) **A**	5) **C**	6) **D**	7) **B**	8) **C**	9) **D**	10) **B**
11) **A**	12) **B**	13) **A**	14) **C**	15) **D**	16) **D**	17) **B**	18) **A**	19) **A**	20) **C**
21) **2454**	22) **8**	23) **54**	24) **30**	25) **51**					

PHYSICS

26) **D**	27) **B**	28) **B**	29) **C**	30) **D**	31) **A**	32) **A**	33) **A**	34) **B**	35) **C**
36) **C**	37) **B**	38) **A**	39) **D**	40) **B**	41) **A**	42) **A**	43) **A**	44) **B**	45) **D**
46) **8**	47) **4**	48) **3**	49) **9.8**	50) **1.96**					

CHEMISTRY

51) **D**	52) **D**	53) **C**	54) **A**	55) **B**	56) **C**	57) **A**	58) **B**	59) **A**	60) **B**
61) **A**	62) **B**	63) **A**	64) **C**	65) **B**	66) **A**	67) **A**	68) **A**	69) **A**	70) **B**
71) **2**	72) **5**	73) **6**	74) **8**	75) **7**					

HINTS & SOLUTIONS

MATHEMATICS

1.

Paper Setters:

SNO	Subject	Name of the Paper Setter	Phone No	Branch
1	MATHS-A	YOUSUF SIR	7989310135	CO ICC
3	PHYSICS	MANOHAR SIR	9666014357	CO ICC
4	CHEMISTRY	KATAMAIAH SIR	9948729934	CO ICC

Paper Verifiers:

SNO	Subject	Name of the Paper Verifier	Phone No	Branch
1				
2				
3				
4				

MATHS

1. $\tan^2(k+1)-\sqrt{2}\lambda\tan x+(k-1)=0$

$$\left.\begin{aligned}\tan\alpha+\tan\beta&=\frac{\sqrt{2}\lambda}{k+1}\\ \tan\alpha\tan\beta&=\frac{k-1}{k+1}\end{aligned}\right\}\tan^2(\alpha+\beta)=50$$

$$\Rightarrow\left(\frac{\frac{\sqrt{2}\lambda}{k+1}}{1-\frac{k-1}{k+1}}\right)=50\Rightarrow\lambda^2=100\Rightarrow\boxed{\lambda=10}$$

2. Let $x^2-x-1=0;\ p_k=\alpha^k+\beta^k;\ k\geq1$

$\Rightarrow\alpha+\beta=1,\alpha\beta=-1\Rightarrow\alpha^k-\alpha^{k-1}-\alpha^{k-2}=0$

$\Rightarrow\beta^k-\beta^{k-1}-\beta^{k-2}=0$

$\Rightarrow\alpha^k+\beta^k=\alpha^{k-1}+\beta^{k-1}+\alpha^{k-2}+\beta^{k-2}$

$\Rightarrow p_k=p_{k-1}+p_{k-2}$

$\Rightarrow$ Let $k=1\Rightarrow p_1=\alpha+\beta=1$

$\Rightarrow$ Let $k=2\Rightarrow p_2=\alpha^2+\beta^2=(\alpha+\beta)^2-2(\alpha\beta)$

$\Rightarrow$ Let $k=3\Rightarrow p_3=\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)=4$

$\Rightarrow p_4=p_3+p_2=4+3=7$

$\Rightarrow p_5=p_4+p_3=7+4=11$

3. Let $x^2-6x-2=0\Rightarrow a_n=\alpha^n-\beta^n;n\geq1$

$\Rightarrow a_{10}-2a_8=\alpha^{10}-\beta^{10}-2\left(\alpha^8-\beta^8\right)$

$\Rightarrow a_{10}-2a_8=\alpha^8\left(\alpha^2-2\right)-\beta^8\left(\beta^2-2\right)$

$=\alpha^8(6\alpha)-\beta^8(6\beta)$

$=6a_9=(2a_9)_3$

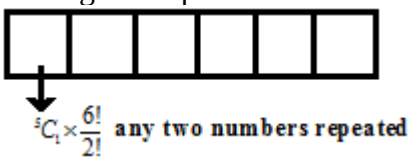
4. Let $x+\frac{1}{x}=t\Rightarrow2\left(t^2-2\right)-7t+9=0$

$\Rightarrow2t^2-7t+5=0$

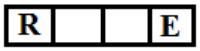
$\Rightarrow t=1,\frac{5}{2}\Rightarrow$ if $t=\frac{5}{2}\Rightarrow x$

$\Rightarrow\boxed{x=2}$

5. Solve given equations.

6. 

7. M, EEE, D, I, T, R, R, AA, NN



$\Rightarrow$ Two empty places, can be filled with identical letters $\{EE,AA,NN\}\Rightarrow3.$ ways

$\Rightarrow$ Two empty places, can be filled with distinct letters $\{M,E,D,I,T,R,A,N\}={}^8P_2$

No. of words $=3+{}^8P_2=59$

8. $x_1+x_2+.....+x_8=30$

$\Rightarrow(y_1+2)+(y_2+2)+....+(y_8+2)=30$

$\Rightarrow y_1 + y_2 + ... + y_8 = 30 - 16 = 14$

each $y_1 \geq 0$

No. of solution $= {}^{(n+r-1)}C_{r-1}$

$= 14 + = {}^{8-1}C_{8-1} = {}^{21}C_7$

9. Selection of 3 elements in A such that $f(x) = y_2 = {}^7C_3$

Now for remaining 4 elements in A we have 2 elements in B

$\therefore$ total no of functions

$= {}^7C_3 \times \left(2^4 - {}^2C_1(2-1)^4\right) = {}^7C_3 \times 14$

10. $(1+x)^{10} + x(1+x)^9 + x^2(1+x)^8 + ... + x^{10}$

GP

$r = x(1+x)^{-1}$

$$\Rightarrow S = \frac{(1+x)^{10}}{1 - \frac{x}{1+x}} = \frac{(1+x)^{10}\left(1 - \frac{x^{11}}{(1+x)^{11}}\right)}{\frac{1+x-x}{1+x}}$$

$$\Rightarrow \frac{(1+x)^{10}\left((1+x)^{11} - x^{11}\right)}{(1+x)^{11}} \times (1+x) = (1+x)^{11} - x^{11}$$

Coefficient of

$x^7 = {}^{11}C_7 = {}^{11}C_4 = \frac{11 \times 10 \times 9 \times 8}{4 \times 3 \times 2}$

11. $T_{r+1} = {}^{10}C_r \left(\sqrt{2}\right)^{10-r} \left(3\frac{1}{5}\right)^r ; r = 0, 10$

$\Rightarrow T_1 + T_{11} = {}^{10}C_0 \left(\sqrt{2}\right)^{10} \left(3\frac{1}{5}\right)^0 + {}^{10}C_{10} \left(\sqrt{2}\right)^{10-10} \left(3\frac{1}{5}\right)^{10}$

$= 32 + 9 = 41$

12. $\left(x^{1/3} + 1 - \frac{\sqrt{x}+1}{\sqrt{x}}\right)^{10} = \left(x^{1/3} - \frac{1}{\sqrt{x}}\right)^{10}$

$$\Rightarrow r = \frac{10 \times \frac{1}{3}}{\frac{1}{2} \times \frac{1}{3}} = 4 \Rightarrow T_5 = {}^{10}C_4 = 210$$

13. $\left(1 + \frac{2x}{3} \cdot \frac{3}{2} + ...\right)\left(\frac{1}{2}\right)\left(1 - \frac{5x}{32} \cdot \frac{1}{5} + ...\right)$

$$\Rightarrow \frac{1}{2}\left(1 + x - \frac{x}{32}\right) = \frac{32 + 31x}{64}$$

14. $n = 5, p = \frac{1}{4} \Rightarrow q = \frac{3}{4}$

Given $P(X=0) + P(X=1) + P(X=2)$

$\Rightarrow {}^5C_0 \left(\frac{3}{4}\right)^{5-0} \left(\frac{1}{4}\right)^0 + {}^5C_1 \left(\frac{3}{4}\right)^4 \left(\frac{1}{4}\right)^1 + {}^5C_2 \left(\frac{3}{4}\right)^{5-2} \left(\frac{1}{4}\right)^2$

$$\Rightarrow \left(\frac{3}{4}\right)^5 + 5.\frac{3^4}{4^5} + 10\left(\frac{3}{4}\right)^3 . \frac{1}{4^2}$$

$$\Rightarrow \left(\frac{3}{4}\right)^5 + \frac{5.3^4}{45} + 10\frac{3^3}{4^5}$$

$$\Rightarrow \frac{1}{4^5}\left\{3^5 + 3^4.5 + 10.3^3\right\} = \frac{3^3}{4^5}\{9 + 15 + 10\}$$

$$\Rightarrow \frac{34 \times 27}{4^3.4^2} = \left(\frac{3}{4}\right)^3 . \frac{34}{16} = \frac{17}{8}\left(\frac{3}{4}\right)^3$$

$k = \frac{17}{8}$

15. $AA + ABA + BAA + ABBA + BBAA + BABA$

$= \frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} = \frac{11}{16}$

16. $\sum p_i = 1 \Rightarrow 6k^2 + 5k = 1$

$\Rightarrow 6k^2 + 5k - 1 = 0$

$\Rightarrow 6k^2 + 6k - k - t = 0$

$\Rightarrow (6k-1)(k+1) = 0 \Rightarrow k = -1$

rejected $\therefore k = \frac{1}{6}$

$\Rightarrow p(x > 2) = k + 2k + 5k^2 = \frac{1}{6} + \frac{2}{6} + \frac{5}{36}$

$= \frac{6+12+5}{36} = \frac{23}{36}$

17.

k	0	1	2	3	4	5
$p(k)$	$\frac{1}{32}$	$\frac{12}{32}$	$\frac{11}{32}$	$\frac{5}{32}$	$\frac{2}{32}$	$\frac{1}{32}$

$k =$ consecutive heads occur

expected value $= \sum xp(pk)$

$= -\frac{1}{32} - \frac{12}{32} - \frac{11}{32} + \frac{15}{32} + \frac{8}{32} + \frac{5}{32}$

$= \frac{28-24}{32} = \frac{1}{8}$

18. $P\left(\overline{A \cup B}\right) = \frac{1}{6}; P(A \cup B) = \frac{5}{6}$

$\Rightarrow P(\bar{A}) = \frac{1}{4}; P(A) = \frac{3}{4}$

$\Rightarrow \frac{5}{6} = P(A) + P(B) - P(A \cap B)$

$\Rightarrow P(B) = \frac{1}{3}$

$\Rightarrow P(A \cap B) = P(A) \times P(B)$

19. $\frac{x_1 + x_2 + ... + x_{10}}{10} = 200 \Rightarrow \sum_{i=1}^{10} x_i = 200$

Given

$$\frac{px_1+px_2+...+px_{10}-100}{10}=\frac{1}{2}\times 20$$

$\Rightarrow 20p-q=10$ and $\sigma_1=2,\sigma_2=|p|\sigma_1$

$\Rightarrow p=\pm 1,2$

$\Rightarrow$ if $p=\frac{1}{2}\Rightarrow q=0$

$\Rightarrow$ if $p=-\frac{1}{2}\Rightarrow \boxed{q=-20}$

20.

21. EXAMINATION

$N-2, A-2, I-2, E, X, M, T, O \to 1$

Category	Selection	Arrangement
1)2 alike one kind and 2 alike of other kind	${}^3C_2=3$	$3\times\frac{4!}{2!2!}=18$
2)2 alike and 2 different	${}^3C_1={}^7C_2$	${}^3C_1\times{}^7C_2\times\frac{4!}{2!}=756$
3)All are 4 Different	${}^8C_4$	${}^8C_4\times 4!=1680$

$\therefore$ no.of 4 letters words $=1680+756+18=2454$

22. $2x^2+(a-10)x+\frac{33}{2}-2a=0$

$\Rightarrow D\geq 0\Rightarrow (a-10)^2-4\times 2\left(\frac{33}{2}-2a\right)\geq 0$

$\Rightarrow a^2+100-20a-4\times 33+16a\geq 0$

$\Rightarrow a^2-4a-32\geq 0\Rightarrow a\in(-\infty,4]\cup[8,\infty)$

$\therefore$ Least positive value =8.

23. $\bar{x}=\frac{3+7+9+12+13+20+x+y}{8}=10$

$\Rightarrow x+y=80+64=16$

$\Rightarrow x+y=16 \Rightarrow \sum x_i^2=125\times 8=1000$

$\frac{\sum x_i^2}{8}-100=25$

$\Rightarrow 3^2+7^2+9^2+12^2+13^2+20^2+x^2+y^2=1000$

$\Rightarrow x^2+y^2=113$

$\Rightarrow xy=54$

24. $(1+x+x^2+...+x^{2n})\ (1-x+x^2-x^3...+x^{2n})$

$\Rightarrow$ Let $(1+x+x^2+...+x^{2n})$

$(1-x-x^2+x^3...+x^{2n})$

$=a_0+a_1x+a_2x^2+...+a_nx^n$

Let $x=1$

$(2n+1)=a_0+a_1+a_2+....a_n\to(1)$

Let $x=-1$

$(1)(2n+1)=a_0-a_1+a_2-a_3+...+a_n(-1)^n\to(2)$

$(1)+(2)$

$2(2n+1)=2\{a_0+a_2+a_4+...+a_n\}$

$\Rightarrow 2n+1=61\Rightarrow \boxed{n=30}$

25. $\sum_{r=0}^{25}(4r+1)^{25}C_r=4\sum_{r=0}^{25}r.{}^{25}C_r+\sum_{r=0}^{25}{}^{25}C_r$

$=4\sum_{r=1}^{25}r\times\frac{25}{r}{}^{25}C_{r-1}+2^{25}$

$=100\sum_{r=1}^{25}{}^{24}C_{r-1}+2^{25}$

$=100\ 2^{24}+2^{25}=2^{25}(51)$

$\therefore \boxed{k=51}$

PHYSICS

26. $u=20\ ms^{-1}$

$v=0$

$f=\mu mg\cos\theta$

$mg\sin\theta+f=ma$

$mg\sin\theta+\mu mg\cos\theta=ma$

$\frac{30}{5}+0.5\times 10\times\frac{4}{5}=a$

$6+4=a$

$a=10\,ms^{-2}$

$v^2-u^2=2as$

$0-20^2=2\times(-10)\times s$

$s=20\,m$

27. $\because\frac{T_{max}}{T_{min}}=4\ \therefore\frac{\frac{mv_l^2}{l}+mg}{\frac{mv_p^2}{l}-mg}=4$

$\Rightarrow \frac{v_l^2+g\ell}{v_p^2-g\ell}=4$

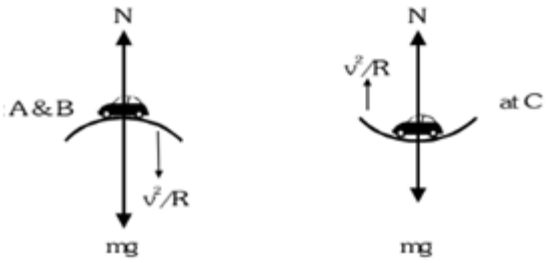
We know $v_l^2=v_p^2+4g\ell \Rightarrow \frac{v_p^2+5g\ell}{v_p^2-g\ell}=4 \Rightarrow 3v_p^2=9g\ell$

$\Rightarrow v_p=\sqrt{3g\ell}=\sqrt{3\times 10\times\frac{10}{3}}=10\ ms^{-1}$

$\Rightarrow v_l=\sqrt{7g\ell}=\sqrt{7\times 10\times\frac{10}{3}}=15.2\ ms^{-1}$

28. Work done by conservative force

$= -\Delta U$ = positive $\Rightarrow \Delta U\downarrow$

29. 

At A & B, $N = mg - mv^2/R$ & at C, $N = mg + mv^2/R$ $\therefore f_{max} = \mu_s N \rightarrow$ maximum for C

30. The value of uncertain digit in recorded measurement should be equal to the least count 0.001 cm. Thus, (D) is correct.

31. Young's modulus is given by $Y = \dfrac{4Fl}{\pi d^2 l}$

$$= \frac{4(50)110.0}{3.14(0.050)^2(0.125)}$$
$$= 2.24 \times 10^7 \text{ N/cm}^2$$
$$= 2.24 \times 10^{11} \text{ N/m}^2$$

32. Conceptual

33. Trajectory equation is $y = ax - bx^2$. The slope of the trajectory is zero at maximum height i.e., $\dfrac{dy}{dx} = a - 2bx = 0.$

Solve above equation to get $x = a/(2b)$. Substitute it in the given trajectory equation to get the maximum height, $y_{\max} = a\left(\dfrac{a}{2b}\right) - b\left(\dfrac{a}{2b}\right)^2 = \dfrac{a^2}{4b}.$

The slope of trajectory at the projection point is given by, $\tan\theta = \left.\dfrac{dy}{dx}\right|_{x=0} = a - 2b(0) = a.$

Thus, the angle of projection is

34. From the graph, slope = (da / at) = (5 / 10) = (1/2)

i.e. da = (dt / 2)

integrating both sides

$\int$ da = $\int$ (dt / 2)

a = (t/2) + c

at t = 0, a = 0 hence 0 = o + c

i.e. c = 0

$\therefore$ a = (t/2)

i.e. (dv / dt) = (t/2)

i.e. dv = {(t dt) / 2}

integrating both sides,

$\int$ dv = $\int$ {(t • at) / 2}

$\therefore$ v = (1/2) × (t^2 / 2) + c^1

at t = 0, v = 10 m/s -------- given

$\therefore$ 10 = 0 + c^1

i.e. c^1 = 10

hence v = (t^2 / 4) + 10

Now at time t = 10, velocity = v = {(10^2) / 4} + 10

= 25 + 10 therefore v = 35 m/s

35. By substituting given expression in the equation $a = v\,dv/dx$ and rearranging, we have $vdv = -4xdx \Rightarrow \int_2^v vdv = -4\int_0^4 xdx$

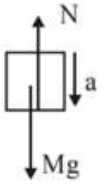
$\Rightarrow v = \pm 2\sqrt{1-x^2} \rightarrow v = 2\sqrt{1-x^2}$

Since the particle the origin with positive velocity of 2 m/s, so the minus sign in the eq. (i) has been dropped.

By substituting above obtained expression of velocity in the equation v = dx/dt and rearranging, we have

$$\frac{dx}{\sqrt{1-x^2}} = 2dt \Rightarrow \int_0^x \frac{dx}{\sqrt{1-x^2}} = 2\int_0^t dt \Rightarrow \sin^{-1}(x) = 2t \rightarrow x = \sin 2t$$

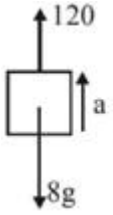
36. FBD of block :



Mg – N = Ma; Now according to question

$$N = \frac{Mg}{10} \text{ so } a = \frac{Mg - \frac{Mg}{10}}{M} = 0.9\ g$$

37. FBD of 8 kg block :



$$a = \frac{120 - 80}{8} = 5 \text{ m/s}^2$$

38. Net force in horizontal direction is more for left block so it will reach the edge of the table first.

39. If $F_1 > F_2$, the system moves towards right so $N_1 < F_1, N_2 < N_1$ & $F_2 < N_2$

$F_2 < N_1$ or $N_2 < F_1$

If $F_1 > F_2$, the system moves towards left so $N_1 < N_2$

If $F = F_3$, the system does not move.

40. Adding $x_3(t)$ brings the mass to complete rest, Thus, $x_1(t)+x_2(t)+x_3(t)=0,$ which gives,

$B\sin(\omega t+\phi)=-A\left[\sin(\omega t)+\sin(\omega t+2\pi/3)\right]$

$=-A\left[2\sin(\omega t+\pi/3)\cos(-\pi/3)\right]$

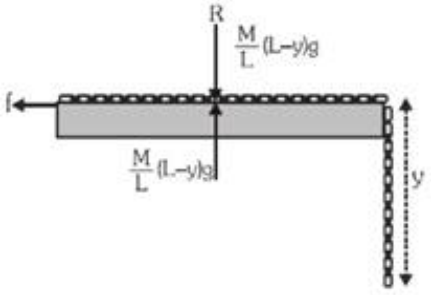
$=-A\sin(\omega t+\pi/3)=A\sin(\omega t+4\pi/3)$

Aliter: The problem can be solved graphically using vector addition. The displacement $x_1(t)$ cab be represented by a vector $v_1=A\angle 0$ and displacement $x_2(t)$ by $v_2=A\angle(2\pi/3)$ (see figure). The resultant of these two is $v'=A\angle(\pi/3)$. The resultant of the three is zero if displacement $x_3(t)$ is $-v=A\angle(4\pi/3)$.

41. Conceptual

42. Let y be the maximum length of the chain that can hang without causing the portion of chain on table to slide.

Length of chain on the table = (L- y)



Weight of part of the chain on table $=\frac{M}{L}(L-y)g$

Weight of hanging part of the chain $=\frac{M}{L}yg$

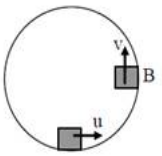
For equilibrium with maximum portion hanging, limiting friction = weight of hanging part of the chain

$\mu\frac{M}{L}(L-y)g\frac{M}{L}yg\Rightarrow y=\frac{\mu L}{1+\mu}$

43. $u^2=5gR$

$\therefore v^2=u^2-2gR$

$=5gR-2gR=3gR$



Centripetal acceleration at B is

$a_C=\frac{v^2}{R}=3g$

Tangential acceleration at B is

$a_t=g$ (downwards)

$\therefore$ Total acceleration will be

$a=\sqrt{a_C^2+a_t^2}=g\sqrt{10}$

44. $a=\sqrt{a_r^2+a_t^2}$

$a_r=\frac{v^2}{r}=\frac{8^2}{8}=8\,m/s^2\Rightarrow a_t=8\,m/s^2$

$\therefore a=8\sqrt{2}\,m/s^2$

45. $a_t=t$

$a_R=\frac{V^2}{R}$

$\int_0^v dV=\int_0^t a_t dt=\int_0^t t\,dt$

$v=\frac{1}{2}t^2$

$a_R=\frac{\left(\frac{1}{2}t^2\right)}{R}=\frac{t^4}{4R}=\frac{2^4}{4\times 1}=4\ m/s^2$

46. Using the equation $W_{i\to f}=\int_{x_1}^{x_f}F_x.dx,$

We have $W_{i\to f}=\int_1^2(4x+2).dx=8J$

47. Differentiate the expression $E(t)=A^2e^{-\alpha t}$ to get $dE=2Ae^{-\alpha t}dA-A^2\alpha e^{-\alpha t}dt.$

Divide above equation by $E(t)$ and simplify to get $\frac{dE}{E}=2\frac{dA}{A}-\alpha dt=2\frac{dA}{A}-\alpha t\frac{dt}{t}.$

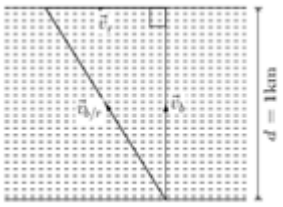
The error in measurement of a parameter x is generally defined by

$x_{\text{actual}}=x_{\text{measured}}\pm\Delta x,$

where Δx is a small positive number representing measurement error. Let ΔA and Δt be the measurement errors (both positives) in A and t. From above equation, dE is maximum when $\Delta A=\Delta A$ and $\Delta t=-\Delta t.$ Thus, the percentage relative error in $E(t)$ is given by

$$\frac{\Delta E}{E} = 2\frac{\Delta A}{A} + \alpha t = 2(1.25\%) + (0.2)(5)(1.5\%) = 4\%.$$

48. The boat crosses the river by the shortest path if it moves perpendicular to the river current (see figure). Let $\vec{v}_b$ and $\vec{v}_r$ be the velocities of the boat and the river current w.r.t. the ground. The velocity of the boat in still water is equal to the relative velocity of the boat w.r.t. water i.e.,



$\vec{v}_{b/r} = \vec{v}_b - \vec{v}_r$,

which gives, $\left|\vec{v}_{b/r}\right|^2 = \left|\vec{v}_b\right|^2 - \left|\vec{v}_r\right|^2$.

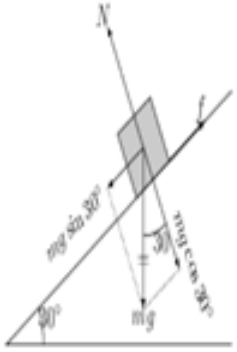
$\left(\because \vec{v}_b \perp \vec{v}_r\right)$.

Given, speed of the boat in still water $\left|\vec{v}_{b/r}\right| = 5$ km/hr and the speed of the boat relative to the ground,

$$\left|\vec{v}_b\right| = \frac{d}{t} = \frac{1}{15/60} = 4 \text{ km/hr.}$$

Substitute $\left|\vec{v}_b\right|$ and $\left|\vec{v}_{b/r}\right|$ to get $\left|\vec{v}_r\right| = 3$ km/hr.

49. The forces on the block of mass m = 2 kg are its weight mg normal reaction N, and the frictional force f (fee figure). The net force on the block is zero because it is at rest. Resolving in the directions parallel and perpendicular to the inclined plane. Apply Newton's second law in these directions to get



$N = mg\cos 30 = (2)(9.8)(0.866) = 16.97\,N,$

$f = mg\sin 30 = (2)(9.8)(0.5) = 9.8N.$

Note that f is less than

$f_{\max} = \mu N = (0.7)(16.97) = 11.88$ N.

50. Total energy $= E = 0.0786\ J$

Period $= T = 2\pi$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{2\pi} = 1 rad/s$$

Displacement after a time $t = \frac{\pi}{4} s$ is $y = 0.2m$

$y = a\sin\omega t$

$$0.2 = a\sin 1 \times \frac{\pi}{4}$$

$$a = \frac{0.2}{\sin\frac{\pi}{4}} = 0.2 \times \sqrt{2} = 0.283 \text{ m}$$

Total energy

$$E = \frac{1}{2}m\omega^2 a^2 = \frac{1}{2} \times m \times 1^2 \times 0.283^2 = 0.04 \text{ m}$$

$$m = \frac{E}{0.04} = \frac{0.0786}{0.04} = 1.96 \text{ kg}$$

CHEMISTRY

51. The correct order of hydration enthalpies of alkali metal ions is $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

52. Temporary hardness of water is due to presence of soluble $Ca(HCO_3)_2$ or $Mg(HCO_3)_2$.

Permanent hardness of water is due to the presence of $CaCl_2$ or $CaSO_4$ or $MgCl_2$ or $MgSO_4$.

Temporary hardness of water is also called carbonate hardness which can be easily removed by boiling or by treatment with $Ca(OH)_2$ (Clark's method).

53. There are three known isotopes of hydrogen, each possessing an atomic number 1 and atomic masses 1,2 and 3 respectively. There are named as protium $\left({}^1H\right)$, deuterium $\left({}^2H \text{ or } D\right)$ and tritium $\left({}^3H \text{ or } T\right)$

The most common isotope is the ordinary hydrogen usually called protium. It consists of one proton in the nucleus and an electron revolving around it.

The second isotope of hydrogen is called heavy hydrogen or deuterium. It consists of one proton and one neutron in the nucleus and an electron revolving around it. The third isotope of hydrogen is called tritium. It consists of one proton and two neutrons in the nucleus and an electron revolving around it.

54. Region 1 (Pre-heating zone)

Region 2 (Primary combustion zone, hottest zone)
Region 3 (Internal zone)
Region 4 (Secondary reaction zone)

55. The correct sequence of thermal stability of carbonates is

$MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

On moving down the group, i.e. from Mg to Ba, atomic radius generally increases. It is due to the addition of shell. As a result, the atomic size increase. CO_3^{2-} is a large anion. Hence, more stabilized by Ba^{2+} (large cation) and less stabilized by Mg^{2+}. Therefore, $BaCO_3$ has highest thermal stability followed by $SrCO_3, CaCO_3$ and $MgCO_3$.

56. The structures of beryllium chloride in the solid state and vapour phase, respectively are dimeric and chain. In vapour phase at above $900^0 C, BeCl_2$ is monomeric having a linear structure Cl-Be-Cl. The bonding in $BeCl_2$ is covalent and Be atom accommodates 2+2=4 electrons in the two sp-hybrid orbitals. Below $900^0 C$, beryllium chloride in vapour phase exists as a mixture of monomer $BeCl_2$ and dimer Be_2Cl_4.

57. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce B_2O_3 and H_3BO_3 respectively. Diborane is a colourless, highly toxic gas, having boiling point 180 K. Because of its inflammable nature, it catches fire spontaneously when exposed to air and burns in oxygen releasing an enormous amount of energy as.

$B_2H_6 + 3O_2 \rightarrow B_2O_3 + 3H_2O + 1976$ kJ/mol

It gets hydrolysed readily o give boric acid.

$$\underset{\text{Borane}}{B_2H_6} + 6H_2O \rightarrow \underset{\text{Orthoboric acid}}{2H_3BO_3} + \underset{\text{Dihydrogen}}{6H_2}\uparrow$$

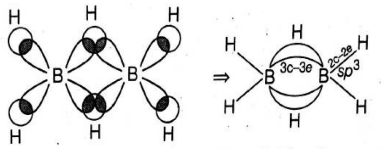
58. The stability order of +3 and +1 oxidation states of group 13 elements will be.

$B^{3+} > Al^{3+} > Ga^{3+} > In^{3+} >> Tl^{3+}$
(order of +3 oxidation state)

$B^{+} << Al^{+} < Ga^{+} < In^{+} < Tl^{+}$
(order of +1 oxidation state)

The presence of two oxidation states in p-block elements is due to the inert pair effect. Because of the presence of poor shielding d and f-orbitals, as we move from Ga to Tl, effective nuclear charge of these elements increases so as to hold the valence ns^2 electrons tightly. It causes difficult to the ionization of ns^2 – electrons and it remains inert, only np^1 – electron ionizes to give +1 oxidation state.

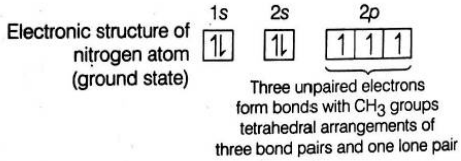
59. The structure of B_2H_6 can be shown as:



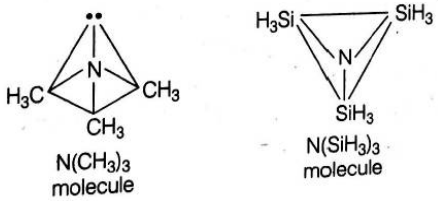
In B_2H_6, four 2-centre-2-electron ($2c-2e$) bonds are present in the same plane and two 3-centre-2-electron ($3c-2e$) bonds are present in another plane.

60. Graphite has layered structure and conducted electricity moderately. Silica and diamond have 3-dimensional network structures and non-conducting.

61. The correct statement is that $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$. The compounds trimethylamine $(CH_3)_3N$ and trisilylamine $(SiH_3)_3N$ have similar formulae, but have totally different structures. In trimethylamine the arrangement of electrons is as follows:



In trisilylamine, three sp^2 orbitals are used for σ-bonding, giving a plane triangular structure.



62. The correct increasing order of oxidation state of nitrogen for nitrogen oxides is

$$\overset{+1}{N_2O} < \overset{+2}{NO} < \overset{+3}{N_2O_3} < \overset{+4}{NO_2}$$

- Oxidation state of N in N_2O is

$$2(x) - 2 = 0$$
$$x = +\frac{2}{2} = +1$$

- Oxidation state of N in NO is

$$x - 2 = 0$$
$$x = +2$$

- Oxidation state of N in N_2O_3 is

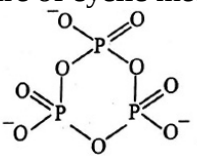
$$2x + 3(-2) = 0$$
$$x = \frac{6}{2} = 3$$

- Oxidation state of N in NO_2 is

$$x + 2(-2) = 0$$
$$x - 4 = 0$$
$$x = +4$$

63. Corresponding acids are $HClO_4, H_2SO_3$ and H_3PO_4. Hence, the order of acidic strength is $Cl_2O_7 > SO_2 > P_4O_{10}$

64. The structure of cyclic metaphosphate is



There is three P—O—P bonds.

65. Actinoids show a variety of oxidation states due to comparable energies of $5f, 6d$ and $7s$ energy levels.
In the actinoids family (5f-block), uranium (U) neptunium (Np), plutonium (Pu) and americium (Am) have highest possible oxidation states of +6,+7,+7 and +6 respectively.

66. The spin only magnetic moment (μ) of each ion can be calculated as :

$$\mu = \sqrt{n(n+2)}\,\text{BM}$$

[$\because n$ = No. of unpaired electron(s)] $\Rightarrow \mu \propto n$, i.e. higher the number of unpaired electron, higher will be the value of μ.

Metal ion	Z	n (for metal ion)	M (BM)	Nature
Ti^{2+}	22	2 $(3d^2)$	$\sqrt{8}$	Paramagnetic
V^{2+}	23	3 $(3d^3)$	$\sqrt{15}$	Paramagnetic
Ti^{3+}	22	1 $(3d^1)$	$\sqrt{3}$	Paramagnetic
Sc^{3+}	21	0 $(3d^0)$	0	Diamagnetic

67. The most stable oxidation states in the compounds of the given transition metals of 3d-series are,
Sc : + 3; Ti : + 3, + 4; V : +2, + 3, + 4, + 5; Cu : + 1, + 2
The electronic configuration of Sc ($Z = 21$) is [Ar] $3d^1, 4s^2$.
Due to the presence of only one $3d$-electron
(no pairing energy) and two $4s$-electrons, they easily ionise to achieve most stable +3 oxidation state.

68. $V^{2+} = 3$ unpaired electrons
$Cr^{2+} = 4$ unpaired electrons
$Mn^{2+} = 5$ unpaired electrons
$Fe^{2+} = 4$ unpaired electrons
Hence, the order of paramagnetic behaviour should be

$$V^{2+} < Cr^{2+} < Fe^{2+} < Mn^{2+}$$

(b) Ionic size decreases from left to right in the same period.
(c) (As per data from NCERT)

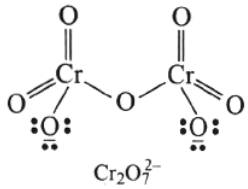
$$Co^{3+}/Co^{2+} = 1.97;$$
$$Fe^{3+}/Fe^{2+} = 0.77;$$
$$Cr^{3+}/Cr^{2+} = -0.41$$

Sc^{3+} is highly stable (It does not show + 2).
(d) The oxidation states increases as we go from group 3 to group 7 in the same period.

69. K_2MnO_4 (purple green) is formed which is the first step of prepration of $KMnO_4$.

$$2MnO_4 + 4KOH + O_2 \rightarrow \underset{\text{Purple geen}}{K_2MnO_4} + 2H_2O$$

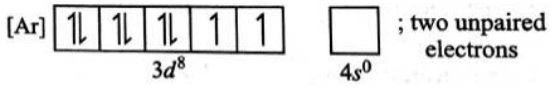
70. The structure of dichromate ion is:



$Cr_2O_7^{2-}$

Exhibit resonance phenomena. Except the bridged Cr-O-Cr, all Cr-O bonds are equivalent

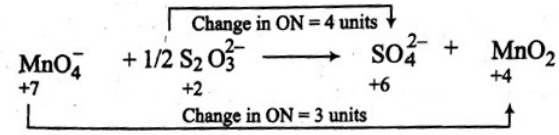
71. The valence shell electronic configuration of Ni^{2+} is



72. Br_2 is disproportionate in basic medium as

$$3Br_2 + 3Na_2CO_3 \longrightarrow 5NaBr + NaBrO_3 + 3CO_2$$

73. In neutral or faintly alkaline solution, MnO_4^- is reduced to MnO_2 and $S_2O_3^{2-}$ is oxidized to SO_4^{2-}.



$$\text{Thus, } 4MnO_4^- + \frac{3}{2}S_2O_3^{2-} \longrightarrow 3SO_4^{2-} + 4MnO_2$$

$$\text{or } 8MnO_4^- + 3S_2O_3^{2-} \longrightarrow 6SO_4^{2-} + 8MnO_2$$

Thus, moles of SO_4^{2-} formed by 8 moles of $MnO_4^- = 6$

74. The balanced redox reaction is

$$MnO_4^- + [Fe(H_2O)_2(C_2O_4)_2]^{2-} + 8H^+ \longrightarrow Mn^{2+} + Fe^{3+} + 4CO_2 + 6H_2O$$

$$\Rightarrow \quad \frac{r[H^+]}{r[MnO_4^-]} = \frac{8}{1} = 8$$

75. Acidified $K_2Cr_2O_7, CuSO_4, H_2O_2, Cl_2, O_3, FeCl_3$ and HNO_3 oxidize aq. Iodide to iodine. Alkaline $KMnO_4$ oxidize aq. Iodide to IO_3^-.