JEE MAIN 2025

Sample Paper - 1

Time Allowed: 3 hours **Maximum Marks: 300**

General Instructions:

1. There are three subjects in the question paper consisting of Physics (Q. no. 1 to 25), Chemistry (Q, no. 26 to 50), and Mathematics (Q. no. 51 to 75).

2. Each subject is divided into two sections. Section A consists of 20 multiple-choice questions & Section B consists of 5 numerical value-type questions.

3. There will be only one correct choice in the given four choices in Section A. For each question for Section A, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero marks will be awarded for not attempted questions.

4. For Section B questions, 4 marks will be awarded for correct answers and zero for unattempted and incorrect answers.

5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.

6. All calculations/written work should be done in the rough sheet is provided with the Question Paper.

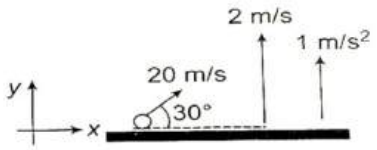
PHYSICS **MAX.MARKS: 100**

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.

1. A very broad elevator platform is going up vertically with a constant acceleration 1 ms^{-2}. At the instant when the velocity of the lift is 2 m/s, a stone is projected from the platform with a speed of 20 m/s relative to the platform at an elevation 30^0. The time taken by the stone to return to the floor will be $(g = 10 m/s^2)$



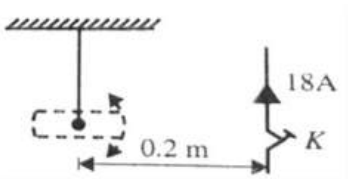
A) $\frac{30}{11}$sec B) $\frac{70}{11}$sec C) $\frac{20}{11}$sec D) $\frac{90}{11}$sec

2. The force exerted by a compression device is given by $F(x) = kx(x-l)$ for $0 \le x \le l$, where l is the maximum possible compression, x is the compression and k is a constant. The work required to compress the body by a distance d will be maximum when:

A) $d = \frac{l}{4}$ B) $d = \frac{l}{\sqrt{2}}$ C) $d = \frac{l}{2}$ D) $d = l$

3. Figure shows a short magnet executing small oscillations in a uniform magnetic field directed into page and magnitude 24 μ T. The period of oscillation is 0.1 s. When the key K is closed, an upward current of 18A is established as shown. The new time period is_____(Neglect the effect of earth's magnetic field)

(Needle oscillates in plane normal to the page)



A) 0.1 s B) 0.2 s C) 0.05 s D) 0.4 s

4. A satellite is moved from one circular orbit around the earth to another of lesser radius. Which of the following statement is true?

A) The kinetic energy of satellite increases and the gravitational potential energy of satellite – earth system increases.

B) The kinetic energy of satellite increases and the gravitational potential energy of satellite – earth system decreases.

C) The kinetic energy of satellite decreases and the gravitational potential energy of satellite – earth system decreases.

D) The kinetic energy of satellite decreases and the gravitational potential energy of satellite – earth system increases.

5. The relation between internal energy U, pressure P and volume V of a gas in an adiabatic process is U = a + bPV.

Where a and b are constant. What is the effective value of adiabatic constant γ?

A) $\frac{a}{b}$ B) $\frac{b+1}{b}$ C) $\frac{a+1}{a}$ D) $\frac{b}{a}$

6. The root mean square speed of the molecules of a diatomic gas is v. when the temperature is doubled, the molecules dissociate into two atoms. The new root mean square speed of the individual atom is

A) $\sqrt{2}v$ B) v C) $2v$ D) $4v$

7. In young's double slit experiment, the two slits are coherent sources of equal amplitude and wave length λ. In another experiment with the same setup, two slits are sources of equal amplitude 'A'and wavelength λ, but are incoherent. The ratio of intensities of light at the midpoint of the screen in the first case to that in second case, is

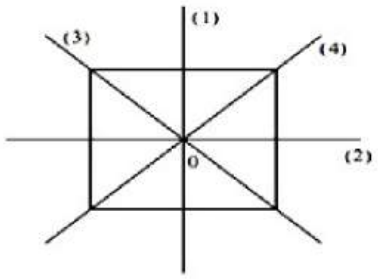
A) 2 : 1 B) 1 : 2 C) 3 : 4 D) 4 : 3

8. The relative error in calculating the value of g from the relation $T = 2\pi\sqrt{\frac{l}{g}}$ is

(given the relative errors in calculating T and l are $\pm x$ and $\pm y$ respectively)

A) $x + y$ B) $2x - y$ C) $2x + y$ D) $x - 2y$

9. I_1, I_2, I_3 and I_4 are the moment of inertial of square plate about the axis marked 1, 2, 3 and 4 respectively and I is the moment of inertia about an axis passing through O and perpendicular to the plate, Relation between them is given as



i) $I = I_1 + I_2$ ii) $I = I_1 + I_3$

iii) $I = I_2 + I_4$ iv) $I = I_1 + I_2 + I_3 + I_4$

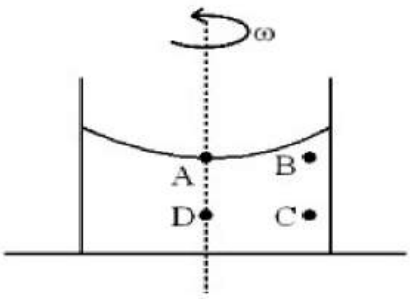
Which of the following options is incorrect?

A) (i) and (iii) B) (ii), (iii) and (iv) C) Only (ii) D) Only (iv)

10. A cylindrical container filled with a liquid is being rotated about its central axis at a constant angular velocity ω. Four points A, B, C and D are chosen in the same plane such that ABCD is a square of side length a and AB is horizontal while BC is vertical. A and D lie on the axis of rotation. Let the pressure at A, B, C and D be denoted by P_A, P_B, P_C and P_D respectively. Now, consider the following two statements.

(i) $P_C > P_A$ for all values of ω (ii) $P_B > P_D$ only if $\omega > \sqrt{\frac{2g}{a}}$

Which of these options is correct?



A) Both (i) and (ii) are correct B) (i) is correct and (ii) is incorrect

C) (ii) is correct and (i) is incorrect D) Both (i) and (ii) are incorrect

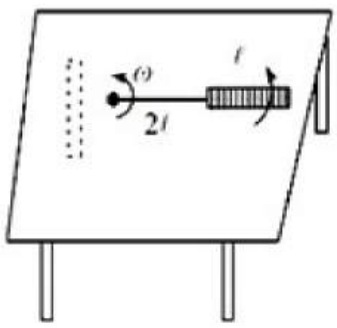
11. Two point dipoles $p\hat{k}$ and $\frac{p}{2}\hat{k}$ are located at (0, 0, 0) and (1 m 0, 2m) respectively. The resultant electric field due to the two dipole at the point (1m, 0, 0) is…

A) $\frac{9p}{32\pi\varepsilon_0}\hat{k}$ B) $-\frac{7p}{32\pi\varepsilon_0}\hat{k}$ C) $\frac{7p}{32\pi\varepsilon_0}\hat{k}$ D) $\frac{11\overline{p}}{32\pi\varepsilon_0}$

12. A electron having kinetic energy T is moving in a circular orbit of radius R perpendicular to a uniform magnetic induction $\vec{B}$ .If kinetic energy is doubled and magnetic induction tripled, the radius will become

A) $\frac{3R}{2}$ B) $\sqrt{\frac{3}{2}}R$ C) $\sqrt{\frac{2}{9}}R$ D) $\sqrt{\frac{4}{3}}R$

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



A) $\frac{3B\omega l^2}{2}$ B) $\frac{4B\omega l^2}{2}$ C) $\frac{5B\omega l^2}{2}$ D) $\frac{2B\omega l^2}{2}$

14. In order to establish an instantaneous displacement current of 1 mA in the space between the plates of 2 μF parallel plate capacitor, the time varying potential difference need to apply is

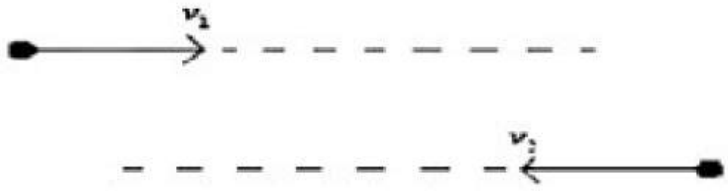
A) 100 Vs^{-1} B) 200 Vs^{-1} C) 300 Vs^{-1} D) 500 Vs^{-1}

15. Light of wavelength 2475 $\overset{0}{A}$ is incident on barium. Photoelectrons emitted describe a circle of maximum radius 100 cm by a magnetic field of flux density $\frac{1}{\sqrt{17}}\times10^{-5}$ Tesla.

Work function of the barium is (nearly (Given $\frac{e}{m}=1.7\times10^{11}$), $hc=12375\left(eV-A^0\right)$

A) 1.8 eV B) 2.1 eV C) 4.5 eV D) 3.3 eV

16. Two positively charged particles are projected along two parallel lines on a smooth horizontal surface as shown. Which of the following statement is incorrect corresponding to their subsequent motion? [Before any collision (except between the particles) takes place]



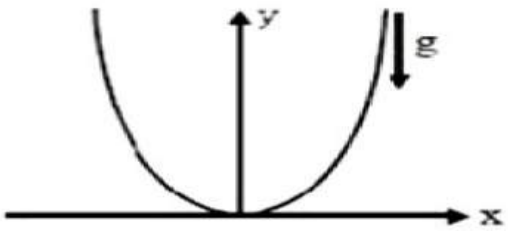
A) The linear momentum of the system of particles is conserved in any direction

B) The angular momentum of the system of particles is conserved about any point in space

C) The angular momentum of each particle is individually conserved about their center of mass

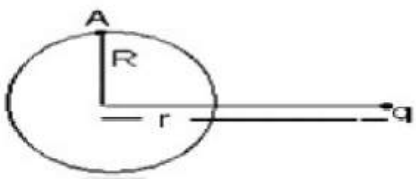
D) The angular momentum of each particle is individually conserved about any point in space

17. A particle of mass 5 x 10^{-5} kg is placed at lowest point of smooth parabola $x^2 = 40y\,(x \text{ and } y \text{ in } m)$. If it is constrained to move along parabola, angular frequency of small oscillations (in rad/s) will be approximately (g=10 m/s^2)



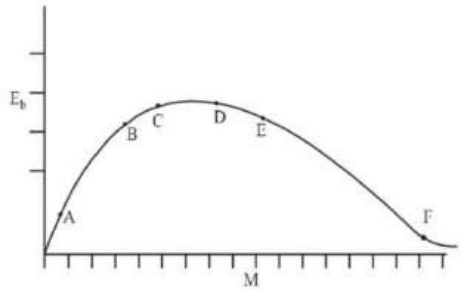
A) $\sqrt{2}$ B) 10 C) $\frac{1}{\sqrt{2}}$ D) 5

18. A point charge q is placed at a distance r from the center of a thin metallic neutral spherical shell of radius R as shown in fig. electric potential at point A is



A) $\frac{1}{4\pi\epsilon_0}\frac{q}{R}$ B) $\frac{1}{4\pi\epsilon_0}\frac{q}{r}$ C) $\frac{1}{4\pi\epsilon_0}\frac{q}{\sqrt{R^2+r^2}}$ D) $\frac{q}{4\pi\epsilon_0}\left(\frac{1}{r}-\frac{1}{R}\right)$

19. There is a plot of binding energy per nucleon E_b, against the nuclear mass M; A, B, C, D, E, F correspond to different nuclei.



Consider four reactions

(i) $A+B \rightarrow C+\varepsilon$ (ii) $C \rightarrow A+B+\varepsilon$ (iii) $D+E \rightarrow F+\varepsilon$ *and* (iv) $F \rightarrow D+E+\varepsilon$

Where ε is the energy released? In which reactions is ε positive?

A) (i) and (iii) B) (ii) and (iv) C) (ii) and (iii) D) (i) and (iv)

20. An R-L-C series circuit with 100 Ω resistance is connected to an AC source of 200 V and $\omega = 300$ rad/s. When only capacitor is removed, the current lags behind voltage by 60^0. When only inductor is removed, the current leads voltage by 60^0. The power dissipated in the R-L-C circuit is

A) 200 W B) 400 W C) 200 $\sqrt{3}$ W D) 100 W

SECTION-II
(NUMERICAL VALUE ANSWER TYPE)

This section contains 5 questions. The answer to each question is a Numerical value. If the Answer in the decimals , **Mark nearest Integer only.**
Marking scheme: +4 for correct answer, -1 in all other cases.

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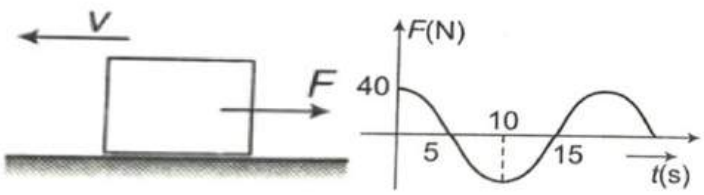
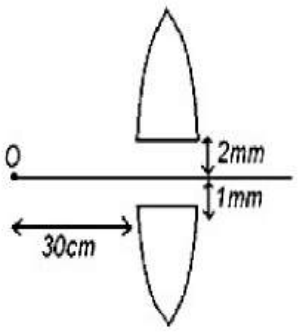
21. A 15 kg block is initially moving along a smooth horizontal surface with a speed of $v = 4\,m/s$ to the left. It is acted by a force F, which varies in the manner shown.
If the velocity of the block at t = 15 seconds is 'X'. Then the value of $[X]$=__

([ ] – greatest integer function)



Given that, $F = 40\cos\left(\frac{\pi}{10}\right)t$

22. A convex lens of focal length f = 20 cm is cut into two equal pieces and the pieces are separated by 3mm as shown in the figure. A point object O is placed at a distance of 30 cm. The distance between the two image points formed will be (in mm)



23. A ball of mass m moving horizontally with a velocity υ strikes the bob of a pendulum at rest. The mass of the bob is also m. If the collision is perfectly inelastic, the height to which the system will rise is given by $h = \frac{v^2}{x.g}$, then the value of x is

24. A copper wire is held at the two ends by rigid supports. At 30^0 C, the wire is just taut, with negligible tension. Find the speed of transverse waves (in m/s) in this wire at 10^0 C in decimeter/second [Given, for copper: Young's modulus = 1.3 x 10^{11} N/m^2, coefficient of linear expansion = 1.7 x 10^{-5}C^{-1}, density = 9 x 10^3 kg/m^3.]

25. In a meter bridge, the wire of length 1 m has a non - uniform cross section such that, the variation $\frac{dR}{dl}$ of its resistance R with length l is $\frac{dR}{dl} \alpha \frac{1}{\sqrt{l}}$. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. The length AP is X (in m), then 100X = …

CHEMISTRY **MAX.MARKS: 100**

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.

26. In which of the following pairs, the hybridization of central atom is same, but shape is not the same?

A) SO_3, CO_3^{2-} B) SO_3^{2-}, NH_3 C) $PCl_5, POCl_3$ D) XeF_2, ClF_3

27. Number of π–bonds in B_2, C_2, N_2 respectively as per molecular orbital theory is :

A) 1,2,3 B) 0,1,2 C) 1,2,2 D) 1,1,2

28. 22.44 kJ of energy is required to convert 8 g of gaseous metal, M to $M^+(g)$. If the first ionisation energy of the metal is 374 kJ/mol, select the incorrect statement from the following.

A) 0.06 moles of gaseous M^+ are formed

B) Same energy can convert all the M^+ to M^{2+}

C) Gram atomic mass of the metal is 133.33 g

D) 3.613×10^{22} atoms of M are converted to M^+

29. Assertion(A):The single N–N bond is weaker than the single P–P bond

Reason(R):High inter electronic repulsion of the non–bonding electrons due to the small N–N bond length

In the light of the above statements, choose the correct answer from the options given below:

A) Both (A) and (R) true but (R) is not the correct explanation of (A)

B) (A) is false but (R) is true.

C) Both (A) and (R) true and (R) is correct explanation of (A).

D) (A) is true but (R) is false.

30. A coordinate complex of formula $CrCl_3.6H_2O$ has green colour. 1L of 0.1 M solution of the complex when treated with excess of $AgNO_3$ gave 28.7g of white precipitate. The formula of the complex would be: [At.wt. Ag : 108 amu; At.wt. of Cl = 35.5 amu]

A) $\left[Cr(H_2O)_6 Cl_3\right]$ B) $\left[CrCl(H_2O)_5\right]Cl_2.H_2O$

C) $\left[CrCl_2(H_2O)_4\right]Cl.2H_2O$ D) $\left[Cr(H_2O)_3 Cl_3\right]$

31. Which type of Isomerism cannot be shown by $\left[Co(en)_2(NO_2)_2\right]Cl$?

A) Geometrical B) Ionisation C) linkage D) hydrate

32. Which of the following does not involve $d \rightarrow d$ transition for causing colour ?

A) $\left[Fe(CN)_6\right]^{-4}$ B) $CuSO_4.5H_2O$ C) $KMnO_4$ D) $CrCl_3.4NH_3$

33. The NH_3 evolved from 0.5 gm of the organic compound in KJeldhal's estimation of Nitrogen neutralizes 10 ml of 1M H_2SO_4. Identify the incorrect statement out of the following.

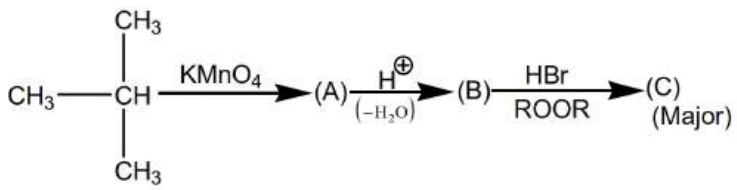
A) Percentage of nitrogen in the organic compound is 56%

B) 20 milli moles of NH_3 is produced

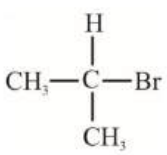
C) 10 milli moles of NH_3 is produced

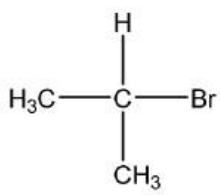
D) if the evolved NH_3 were neutralized by 10 ml of 1M HCl, the % of nitrogen, would have been 28%.

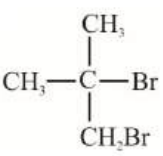
34.

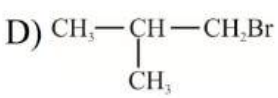


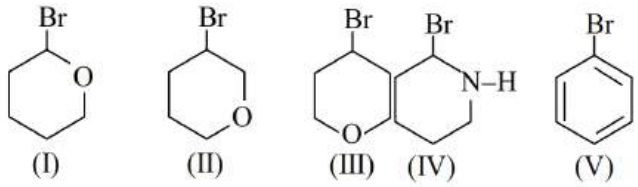
The product "C" in the above reaction formed is

A) 

B) 

C) 

D) 

35. 

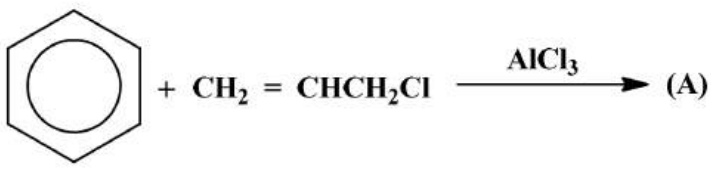
Ease of S_N1 reactions among these compounds upon treatment with aqueous NaOH will be in the order as:

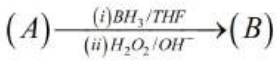
A) (I) > (II) > (III) > (IV) > (V)

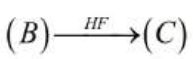
B) (IV) > (I) > (III) > (II) > (V)

C) (I) > (IV) > (III) > (II) > (V)

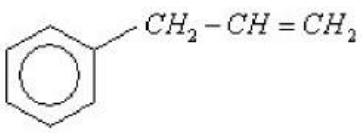
D) (V) > (IV) > (III) > (II) > (I)

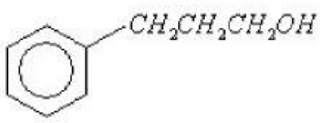
36. 

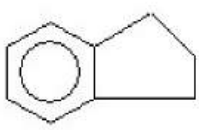


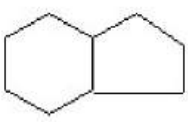


The compound(C) is

A) 

B) 

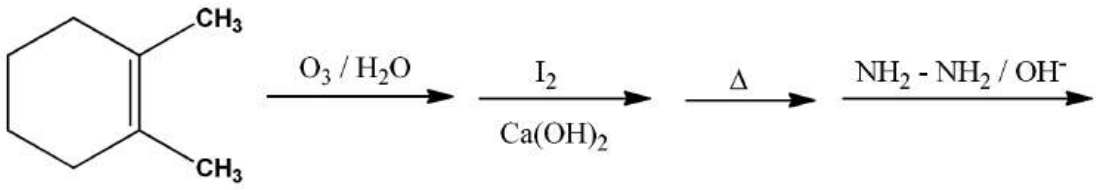
C) 

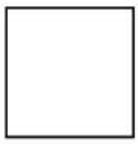
D) 

37. When neopentyl alcohol is heated with an acid, it slowly converted into an 85 : 15 mixture of alkenes A and B, respectively. Then, the ratio between number of hyper conjugated structures for A and B is :

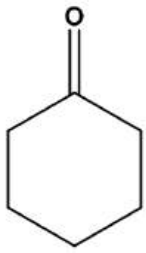
A) 5 : 9 B) 5 : 1 C) 1 : 5 D) 9 : 5

38. End product in the following sequence of reactions is :

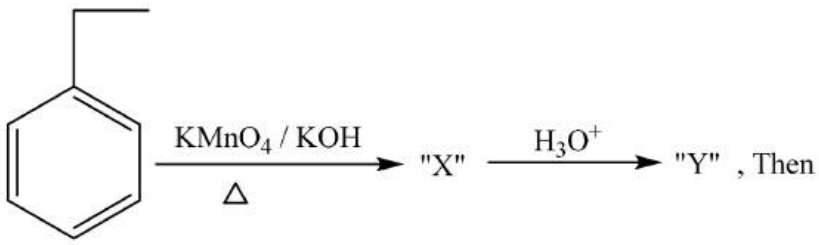


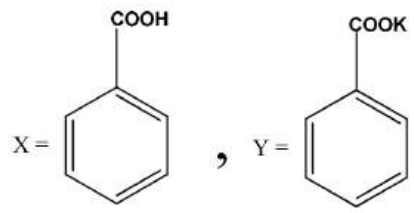
A) 

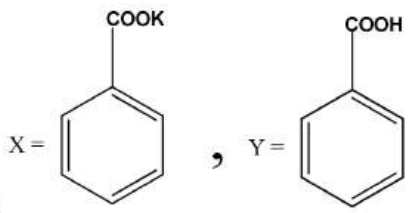
B) 

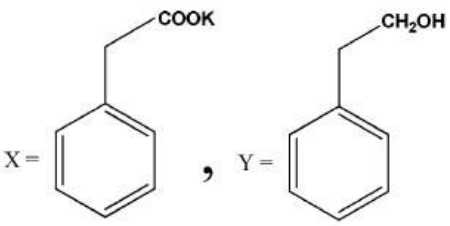
C) 

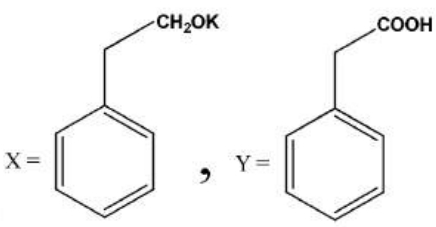
D) 

39. 

A) 

B) 

C) 

D) 

40. Given below are two statements, one is labelled as Assertion (A) and other is labelled as Reason(R):

Assertion (A): Gabriel phthalimide synthesis cannot be used to prepare aromatic primary amines.

Reason (R): Aryl halides do not undergo nucleophilic substitution reaction at room temperature.

In the light of the above statements, choose the correct answer from the options given below:

A) Both (A) and (R) true but (R) is not the correct explanation of (A)

B) (A) is false but (R) is true.

C) Both (A) and (R) true and (R) is correct explanation of (A).

D) (A) is true but (R) is false.

41. Which of the following statement is false?

A) In fibrous proteins, poly peptide chains are held by hydrogen & disulphide bonds.

B) In Globular proteins, chains of polypeptides coil around to give a spherical shape

C) Keratin & myosin are fibrous proteins and soluble in water

D) Insulin & albumin are globular proteins and soluble in water

42. The conductivity of a saturated aq.solution of $AgCl$ at 298 K is found to be $1.382\times10^{-2}\Omega^{-1}m^{-1}$. The ionic conductance of Ag^{+} and Cl^{-} at infinite dilution are $61.9\Omega^{-1}cm^{2}mol^{-1}$ and $76.3\Omega^{-1}cm^{2}mol^{-1}$ respectively. The solubility of $AgCl$ is

A) $1\times10^{-1}mol\,L^{-1}$ B) $1\times10^{-2}mol\,L^{-1}$ C) $1\times10^{-3}mol\,L^{-1}$ D) $1.9\times10^{-5}mol\,L^{-1}$

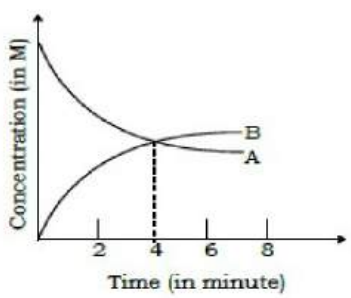
43. 50 g of antifreeze (ethylene glycol) is added to 200 g water. What amount of ice will separate out at $-9.3^{0}C$? $\left(K_f=1.86K\,kg\,mol^{-1}\right)$.

A) 38.71 mg B) 42 g C) 38.71 g D) 42 mg

44. An energy of 24.6eV is required to remove the first electron from helium atom. The energy required to remove both electrons from helium atom is

A) 54.4eV B) 79 eV C) 49.2 eV D) 51.8 eV

45. For the first order reaction $3A\rightarrow B$ concentration varies with time as shown in the adjacent graph. The half – life of the reaction would be



A) 4 minutes B) 2 minutes C) 6 minutes D) 8 minutes

SECTION-II
(NUMERICAL VALUE ANSWER TYPE)

This section contains 5 questions. The answer to each question is a Numerical value. If the Answer in the decimals , **Mark nearest Integer only.**

Marking scheme: +4 for correct answer, -1 in all other cases.

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46. When the ionization energy Vs atomic number is plotted for the elements, of atomic number 11 to 18, two peaks are observed for the element X and Y in between the curve. What is the difference between atomic number of element X and element Y?

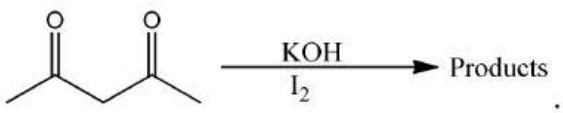
47. For a low spin , Cr^{2+} complex, the value of spin only magnetic moment is x B.M in an octahedral field. Then the value of x^2 is_____

48. The number of compounds among the following more reactive than acetic acid towards decarboxylation by soda-lime is

$HC \equiv CCH_2COOH$, $H_2C = CH - COOH$, $PhCH_2COOH$, CCl_3COOH , Me_3CCOOH

49. How many of the following groups activates benzene ring towards electrophilic aromatic substitution?

$-NHCOR$, $-OCOR$, $-\overset{\overset{O}{\|}}{C}-O-R$, $-NR_2$, $-NH_2$, $-OH$, $-OR$

50. 

The number of iodoform molecules produced per molecule of the reactant in above reaction is _____

MATHEMATICS **MAX.MARKS: 100**

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.

51. If 'α' is a complex number satisfying the relation $|\alpha-1|=\alpha-3(1+i)$. Then α equals to

A) $-\frac{1}{4}+3i$ B) $\frac{1}{4}+3i$

C) $\frac{1}{4}-3i$ D) No such complex number exists

52. The greatest integral value of k such that both the roots of the equation $(k-5)x^2-2kx+(k-4)=0$ are positive, one root is less than 2 and the other root lies between 2 and 3 is

A) 13 B) 14 C) 23 D) 24

53. Let matrix $A=\begin{pmatrix}3 & 1\\ -6 & -2\end{pmatrix}$ then $(I+A)^{99}$ (where I is a unit matrix of order 2) equals to

A) $I+2^{98}A$ B) $I+2^{99}A$ C) $I+\left(2^{99}+1\right)A$ D) $I+\left(2^{99}-1\right)A$

54. In a bag there are three tickets with number 1, 2, 3. A ticket is drawn at random and the number is noted and put back in the bag, this is repeated for four times. Then the chance that the sum of those numbers is even is

A) $\frac{39}{81}$ B) $\frac{40}{81}$ C) $\frac{41}{81}$ D) $\frac{42}{81}$

55. If $g(y)=y^5+2y^3+3y+4$, then the value of $28\frac{d}{dy}\left(g^{-1}(y)\right)$ at $y=-2$ is

A) -2 B) 1 C) $\frac{1}{14}$ D) 2

56. Given lines $\frac{x-4}{2}=\frac{y+5}{4}=\frac{z-1}{-3}$, $\frac{x-2}{1}=\frac{y+1}{3}=\frac{z}{2}$

S1: The lines are intersecting

S2: The lines are not parallel

A) Both S1 and S2 are true B) S1 is true and S2 are false

C) S1 is false and S2 is true D) Both S1 and S2 are false

57. $\int\left(\sqrt{\frac{\cos\theta}{\theta}}-\sqrt{\frac{\theta}{\cos\theta}}.\sin\theta\right)d\theta=$

A) $\sqrt{\theta.\sin\theta}+c$ B) $-\sqrt{\theta.\cos\theta}+c$ C) $2\sqrt{\theta.\cos\theta}+c$ D) $c-2\sqrt{\theta.\cos\theta}$

58. $\lim\limits_{\theta\to 0}\frac{\int_0^{\theta}\frac{x^2}{\sqrt{k+x}}dx}{(\theta-\sin\theta)}=1$ where $k>0$ then the value of 'k' is

A) $\frac{1}{2}$ B) $\frac{1}{4}$ C) 2 D) 4

59. The solution of the differential equation $\frac{dy}{dt}=\frac{\tan y}{(1+t)}+(1+t)\,e^t\sec y$ is, where 'c' is an arbitrary constant

A) $\cos y=\left(e^t+c\right)(t+1)$ B) $\cos y=\left(e^t-c\right)(x-1)$

C) $\sin y=\left(e^t+c\right)(t-1)$ D) $\sin y=\left(e^t+c\right)(t+1)$

60. The minimum value of k for which the quadratic equation

$\left(\cot^{-1}k\right)y^2-\left(\tan^{-1}k\right)^{3/2}y+2\left(\cot^{-1}k\right)^2=0$ has both positive roots is: $(k\in I)$

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

61. If $\alpha^3+\beta^6=2$ then the maximum value of the independent term of x in the expansion of $\left(\alpha x^{1/3}+\beta x^{-1/6}\right)^9\ (\alpha>0,\ \beta>0)$ is

A) 42 B) 68 C) 84 D) 148

62. The set of critical points of the function $g(x)=(x-2)^{2/3}\,(2x+1)$ is

A) $\{1\}$ B) $\{1,2\}$ C) $\{-1,2\}$ D) $\left\{\frac{-1}{2},1\right\}$

63. The mean and variance of the marks obtained by the students in a test are 10 and 4 respectively. It is known that one of the students got '12' instead of 8. If the new mean of the marks is 10.2 then the new variance is equal to

A) 4.04 B) 4.08 C) 3.96 D) 3.92

64. The area enclosed between the curves $y = x^2$ and $y = \sqrt{|x|}$ is

A) $\frac{1}{3}$ B) $\frac{2}{3}$ C) $\frac{4}{3}$ D) 2

65. Statement 1: $f(x) = |x| \sin x$ is differentiable at $x = 0$

Statement 2: If $f(x)$ is not differentiable and $g(x)$ is differentiable at $x = a$, then $f(x).g(x)$ can still be differentiable at $x = a$

A) Statement 1 is true, Statement 2 is true

B) Statement 1 is true, Statement 2 is false

C) Statement 1 is false and Statement 2 is true

D) Statement 1 is false and Statement 2 is false

66. If $f(\alpha) = \begin{cases} 1 & ; \ \alpha = \pi/2 \\ \dfrac{\sin\{\cos\alpha\}}{(\alpha - \pi/2)} & ; \ \alpha \neq \pi/2 \end{cases}$, where $\{.\}$ represents fractional part function, then

A) $f(\alpha)$ is continuous at $\alpha = \pi/2$

B) $\lim\limits_{\alpha \to \pi/2} f(\alpha)$ exists but not continuous at $\alpha = \pi/2$

C) $\lim\limits_{\alpha \to \pi/2} f(\alpha)$ does not exist

D) $\lim\limits_{\alpha \to \pi/2} f(\alpha) = 1$

67. Match the following

Column – I	Column – II
A) $g(x) = 2 - x^{1/3}$ and $f(g(x)) = -x + 5x^{1/3} - x^{2/3}$, the local maximum value of f(x) is	P) 0
B) No. of points of intersection of the curves $\arg\left(\frac{z-3}{z-1}\right) = \frac{\pi}{4}$ and $z(1-i) + \bar{z}(1+i) - 4 = 0$	Q) 1
C) If $f(x) = ax^3 + bx^2 + cx + d$, $(a, b, c, d \in Q)$ and two roots of $f(x)=0$ are eccentricities of a parabola and a rectangular hyperbola, then $a + b + c + d =$	R) 2
D) Number of solution of equation $1^x + 2^x + 3^x \ldots + n^x = (n+1)^x$ are	S) 3

A) A – Q ; B – S ; C – R ; D – P B) A – S ; B – Q ; C – P ; D – Q

C) A – S ; B – Q ; C – R ; D – Q D) A – S ; B – Q ; C – P ; D – R

68. The value of $[100(k-1)]$ where $[x]$ represents the G.I.F. and $k=\dfrac{\sum_{r=1}^{44^0}\cos r^o}{\sum_{r=1}^{44^0}\sin r^o}$ is

A) 144 B) 142 C) 141 D) 140

69. The sum of possible integral values of k for which the point P(0, k) lies on or inside the triangle formed by the lines $y+3x+2=0, 3y-2x-5=0$ and $4y+x-14=0$ is

A) 4 B) 5 C) 6 D) 7

70. The acute angle between the lines $\dfrac{x-1}{a}=\dfrac{y+1}{b}=\dfrac{z}{c}$ and $\dfrac{x+1}{b}=\dfrac{y-3}{c}=\dfrac{z-1}{a}$ where $a>b>c$ and a,b,c are the roots of the equation $t^3-t^2-4t+4=0$ is

A) $\sin^{-1}\left(\dfrac{\sqrt{63}}{9}\right)$ B) $\cos^{-1}\dfrac{4}{9}$ C) $\tan^{-1}\left(\dfrac{2}{3}\right)$ D) $\cos^{-1}\left(\dfrac{3}{\sqrt{13}}\right)$

SECTION-II
(NUMERICAL VALUE ANSWER TYPE)

This section contains 5 questions. The answer to each question is a Numerical value. If the Answer in the decimals , **Mark nearest Integer only.**

Marking scheme: +4 for correct answer, -1 in all other cases.

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71. If $(p+iq)^{2018}=p-iq$. Then the number of real ordered pairs (p,q) that satisfy the given equation is N. Then $\left[\dfrac{N}{100}\right]$ where $[x]$ represents G.I.F. equals to _____

72. An equilateral triangle has its centroid at the origin and one side is $x+y=1$, then the sum of the slopes of the other two sides is

73. If $|\bar{a}|=|\bar{b}|=2, |\bar{c}|=1, (\bar{a}-\bar{c}).(\bar{b}-\bar{c})=0$. Then the value of $|\bar{a}-\bar{b}|^2+2\bar{c}.(\bar{a}+\bar{b})$ is equal to

74. If x_1, x_2 are the roots of $x^2-x+K=0$ and x_3, x_4 are the roots of $x^2-4x+L=0$ such that x_1, x_2, x_3, x_4 are in G.P. Then the product of the integral values of K and L is _____

75. The total number of distinct real values of 't' for which $\begin{vmatrix} t & t^2 & 1+t^3 \\ 2t & 4t^2 & 1+8t^3 \\ 3t & 9t^2 & 1+27t^3 \end{vmatrix} = 10$ is _____

KEY SHEET

PHYSICS

1	**C**	2	**D**	3	**B**	4	**B**	5	**B**
6	**C**	7	**A**	8	**C**	9	**D**	10	**A**
11	**B**	12	**C**	13	**C**	14	**D**	15	**C**
16	**D**	17	**C**	18	**B**	19	**D**	20	**B**
21	**-13**	22	**9**	23	**8**	24	**701**	25	**25**

CHEMISTRY

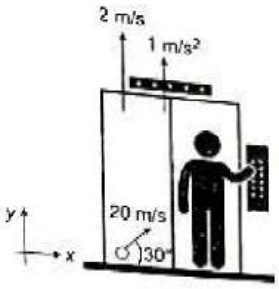
26	**D**	27	**C**	28	**B**	29	**C**	30	**B**
31	**D**	32	**C**	33	**C**	34	**D**	35	**B**
36	**C**	37	**D**	38	**B**	39	**B**	40	**C**
41	**C**	42	**C**	43	**C**	44	**B**	45	**B**
46	**3**	47	**8**	48	**4**	49	**6**	50	**1**

MATHEMATICS

51	**D**	52	**C**	53	**D**	54	**C**	55	**D**
56	**C**	57	**C**	58	**D**	59	**D**	60	**B**
61	**C**	62	**B**	63	**C**	64	**B**	65	**A**
66	**C**	67	**B**	68	**C**	69	**B**	70	**B**
71	**20**	72	**4**	73	**10**	74	**64**	75	**2**

SOLUTIONS
PHYSICS

1. Initial velocity of stone w.r.t lift $= 20\sin 30^0\,\hat{j} + 20\cos 30^0\,\hat{i} = \left(10\sqrt{3}\,\hat{i} + 10\,\hat{j}\right) m/s$



Initial velocity of stone w.r.t ground $= \left(10\sqrt{3}\,\hat{i} + 12\,\hat{j}\right) m/s$

The initial position of stone and lift are same and when they again meet their final positions will also be same. So both will have same displacement in vertical direction in same time

Displacement of lift $= 2(t) + \frac{1}{2}\times 1\times t^2 = 2t + \frac{t^2}{2}$

Displacement of stone $= 12(t) - \frac{1}{2}\times 10\times t^2 = 12t - 5t^2$

So $2t + \frac{t^2}{2} = 12t - 5t^2$

$\frac{11t^2}{2} = 10t \quad or \quad t = \frac{20}{11}\sec$

So time taken by stone to return to the floor of lift is $\frac{20}{11}\sec$

2. For W to be maximum; $\frac{dW}{dx} = 0$;

i.e., $F(x) = 0 \Rightarrow x = l, x = 0$

Clearly for $d = l$, the work done is maximum.

Alternate Solution:

External force and displacement are in the same direction

$\therefore$ work will be positive continuously so it will be maximum when displacement is maximum.

3. $B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi\times 10^{-7}\times 18}{2\pi\times 0.2} T = 18\mu t$

Now, $T = 2\pi\sqrt{\frac{I}{MB_H}}$ *and* $T' = 2\pi\sqrt{\frac{I}{M(B_H - B)}}d$

Dividing $\frac{T'}{T} = \sqrt{\frac{B_H}{B_H - B}}$ *or* $\frac{T'}{T} = \sqrt{\frac{24}{24-18}} = 2$

$T' = 2\times 0.1s = 0.2s$

4. In the circular motion around the earth, the centripetal force on the satellite is a gravitational force. Therefore, $v^2 = GM/R$, where M is the mass of the Earth, R is the radius of the orbit of satellite and G is the universal gravitational constant. Therefore, the kinetic energy increases with the decrease in the radius of the orbit. The gravitational potential energy is negative and decreases with the decrease in radius.

5. For an adiabatic process,
$0 = dU + PdU$
or $d(a+bPV) + PdV=0$
or $(b+1)\frac{dV}{V} + b\frac{dP}{P} = 0$
or $(b+1)\log V + b \log P = \text{constant}$
$V^{b+1}p^{b} = \text{constant}$
or $PV^{\frac{b+1}{b}} = \text{constant}$
$\therefore \gamma = \frac{b+1}{b}$

6. $v_{rms} = \sqrt{\frac{3RT}{M}}$. According to problem T will becomes 2T and M will become M/2 so the value of v_{rms} will increase by $\sqrt{4} = 2$ times i.e., new root mean square velocity will be $2v$.

7. When sources are coherent, then $I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$
At middle point of the screen, $\phi = 0$ then
$I_R = I + I + 2\sqrt{II}\cos 0 = 4I$
When sources are in coherent, then $I_R^{'} = I_1 + I_2 = I + I = 2I$
$\frac{I_R}{I_R^{'}} = \frac{4I}{2I} = 2$

8. $T^2 = 4\pi^2\frac{l}{g}$
$\Rightarrow g = \frac{4\pi^2 l}{T^2}$
$\Rightarrow \frac{\Delta g}{g}\times 100 = \frac{\Delta l}{l}\times 100 + 2\frac{\Delta T}{T}\times 100$
$\Rightarrow \frac{\Delta g}{g} = y + 2x$

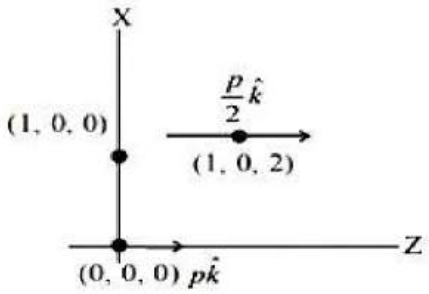
9. Using perpendicular axis theorem $I = I_1 + I_2$ and $I = I_3 + I_4$ also, $I_1 = I_2 = I_3 = I_4$ hence option 4 is wrong.

10. We know that
$P_B = P_A + \frac{1}{2}\rho\omega^2 a^2$
$P_D = P_A + \rho g a$
$P_C = P_D + \frac{1}{2}\rho\omega^2 a^2 = P_A + \rho g a + \frac{1}{2}\rho\omega^2 a^2$
Therefore,
$P_c > P_A$ for all the values of ω and $P_B > P_D$ only
If $\omega > \sqrt{\frac{2g}{a}}$

11. For $p\hat{k}$ it is equatorial point
$\therefore \overline{E_1} = \frac{1}{4\pi\varepsilon_0}\frac{P}{1}\left(-\hat{k}\right)$
For $\frac{P}{2}\hat{k}$ it is axial point

$$\therefore \ \overline{E_2} = \frac{1}{4\pi\varepsilon_0}\frac{\frac{P}{2}\times 2\left(\hat{k}\right)}{2^3} = \frac{1}{4\pi\varepsilon_0}\frac{p}{8}\hat{k}$$

$$\therefore \ \overline{E} = \overline{E_1} + \overline{E_2} = -\frac{7p}{32\pi\varepsilon_0}\hat{k}$$

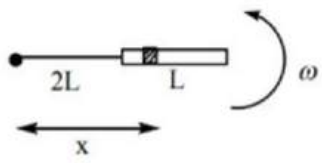


12. Radius of circular orbit $R = \frac{mv}{qB}$

$$= \frac{\sqrt{2mKE}}{qB} = \frac{\sqrt{2mT}}{qB}$$

If T becomes double & 'B" becomes tripled then radius becomes $\sqrt{\frac{2}{9}}R$

13. $de = B(\omega x)dx$



$$e = B\omega\int_{2L}^{3L} x\,dx$$

$$= \frac{5B\omega L^2}{2}$$

14. $I_d = 1mA = 10^{-3}A$

$C = 2\mu F = 2\times 10^{-6}F$

$$I_D = I_C = \frac{d}{dt}(CV) = V\frac{dV}{dt}$$

Therefore, $\frac{dV}{dt} = \frac{I_D}{C} = \frac{10^{-3}}{2\times 10^{-6}} = 500\ Vs^{-1}$

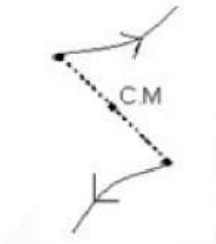
Therefore, applying a varying potential difference of 500 Vs^{-1} would produce a displacement current of desired value.

15. Radius of circular path described by a charged particle in a magnetic field is given by $r = \frac{\sqrt{2mK}}{qB}$; Where K = Kinetic energy of electron $\Rightarrow K = \frac{q^2B^2r^2}{2m} = \left(\frac{e}{m}\right)\frac{eB^2r^2}{2}$

$$= \frac{1}{2}\times 1.7\times 10^{11}\times 1.6\times 10^{-19}\times\left(\frac{1}{\sqrt{17}}\times 10^{-5}\right)^2\times(1)^2 = 8\times 10^{-20}\ J = 0.5eV$$

By using $\Rightarrow W_0 = E - K_{max} = \left(\frac{12375}{2475}\right)eV - 0.5eV = 4.5eV$

16.



1. As mutual repulsive force between the particles is internal for the system and as there is no other external force on the system, linear momentum of the system is conserved in any direction.
2. As the forces on the particles due to one on the other are equal in magnitude. Opposite in direction and act along the line joining them always, net torque on the system due to these forces about any point in space in zero. Therefore angular momentum of the system remains constant about any point in space.
3. As center of mass of the system lies on the line joining the particles always and force on any of them is passing through C.M always, torque due to this force on any particle about C.M is zero. Hence angular momentum of any particle about C.M is conserved individually.
4. About any other point except C.M, torque on any individual particle is not zero. Hence angular momenta of individual particles change but total angular momentum of the system remains constant.

17.

$F = mg \sin\theta \approx mg\tan\theta \left(\because \theta \, is \, small\right).$

$i.e, \quad F = mg\frac{dy}{dx} = -mg \times \frac{2x}{40}$

$\Rightarrow a = -\frac{x}{2} \Rightarrow \omega = \frac{1}{\sqrt{2}}$

18. Potential at any point inside the shell = potential at any point on the surface
$\therefore$ potential at A = potential at C due to 'q' and induced charges =

$$\frac{1}{4\pi \in_0}\frac{q}{r} + \frac{1}{4\pi \in_0}\frac{q}{R} + \frac{1}{4\pi \in_0}\left(\frac{-q}{R}\right) = \frac{1}{4\pi \in_0}\frac{q}{r}$$

19. For $A + B \rightarrow C + \varepsilon$, ε is the positive. This is because E_b for D and E is greater then E_b for F.

20. It is a case of resonance

$\therefore X_L = X_C$

$\Rightarrow Z = R$

$\therefore \quad I_{rms} = \frac{V_{rms}}{Z} = \frac{200}{100} = 2A$

$\therefore \quad P_{av} = I_{rms}^2 R = 4 \times 100 = 400W$

21. Change in linear momentum $\Delta P = \int F dt$

$$15\left(v_f + u\right) = \int_0^{15} 40\cos\left(\frac{\pi}{10}\right)t \, dt$$

$$v_f = -4 + \frac{40}{15}\left[\frac{\sin\left(\pi/10\right)t}{\pi/10}\right]_0^{15} = -4 + \frac{400}{15\pi}(-1) = -12.5 m/s$$

22. 'O' is off axis for axis for both the parts. Size of object for upper and lower parts is 2mm and 1 mm respectively.

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\frac{1}{20}=\frac{1}{v}-\frac{1}{30}\Rightarrow v=60Cm$$

$$\Rightarrow m=\left|\frac{v}{u}\right|=2$$

$\therefore$ Distance between the two image points is 4 + 2 + 1 + 2 = 9mm

23. Because the collision is perfectly inelastic, the two blocks stick together. By conservation of linear momentum.

$$2mV=mv\,or\,V=\frac{v}{2}$$

By conservation of energy,

$$2mgh=\frac{1}{2}\times 2mv^2\ or\ h=\frac{v^2}{8.g}$$

$$\Rightarrow x=8$$

24. $$V=\sqrt{\frac{T}{\mu}}\quad \&\quad Y=\frac{TL}{A\Delta L}\quad \&\quad \frac{\Delta L}{L}=\alpha\Delta\theta$$

$$\Rightarrow V=\sqrt{\frac{T}{A\rho}}\quad =\sqrt{\frac{Y\Delta L}{L\rho}}=\sqrt{\frac{Y\alpha\Delta\theta}{\rho}}$$

$$V=\sqrt{\frac{1.3\times10^{11}\times1.7\times10^{-5}\times20}{9\times10^{3}}}=70\ m/s$$

25. $$dR=\frac{Cdl}{\sqrt{l}}$$

$$\int_0^l C\frac{dl}{\sqrt{l}}=C\int_l^1\frac{dl}{\sqrt{l}}$$

$$2\sqrt{l}\Big|_0^l=2\sqrt{l}\Big|_l^1$$

$$2\sqrt{l}=2-2\sqrt{l}$$

$$\Rightarrow 4\sqrt{l}=2$$

$$\Rightarrow l=\frac{1}{4}=0.25m$$

CHEMISTRY

26. A) SO_3 & CO_3 ; Both are sp^2 & planar triangular

B) SO_3^{2-} & NH_3 ; Both are sp^3 & pyramidal

C) PCl_5 : sp^3d & trigonal bipyramidal

$POCl_5$: sp^3 & tetra hedral

D) XeF_2 : sp^3d & linear

ClF_3 : sp^3d & T–shape

As per M.O.T

27. B_2 : By distributing 10 electrons only two electrons in $\pi - B.M.O$ are extra left without cancelling with A.B.M.O electrons

C_2 : By distributing 12 electrons, only 4 electrons in $\pi\, B.M.O$ are extra left without cancelling with A B M O electrons

N_2 : By distributing 14 electrons only 4π electrons & 2 σ electrons in B M O & extra left without cancelling with A B M O electrons.

28. No of moles of $M^{+}_{(g)}$ formed = $\dfrac{22.44}{374}$

$= 0.06\, moles = 0.06 \times 6.023 \times 10^{23}$

$= 3.613 \times 10^{22}\, atoms$

$\dfrac{At.wt.}{8} \times 22.44 = 374$

$\Rightarrow At.Wt. = 133.33g$.

29. Due to small B.L of N–N bond *lp–lp* repulsions on 'N' weaken the bond.

30. 0.1 moles of the complex – 28.7 g of AgCl
1 mole gives of complex – 287 g of AgCl
– 2 moles of AgCl

$\Rightarrow$ 2 Cl^- ions should be ionisable.

31. The complex cannot show hydration isomerism as no H_2O ligands are present.

32. The colour of $KMnO_4$ is due to charge transfer phenomenon

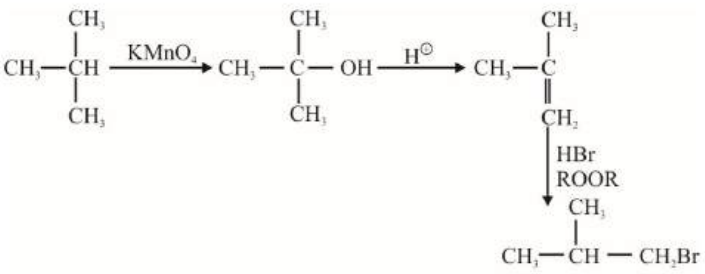
33. $n_{m.eq} NH_3 = n_{m.eq} H_2SO_4$

$= 10 \times 1 \times 2 = 20\, meq\, of\, NH_3 = 20$ m mol of NH_3

$\%N = \dfrac{1400 \times n_{eq} NH_3}{wt.of\ organic\ compound}$

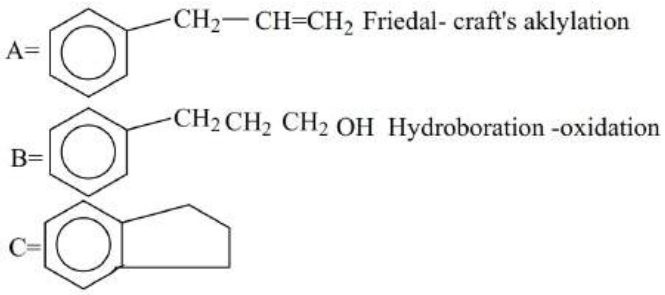
$= \dfrac{1400 \times 20 \times 10^{-3}}{0.5} = 56\%$.

34.

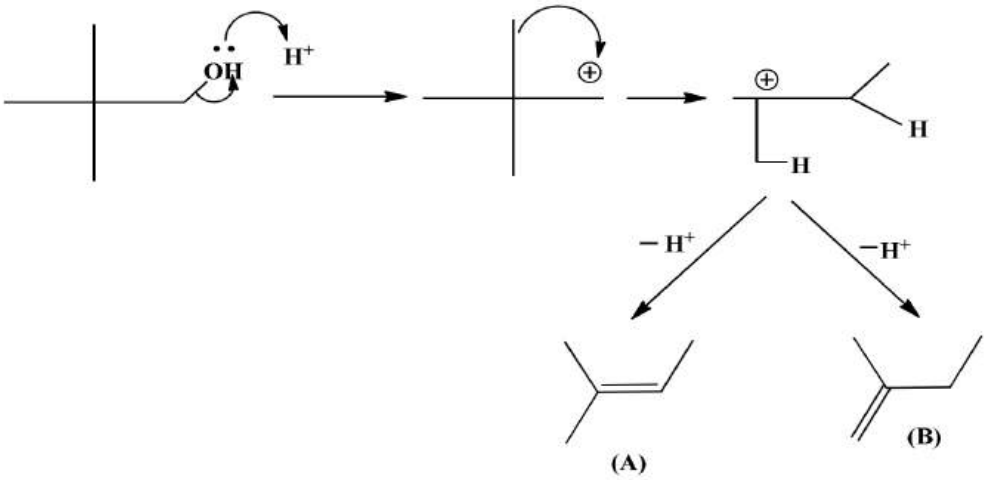


35. Reactivity order IV > I > III > II > V on the basis of R and I effect of associated groups.

36.



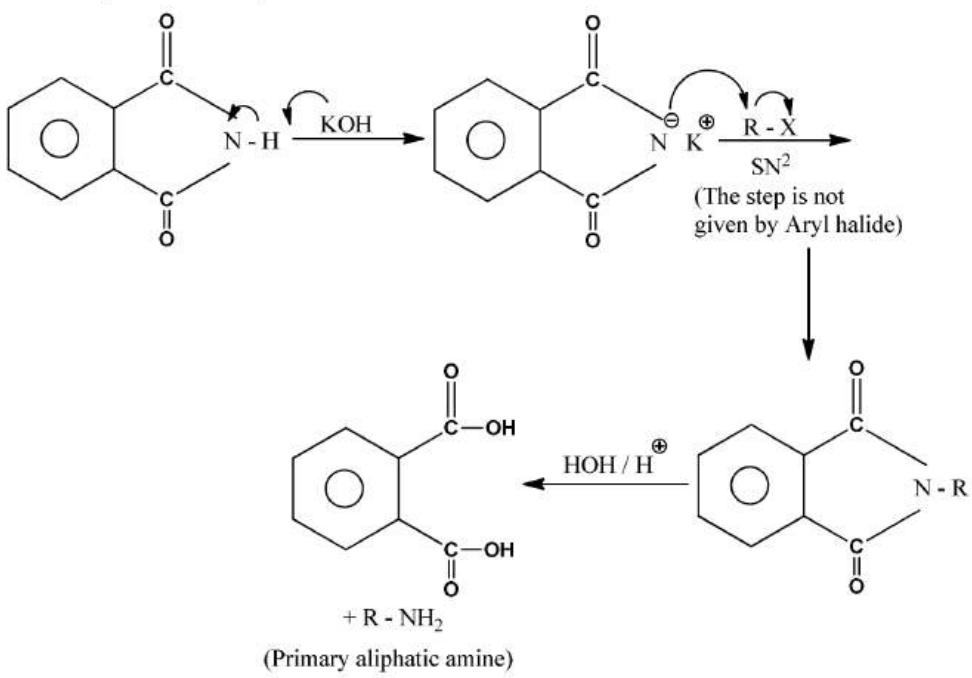
37.



38. Cleavage of the double bond by Ozonolysis, iodoform Rxn, dry distillation of calcium salts to give cyclopentanone, followed by wolf–kishner reduction to give cyclohexane.

39. Benzyllic oxidation to give potassium salt of Benzoic acid, followed by acidification to give Benzoic acid.

40. Gabriel pthalamide synthesis



41. Keratin and myosin are fibrous proteins and insoluble in H_2O.

42. $(61.9+76.3)=\dfrac{1.382\times10^{-4}\times1000}{S}$

$\therefore S \quad = 10^{-3} M$.

43. $\Delta T_f = K_f \times m$

$$9.3 = 1.86\times\frac{50}{62}\times\frac{1000}{x}$$

$$\Rightarrow x = 161.29g$$

$\therefore$ Amount of ice separated $= 200 - 161.29$

$= 38.71g$

44. Required energy $= I_1 + I_2$

$I_1 = 24.6eV$

$I_2 = I_H \times Z^2 = 13.6\times 2^2 = 54.4eV$

$\therefore E = 24.6 + 54.4 = 79eV$

45. $3A \quad \rightarrow B$

$t = 4\,\text{min}; a - 3x \;=\; x$

$\Rightarrow 4x = a \Rightarrow x = \dfrac{a}{4}$

$\therefore$ At 4 min 75% of first order is completed.

$\therefore t_{75\%} = \dfrac{2t_1}{2} \Rightarrow \dfrac{t_1}{2} = 2\,\text{min}$.

46. $X = 12(Mg);\ Y = 15(P)$

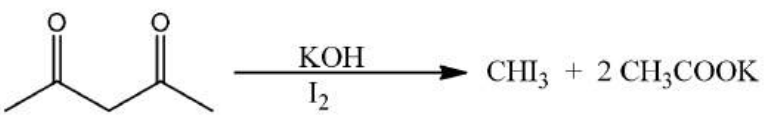
47. conceptual

48. Greater the stability of carbanion, greater is the rate of decarboxylation.

Except $(CH_3)_3 C - COOH$ remaining are more reactive than CH_3COOH .

49. Except $-\overset{\overset{O}{\|}}{C}-O-R$, remaining are ring activating groups.

50.



MATHS

51. Clearly $\sqrt{(x-1)^2+y^2}=(x-3)+i(y-3)$

$\Rightarrow y=3 \ \ and \ \ (x-1)^2+9=(x-3)^2$

$\Rightarrow \ x=\dfrac{-1}{4}$

But $\alpha=\dfrac{-1}{4}+3i$ does not satisfy the given equation

52. Let $f(x)=x^2-\left(\dfrac{2k}{k-5}\right)x+\left(\dfrac{k-4}{k-5}\right)=0$ by the given data, $\quad f(0)>0, f(2)<0, f(3)>0$

$\Rightarrow \dfrac{k-4}{(k-5)}>0 \qquad \ldots\ldots\ldots (1)$

$\Rightarrow \ \dfrac{k-24}{(k-5)}<0 \qquad \ldots\ldots\ldots (2)$

$\Rightarrow \ \dfrac{4k-49}{(k-5)}>0 \qquad \ldots\ldots\ldots (3)$

From (1), (2) and (3), $k\in\left(\dfrac{49}{4},24\right)$

53. Here $A^2=A\Rightarrow A$ is an Idempotent matrix

$\Rightarrow A=A^2=A^3=\ldots\ldots\ldots=A^{99}$

Hence $(I+A)^{99}=I+\left(2^{99}-1\right)A$

54. We can take 3 cases namely four odd numbers, two odd numbers and zero odd numbers.

Let X be the number of odd numbers chosen

$\therefore$ P(sum is even) $=P(X=4)+P(X=2)+P(X=0)$

$=\left(\dfrac{2}{3}\right)^4+{}^4C_2\left(\dfrac{2}{3}\right)^2\left(\dfrac{1}{3}\right)^2+\left(\dfrac{1}{3}\right)^4=\dfrac{41}{81}$

55. Let $f(y)$ be the inverse of $g(y)$

$\Rightarrow f'\left(g(y)\right)g'(y)=1$

$\Rightarrow f'\left(g(-2)\right)g'(-2)=1 \ \Rightarrow\left(g^{-1}(y)\right)_{y=-2}=\dfrac{1}{f'(-1)}=\dfrac{1}{14}$

56. S1 and S2 are skew lines

57. $I=\int \frac{\cos x - x\sin x}{\sqrt{x.\cos x}}\,dx$

Put $x.\cos x = t^2 \Rightarrow I = 2\sqrt{x.\cos x}+c$

58. $\mathrm{I}=\lim_{\theta\to 0}\frac{\int_0^{\theta}\frac{\mathrm{x}^2}{\sqrt{\mathrm{k}+\mathrm{x}}}\,\mathrm{d}}{(\theta-\sin\theta)}=\lim_{\theta\to 0}\frac{\frac{\mathrm{d}}{\mathrm{d}\theta}\int_0^{\theta}\frac{\mathrm{x}^2}{\sqrt{\mathrm{k}+\mathrm{x}}}\,\mathrm{d}}{(1-\cos\theta)}$

(By. L. Hospitals Rule)

$=\lim_{\theta\to 0}\frac{\left(\frac{\theta^2}{\sqrt{k+\theta}}\right)}{\left(2\sin^2\theta/2\right)}=\frac{2}{\sqrt{k}}=1 \Rightarrow k=4$

59. Given equation can be reduced to

$\cos y\frac{dy}{dt}+(-\sin y)\frac{1}{(1+t)}=e^t(1+t)$

Put $\sin y = v \Rightarrow \cos y\frac{dy}{dt}=\frac{dv}{dt}$

Hence the solution is $\frac{\sin y}{(t+1)}=\left(e^t+c\right)$

60. $\left(\cot^{-1}k\right)y^2-\left(\tan^{-1}k\right)^{3/2}y+2\left(\cot^{-1}k\right)^2=0$ has real roots

$\Rightarrow D\geq 0 \Rightarrow \tan^{-1}k\geq \pi/3 \Rightarrow k\geq\sqrt{3}$ and sum of roots >0, product of roots >0

$\Rightarrow k>0$ and $k\geq\sqrt{3}$

61. Let T_{r+1} be the Independent term of x then $r=6$,

$\therefore\ t_{6+1}=84\alpha^3\beta^6$

62. Check for what values of x, $g'(x)=0$ or does not exist

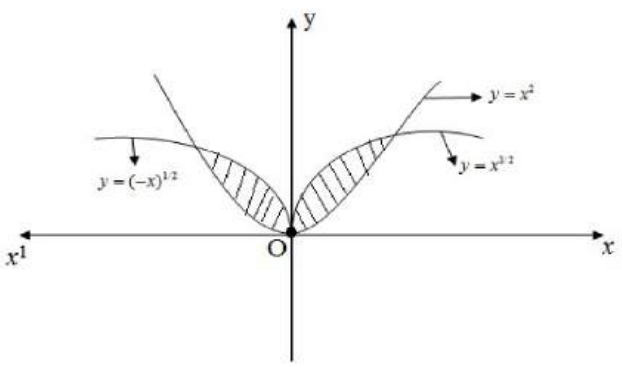
63. Mean $\frac{\sum x_i}{n}=10$ and Variance $\frac{\sum x_i^2}{n}-\left(\frac{\sum x_i}{n}\right)^2=4$

$\Rightarrow \frac{\sum x_i^2}{n}=104 \quad \therefore \frac{\sum x_i}{n}+\frac{4}{n}=102$

$\Rightarrow n=20$

Hence new Variance = 3.96

64. From the graph of the functions, the required area $= 2\int_0^1\left(\sqrt{x}-x^2\right)dx=\frac{2}{3}$



65. $f(x)=|x|\sin x$ is differentiable at $x=0$

66. L.H.L. $= \lim\limits_{\alpha \to \frac{\pi^-}{2}} f(\alpha) = 0$ and R.H.L. $= \lim\limits_{\alpha \to \frac{\pi}{2}^+} f(\alpha) = \infty$

$\therefore \lim\limits_{\alpha - \pi/2} f(\alpha)$ does not exist

67.

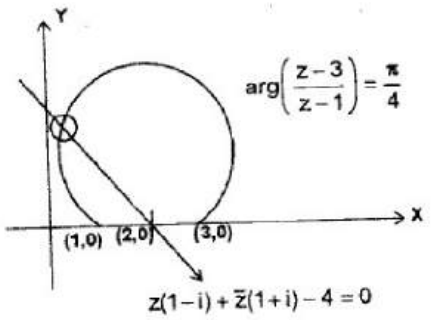
$x^{1/3} = 2 - g(x)$

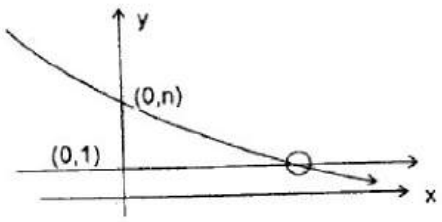
$\Rightarrow f(x) = 5(2-x) - (2-x)^2 - (2-x)^3$

$\Rightarrow x^3 - 7x^2 + 11x - 2 \Rightarrow f_{\max} = 3$

Clearly 1 is the root $\Rightarrow$ a + b + c + $= 0$

$\left(\frac{1}{n+1}\right)^x + \left(\frac{2}{n+1}\right)^x + ... \left(\frac{n}{n+1}\right)^x = 1$





68. Clearly $k = \cot 22\frac{1}{2}^0 = \sqrt{2} + 1$

Hence $[100\,(k-1)] = 141$

69. Use $L_{11} \,.\, L_{22} \geq 0$ for three sides of the triangle

70. Clearly $a = 2;\ b = 1$ *and* $c = -2$ and

Use $\theta = \cos^{-1}\left|\frac{a_1a_2 + b_1b_2 + c_1c_2}{\sqrt{\sum a_1^2}\sqrt{\sum a_2^2}}\right|$

71. $p^2 + q^2 = 1$ *or* $p^2 + q^2 = 0$

$\Rightarrow z^{2018} = \overline{z} = \frac{1}{z} \Rightarrow z^{2019} = 1$

So there are total 2020 solutions

72. The inclination of the line $L \equiv x + y = 1$ is 135^0. So the slopes of the other two sides will be $\tan\left(135^0 \pm 60^0\right)$

73. $E = |\overline{a} - \overline{b}| + 2\left(\overline{c}.\overline{a} + \overline{c}.\overline{b}\right)$

$= |\overline{a}|^2 + |\overline{b}|^2 + 2\left(\overline{c}.\overline{a} + \overline{c}.\overline{b} - \overline{a}.\overline{b}\right)$

But $(\overline{a} - \overline{c}).(\overline{b} - \overline{c}) = 0$

$\Rightarrow \overline{a}.\overline{c} + \overline{b}.\overline{c} - \overline{a}.\overline{b} = 1$

$\therefore E = 8 + 2 = 10$

74. Let the common ratio of G.P. be 'r' then $x_2 = x_1 r,\ x_3 = x_1 r^2, x_4 = x_1 r^3$

And $x_1 + x_2 = 1,\ x_1 x_2 = K, x_3 + x_4 = 4, x_3 \,.\, x_4 = L$

$\therefore r = -2$ and $x_1 = -1$

$\Rightarrow K = -2,\ L = -32$

75. $$\begin{vmatrix} t & t^2 & 1+t^3 \\ 2t & 4t^2 & 1+8t^3 \\ 3t & 9t^2 & 1+27t^3 \end{vmatrix} = 10$$

$$\Rightarrow x^3 \begin{vmatrix} 1 & 1 & 1 \\ 2 & 4 & 1 \\ 1 & 9 & 1 \end{vmatrix} + x^6 \begin{vmatrix} 1 & 1 & 1 \\ 2 & 4 & 8 \\ 3 & 9 & 27 \end{vmatrix} = 10$$