JEE Main

MOCK TEST - 10

Instructions:

I. The JEE Main Test Paper consists of one paper containing 60 objective questions (four options with single correct answer) and 30 numerical value type questions from the syllabus of Physics, Chemistry and Mathematics.
II. The duration of paper would be 3 hours (180 minutes).
III. There will be total 90 questions : Physics - 30, Chemistry - 30, Mathematics - 30.
IV. Each question will carry 4 marks. For each correct response the applicant will be awarded four marks. For each incorrect answer there will be deduction of one mark.
V. There will be no negative marking for unattended questions. More than one answer of single question will also be considered as incorrect response and will be negatively marked.

Max. Marks : 300 **Time :** 180 minutes

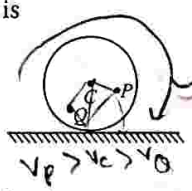
PHYSICS

Section-A (Multiple Choice Questions)

1. An ideal spring with spring-constant k is hung from the ceiling and a block of mass M is attached to its lower end. The mass is released with the spring initially unstretched. Then the maximum extension in the spring is

(a) $\frac{4Mg}{k}$ (b) $\frac{2Mg}{k}$ (c) $\frac{Mg}{k}$ (d) $\frac{Mg}{2k}$.

2. A disc is rolling without slipping with angular velocity w. P and Q are two points equidistant from the centre C. The order of magnitude of velocity is



(a) $v_Q > v_C > v_P$
(b) $v_P > v_C > v_Q$
(c) $v_P = v_C, v_Q = v_C/2$
(d) $v_P < v_C > v_Q$.

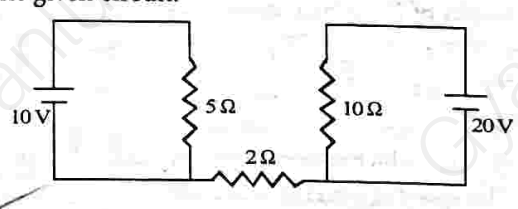
3. A solid sphere of mass M and radius R having moment of inertia I about its diameter is recast into a solid disc of radius r and thickness t. The moment of inertia of the disc about an axis passing the edge and perpendicular to the plane remains I. Then R and r are related as

(a) $r = \sqrt{\frac{2}{15}}R$ (b) $r = \frac{2}{\sqrt{15}}R$
(c) $r = \frac{2}{15}R$ (d) $r = \frac{\sqrt{2}}{15}R$.

4. Water is filled in a container upto height 3 m. A small hole of area a is punched in the wall of the container at a height 52.5 cm from the bottom. The cross-sectional area of the container is A. If $a/A = 0.1$ then v^2 is (where v is the velocity of water coming out of the hole)

(a) 50 m^2s^{-2} (b) 51 m^2s^{-2}
(c) 48 m^2s^{-2} (d) 51.5 m^2s^{-2}

5. Find out the value of current through 2 Ω resistance for the given circuit.



(a) zero (b) 2 A
(c) 5 A (d) 4 A.

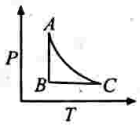
6. In a series LCR circuit the voltages across resistance, capacitance and inductance are 20 V each. If the capacitance is short-circuited, the voltage across the inductance will be

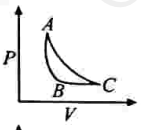
(a) $\frac{20}{\sqrt{2}}$ V (b) 20 V (c) $20\sqrt{2}$ V (d) 40 V

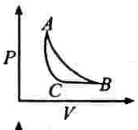
7. A wire of length L and three identical cells of negligible internal resistances are connected in series. Due to the current, the temperature of the wire is raised by ΔT in a time t. N number of similar cells are now connected in series with a wire of the same material and cross-section but of length $2L$. The temperature of the wire is raised by the same amount ΔT in the same time t. The value of N is

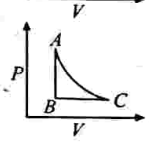
(a) 4 (b) 6 (c) 8 (d) 9.

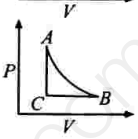
8. The PT diagram for an ideal gas is shown in the figure, where AC is an adiabatic process. Find the corresponding PV diagram.



(a) 

(b) 

(c) 

(d) 

9. Two identical rods are connected between two containers. One of them is at 100°C and another is at 0°C. If rods are connected in parallel then the rate of melting of ice is q_1 g/s. If they are connected in series then the rate is q_2. The ratio q_2 / q_1 is

(a) 2 (b) 4 (c) 1/2 (d) 1/4

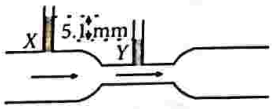
10. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = Kt^2$, (K = 1 m/s^2) where y is the vertical displacement. The time period now becomes T_2. The ratio of $\frac{T_1^2}{T_2^2}$ is (Take g = 10 m/s^2)

(a) 5/6 (b) 6/5 (c) 1 (d) 4/5

11. Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that of X_2 will be 1/e after a time

(a) $\frac{1}{10\lambda}$ (b) $\frac{1}{11\lambda}$ (c) $\frac{11}{10\lambda}$ (d) $\frac{1}{9\lambda}$

12. Figure shows a venturimeter, through which water is flowing. The speed of water at X is 2 cm s^{-1}. The speed of water at Y is (Take g = 1000 cm s^{-2})



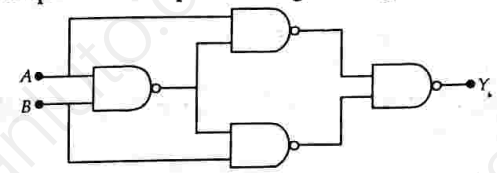
(a) 23 cm s^{-1} (b) 32 cm s^{-1}
(c) 101 cm s^{-1} (d) 1024 cm s^{-1}

13. Let T_1 and T_2 be the time period of springs A and B when mass M is suspended from one end of each spring. If both springs are taken in series and the same mass M is suspended from the series combination, the time period is T, then

(a) $T = T_1 + T_2$ (b) $\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}$

(c) $T^2 = T_1^2 + T_2^2$ (d) $\frac{1}{T^2} = \frac{1}{T_1^2} + \frac{1}{T_2^2}$

14. The simplified Y output of the given logic circuit is



(a) $\bar{A} \cdot B + A \cdot \bar{B}$ (b) $A \cdot \bar{B} + A \cdot B$
(c) $\bar{A} \cdot \bar{B} + A \cdot B$ (d) $A \cdot \bar{B} + \bar{A} \cdot \bar{B}$

15. **Statement 1:** ${}_ZX^A$ undergoes two a decays, two b decays (negative b) and two g decays. As a result the daughter product is ${}_{Z-2}Y^{A-8}$.
Statement 2 : In α decay the mass number decreases by 4 unit and atomic number decreases by 2 unit. In β decay (negative β) the mass number remains unchanged and atomic number increases by 1 unit. In g decay, mass number and atomic number remains unchanged.

(a) Statement-1 is true, Statement-2 is false.
(b) Statement-1 is false, Statement-2 is true.
(c) Statement-1 is true, Statement-2 is true and Statement-2 is a correct explanation for Statement-1.
(d) Statement-1 is true, Statement-2 is true but Statement-2 is not a correct explanation for Statement-1.

16. A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be

(a) halved (b) the same
(c) doubled (d) quadrupled

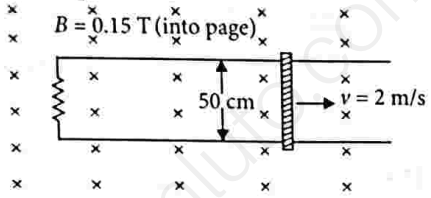
17. Potential energy between a proton and an electron is given by $U = \frac{Ke^2}{3R^3}$, then radius of Bohr's orbit can be given by

(a) $\frac{2\pi}{n}\frac{Ke^2m}{h^2}$ (b) $\frac{6\pi^3}{n^3}\frac{Ke^2m}{h^2}$

(c) $\frac{2\pi}{n}\frac{Ke^2m}{h^2}$ (d) $\frac{4\pi^2Ke^2m}{n^2h^2}$

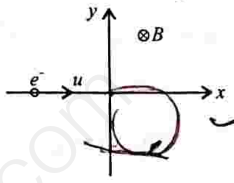
18. A man's near point is 0.5 m and far point is 3 m. Power of spectacle lenses required for (i) reading purposes, (ii) seeing distant objects, respectively, are
(a) −2 D and +3 D (b) +2 D and −3 D
(c) +2 D and −0.33 D (d) −2 D and +0.33 D

19. As shown in the figure, a metal rod makes contact with a partial circuit and completes the circuit. The circuit area is perpendicular to a magnetic field with $B = 0.15$ T. If the resistance of the total circuit is 3 W, the force needed to move the rod as indicated with a constant speed of 2 m/s will be equal to



(a) 3.75×10^{-3} N (b) 2.75×10^{-3} N
(c) 6.57×10^{-4} N (d) 4.36×10^{-4} N

20. An electron travelling with a speed u along the positive x-axis enters into a region of magnetic field where $B = -B_0\hat{k}\,(x > 0)$. It comes out of the region with speed v then
(a) $v = u$ at $y > 0$
(b) $v = u$ at $y < 0$
(c) $v > u$ at $y > 0$
(d) $v > u$ at $y < 0$.



Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

21. A transmitting antenna at the top of the tower has a height 18 m and the height of the receiving antenna is 32 m. The maximum distance (in km) between them for satisfactory communication in line of sight mode is _____.
(Radius of earth = 6.4×10^6 m)

22. A 2 g ball of glass is released from the edge of a hemispherical cup whose radius is 20 cm. The work done on the ball (in mJ) by the gravitational force during the ball's motion towards the bottom of the cup is _____.

23. A soap bubble of radius 3 cm is formed inside the another soap bubble of radius 6 cm. The radius of an equivalent soap bubble which has the same excess pressure as inside the smaller bubble with respect to the atmospheric pressure is _____ cm.

24. An alternating voltage $V = 200\sqrt{2}\sin(100t)$ V is connected to a 1 μF capacitor through an ac ammeter. The reading of the ammeter (in mA) is _____.

25. 1 mW of light of wavelength 456 nm is incident on a cesium surface. If the quantum efficiency of the surface for photoelectric emission is only 0.5% then, the photoelectric current produced (in μA) is _____.

26. A 50 MHz sky wave takes 4.04 ms to reach a receiver via re-transmission from a satellite 600 km above earth's surface. Assuming re-transmission time by satellite negligible, the distance between source and receiver (in km) is _____.

27. A cheetah weighing 150 kg, chases a deer, weighing 30 kg, in a straight path. The speed of the cheetah is 20 m/s and that of the deer is 25 m/s. The approximate speed (in m s^{-1}) of the centre of mass of the pair is _____

28. The potential energy U of a particle varies with distance x from a fixed origin as $U = \dfrac{A\sqrt{x}}{x^2 + B}$, where A and B are dimensional constants. The dimensional formula for AB is $[M^1 L^{x/2} T^{-2}]$, where the value of x is _____.

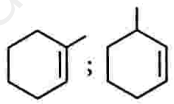
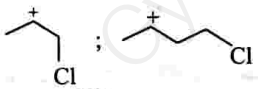
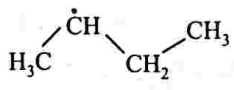
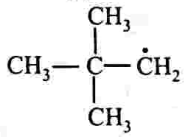
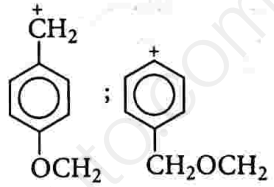
29. If it takes 5 minutes to fill a 15 litre bucket from a water tap of diameter $\dfrac{2}{\sqrt{\pi}}$ cm then the Reynolds number for the flow is (density of water = 10^3 kg/m^3 and viscosity of water = 10^{-3} Pa.s) close to _____.

30. Consider a system of gas of a diatomic molecule in which the speed of sound at 0°C is 1260 m s^{-1}. Then, the molecular weight of the gas is g/mol.
(Given the gas constant R is 8.314 J/mol K) _____

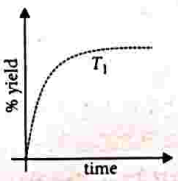
CHEMISTRY

Section-A (Multiple Choice Questions)

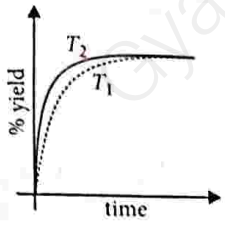
31. In which of the following pairs, the second member is more stable than first?

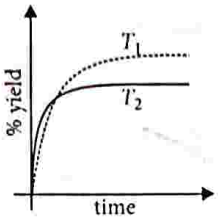
(a) 
(b) 
(c) 

(d) 

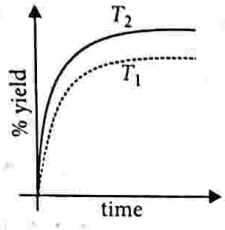
32. The % yield of ammonia as a function of time in the reaction, $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, $\Delta H < 0$ at (P, T_1) is given as :



If this reaction is conducted at (P, T_2), with $T_2 > T_1$, the % yield of ammonia as a function of time is represented by

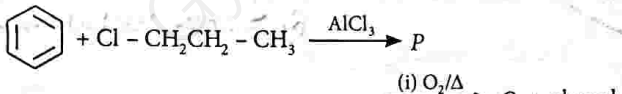
(a) 

(b) 

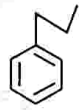
(c) 

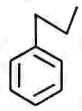
(d) none of these

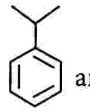
33. 2-Hexyne gives *trans*-2-hexene on treatment with
(a) Li/NH_3 (b) $Pd/BaSO_4$
(c) Pt/H_2 (d) none of these.

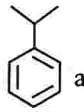
34. 

The major products *P* and *Q* are

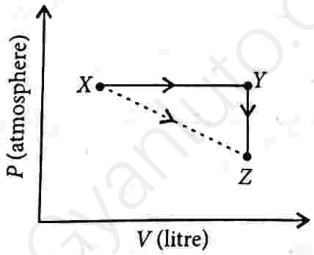
(a)  and CH_3CH_2CHO

(b)  and CH_3COCH_3

(c)  and CH_3COCH_3

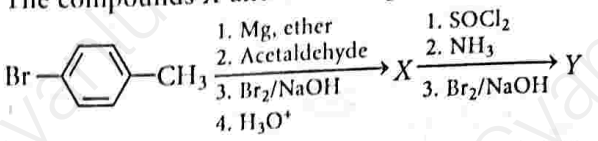
(d)  and CH_3CH_2CHO

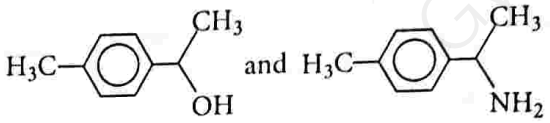
35. For an ideal gas, consider only *P-V* work in going from an initial state *X* to the final state *Z*. The final state *Z* can be reached by either of the two paths shown in the figure. Which of the following choice(s) is correct?

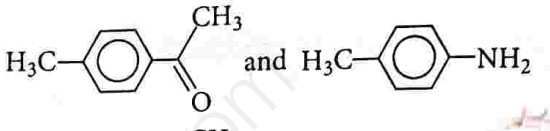


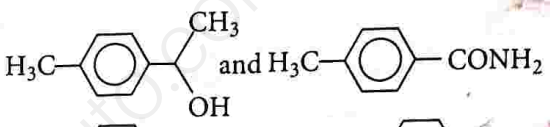
(a) $\Delta S_{X \to Z} = \Delta S_{X \to Y}$
(b) $w_{X \to Z} = w_{X \to Y} + w_{Y \to Z}$
(c) $w_{X \to Y \to Z} = w_{X \to Y}$
(d) $\Delta S_{X \to Y \to Z} = \Delta S_{X \to Y}$

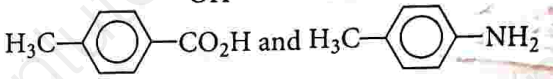
36. The compounds *X* and *Y* are respectively



(a) 

(b) 

(c) 

(d) 

37. On the basis of data given below, predict which of the following gases shows least adsorption on a definite amount of charcoal?

Gas	CO_2	SO_2	CH_4	H_2
Critical temp./K	304	630	190	33

(a) CO_2 (b) SO_2 (c) CH_4 (d) H_2

38. Match the column I with column II and mark the appropriate choice.

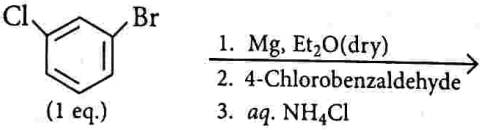
	Column I		Column II
(A)	Raincoats, hand bags	(i)	PHBV
(B)	Laminated sheets	(ii)	PVC
(C)	Television cabinets	(iii)	Urea-formaldehyde resin
(D)	Orthopaedic devices	(iv)	Polystyrene

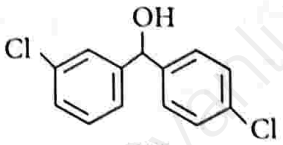
(a) (A) → (i), (B) → (ii), (C) → (iii), (D) → (iv)
(b) (A) → (iv), (B) → (i), (C) → (ii), (D) → (iii)
(c) (A) → (ii), (B) → (iii), (C) → (iv), (D) → (i)
(d) (A) → (iii), (B) → (iv), (C) → (i), (D) → (ii)

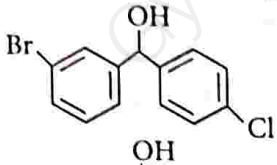
39. The freezing point of a dilute solution of acetamide in glacial acetic acid is 298 K. This is the value when crystals of
(a) ice first appears
(b) acetamide first appears
(c) acetic acid first appears
(d) both acetic acid and acetamide appear together.

40. Which of the following elements with atomic numbers 25, 30, 48 and 80 has the highest vapour pressure at room temperature?
(a) $Z = 80$ (b) $Z = 48$ (c) $Z = 30$ (d) $Z = 25$

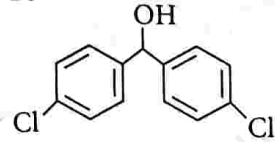
41. The product of the following reaction is



(a) 

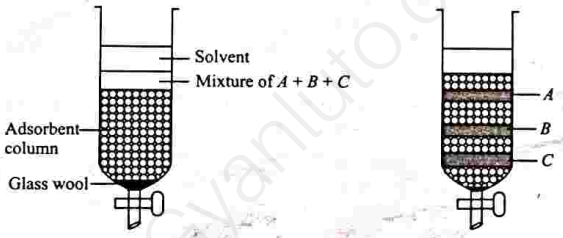
(b) 

(c) 

(d) 

42. 10 g of ammonium chloride was mixed with 10 g of slaked lime and the mixture was heated. Then
(a) 3.1 g $Ca(OH)_2$ will be left unreacted
(b) 10.4 g of $CaCl_2$ will be formed
(c) 3.2 g of NH_3 will be formed
(d) all of these are correct.

43. Given below is a column of adsorbent in which the mixture of compounds $A + B + C$ is placed. When the solvent is poured through the column, the components are separated depending upon the degree of adsorption. Which of the given statements is correct?



(a) A is the most weakly adsorbed component hence remains near the top.
(b) A is the most strongly adsorbed component hence remains near the top.
(c) C is the most strongly adsorbed component hence is found near the bottom.
(d) B is the most strongly adsorbed component hence is found in the centre of the column.

44. (Yellow ppt.) $T \xleftarrow{K_2CrO_4/H^+} X \xrightarrow{\text{dil.HCl}} \underset{\text{(Yellow ppt.)}}{Y} + \underset{\text{(Pungent smelling gas)}}{Z\uparrow}$

If X gives green flame test, then X is
(a) $MgSO_4$ (b) BaS_2O_3
(c) $CuSO_4$ (d) PbS_2O_3

45. Given below are two statements.
Statement (I) : Hybridisation of N in NH_2^-, NH_3 and NH_4^+ is same.
Statement (II) : Number of lone pairs on N in NH_2^-, NH_3 and NH_4^+ are same.
Choose the correct option.
(a) Both the statements I and II are correct.
(b) Both the statements I and II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement II is correct but statement I is incorrect.

46. Which of the following statements are incorrect?
I. Zinc can be extracted by self-reduction.
II. A depressant prevents certain type of particles to come to the froth.
III. Copper matte contains ZnS and Cu_2S.
IV. The solidified copper obtained from reverberatory furnace has blistered appearance due to evolution of SO_2 during the extraction.
(a) I and II (b) II and III
(c) I and III (d) II and IV

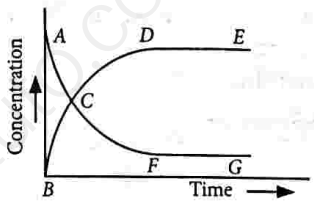
47. Match the column I with column II and mark the appropriate choice.

	Column I (Property)	Column II (Metal)	
(A)	Element with highest second ionisation enthalpy	(i)	Cr
(B)	Element with highest third ionisation enthalpy	(ii)	Cu
(C)	M in $M(CO)_6$ is	(iii)	Zn
(D)	Element with highest heat of atomisation	(iv)	Ni

(a) (A) → (ii), (B) → (iii), (C) → (i), (D) → (iv)
(b) (A) → (iv), (B) → (iii), (C) → (i), (D) → (ii)
(c) (A) → (iii), (B) → (i), (C) → (ii), (D) → (iv)
(d) (A) → (i), (B) → (ii), (C) → (iii), (D) → (iv)

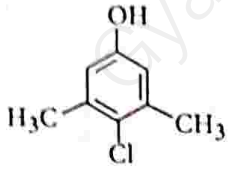
48. Which of the following is/are not correctly matched?
(1) Basic strength of hydroxides :
$CsOH < RbOH < KOH < NaOH < LiOH$
(2) Stability of peroxides :
$Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$
(3) Stability of bicarbonates :
$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$
(a) Only 1 (b) Only 3
(c) Only 1 and 2 (d) Only 2 and 3

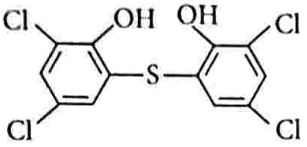
49. Reversible reaction is studied graphically as shown in the given figure.
$N_2O_4 \rightleftharpoons 2NO_2$, $K_c = 4$

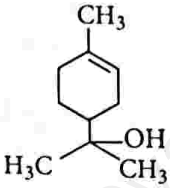


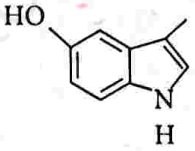
Select the correct statements out of I, II and III.
I. Reaction quotient has maximum value at point A.
II. Reaction proceeds left to right at a point when $[N_2O_4] = [NO_2] = 0.1$ M.
III. $K_c = Q$ when point D or F is reached.
(a) I, II (b) II, III (c) I, III (d) I, II, III

50. From the following, choose the correct structures of chloroxylenol and terpineol, which are the constituents of "Dettol".

(A) 

(B) 

(C) 

(D) 

(a) A and B (b) B and C
(c) A and D (d) A and C

Section-B (Numerical Value Type)

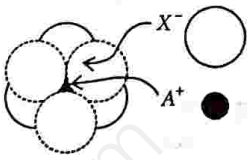
Attempt any 5 questions out of 10

51. The rate constant of a second order reaction is 5.70×10^{-5} dm^3 mol^{-1} s^{-1} at 25°C. Value of activation energy is 54.48 kJ/mol and the Arrhenius pre-exponential factor is $x \times 10^5$ dm^3 mol^{-1} s^{-1}, x is _____.

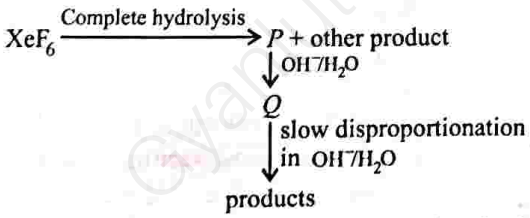
52. The complex $CoCl_3 \cdot 5NH_3$ is treated with silver nitrate solution. Maximum number of chloride ions that can be precipitated is _____.

53. An aromatic compound $A(C_7H_9N)$ on reacting with $NaNO_2/HCl$ at 0°C forms benzyl alcohol and nitrogen gas. The number of isomers possible for the compound A is _____.

54. The arrangement of X^- ions around A^+ ion in solid AX is given in the figure (not drawn to scale). If the radius of X^- is 250 pm, the radius of A^+ (in ppm) is _____.



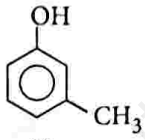
55. Under ambient conditions, the total number of gases released as products in the final step of the reaction scheme shown below is _____.

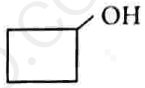


56. A decapeptide (mol. wt. 796) on complete hydrolysis gives glycine, alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is _____.

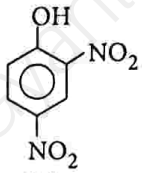
57. A 2 L vessel is filled with air at 50 °C and a pressure of 3 atm. The temperature is now raised to 200 °C. A valve is now opened so that the pressure inside drops to one atm. What will be the fraction of the total number of moles, inside escaped on opening the valve? (Assume no change in the volume of the container.)

58. Out of the following, how many of the compounds are more acidic than phenol?


(i)


(ii)


(iii)


(iv)


(v)

$CH_3CH_2CH_2OH$
(vi)

CCl_3CH_2OH
(vii)

H_2SO_4
(viii)

59. 2.496×10^{-x} g of pyrolusite containing 89.21% of MnO_2 will oxidise the same amount of oxalic acid as 37.12 mL of permanganate solution, one mL of which liberates 0.0175 g of I_2 from KI. The value of x is _____.

60. How many nodal planes are there in the atomic orbitals for the principal quantum number, $n = 3$?

MATHEMATICS

Section-A (Multiple Choice Questions)

61. Let $OP \times OQ = 1$ and let O, P and Q be three collinear points. If O and Q represent the complex numbers of origin and z respectively, then P can represent

(a) $\frac{1}{z}$ (b) $\frac{-1}{\bar{z}}$

(c) $\frac{-1}{z}$ (d) None of these

62. Let $\alpha > 0$, $\beta > 0$ be such that $\alpha^3 + \beta^2 = 4$. If the maximum value of the term independent of x in the binomial expansion of $\left(\alpha x^{\frac{1}{9}} + \beta x^{-\frac{1}{6}}\right)^{10}$ is $10\,k$, then k is equal to

(a) 336 (b) 352 (c) 84 (d) 176

63. Let $f(x) = \begin{cases} -1, & -2 \le x \le 0 \\ x-1, & 0 < x \le 2 \end{cases}$. Then $g(x) = f(|x|) + |f(x)|$ is not differentiable at how many points?

(a) 1 (b) 2 (c) 3 (d) 0

64. Out of all the patients in a hospital 89% are found to be suffering from heart ailment and 98% are suffering from lungs infection. If K% of them are suffering from both ailments, then K can not belong to the set
(a) {79, 81, 83, 85} (b) {84, 87, 90, 93}
(c) {80, 83, 86, 89} (d) {84, 86, 88, 90}

65. Let $f: R \to R$ be a function defined as

$$f(x)=\begin{cases}\dfrac{\sin(a+1)x+\sin 2x}{2x}, & \text{if } x<0\\ b, & \text{if } x=0\\ \dfrac{\sqrt{x+bx^3}-\sqrt{x}}{bx^{5/2}}, & \text{if } x>0\end{cases}$$

If f is continuous at $x = 0$, then the value of $a + b$ is equal to
(a) $-\frac{3}{2}$ (b) -3 (c) $-\frac{5}{2}$ (d) -2

66. If $\begin{bmatrix}\cos\frac{2\pi}{3} & -\sin\frac{2\pi}{3}\\ \sin\frac{2\pi}{3} & \cos\frac{2\pi}{3}\end{bmatrix}^k=\begin{pmatrix}1 & 0\\ 0 & 1\end{pmatrix}$, then the least positive value of k equals $(k \neq 0)$
(a) 1 (b) 2 (c) -1 (d) 3

67. A hyperbola having the transverse axis of length $\sqrt{2}$ has the same foci as that of the ellipse $3x^2 + 4y^2 = 12$, then this hyperbola does not pass through which of the following points?
(a) $\left(\frac{1}{\sqrt{2}},0\right)$ (b) $\left(-\sqrt{\frac{3}{2}},1\right)$
(c) $\left(1,-\frac{1}{\sqrt{2}}\right)$ (d) $\left(\sqrt{\frac{3}{2}},\frac{1}{\sqrt{2}}\right)$

68. Find the numbers of arrangements of the letters of word SALOON, if the two O's do not come together.
(a) 230 (b) 220 (c) 250 (d) 240

69. If A, B, C, D are any four points in a space, then $|\overrightarrow{AB}\times\overrightarrow{CD}+\overrightarrow{BC}\times\overrightarrow{AD}+\overrightarrow{CA}\times\overrightarrow{BD}|$ is equal to λ (area of triangle ABC), then λ is
(a) 2 (b) 4 (c) 6 (d) 8

70. The mean deviation and S.D. about actual mean of the series $a, a + d, a + 2d, ..., a + 2nd$ are respectively
(a) $\frac{n(n+1)d}{2n+1}, \sqrt{\frac{n(n-1)}{3}}\cdot d$ (b) $\frac{n(n-1)}{3}, \frac{n(n+1)}{2n}\cdot d$
(c) $\frac{n(n+1)d}{(2n+1)}, \sqrt{\frac{n(n+1)}{3}}\cdot d$ (d) $\frac{n(n-1)d}{2n-1}, \sqrt{\frac{n(n-1)}{3}}\cdot d$

71. Find domain and range of $f(x) = \sec^{-1}\left(\frac{1}{e^x}\right)$.
(a) $f_D = (-\infty, \infty), f_R = (0, \pi)$
(b) $f_D = (-\infty, 0], f_R = \left[0, \frac{\pi}{2}\right)$
(c) $f_D = \left(\frac{-\pi}{2}, \frac{\pi}{2}\right], f_R = \left(\frac{\pi}{2}, \pi\right)$
(d) $f_D = [0, \infty), f_R = [0, \pi/2)$

72. Let a_1, a_2, a_3 ... and b_1, b_2, b_3 ... be arithmetic progressions such that $a_1 = 50$, $b_1 = 150$ and $a_{100} + b_{100} = 200$, then
(a) the difference between successive terms in progression 'a' is opposite in sign of the difference in progression 'b'.
(b) $a_n + b_n = 100$ for any n.
(c) $(a_1 + b_1), (a_2 + b_2), (a_3 + b_3)$, ... are in A.P.
(d) All of these

73. The coordinates of points P lying in first quadrant on the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ for which the area of the triangle PON is maximum, where O denotes the origin and N, the foot of the perpendicular from O to the tangent at P.
(a) $\left(\frac{b^2}{a^2+b^2}, \frac{a^2}{a^2+b^2}\right)$ (b) $\left(\frac{a^2}{\sqrt{a^2+b^2}}, \frac{b^2}{\sqrt{a^2+b^2}}\right)$
(c) $\left(\frac{a}{\sqrt{a^2+b^2}}, \frac{b}{\sqrt{a^2+b^2}}\right)$ (d) $\left(\frac{a^2}{a^2+b^2}, \frac{b^2}{b^2+a^2}\right)$

74. Find the moment of the forces $\vec{p}_1 = 2\hat{i}+\hat{j}+\hat{k}$ and $\vec{p}_2 = 2\hat{i}+2\hat{j}+2\hat{k}$ about the point $\vec{r} = \hat{i}+\hat{j}+\hat{k}$.
(a) $\hat{i}-\hat{j}+\hat{k}$ (b) $\hat{j}+\hat{k}$
(c) $-(\hat{j}-\hat{k})$ (d) $\hat{i}+\hat{j}-\hat{k}$

75. The curve satisfying the equation $\frac{dy}{dx}=\frac{y(x+y^3)}{x(y^3-x)}$ and passing through the point (4, 6) is $y^3 + 2x = k\,x^2y$, the value of k equals
(a) $\frac{19}{72}$ (b) $\frac{7}{6}$ (c) $\frac{7}{3}$ (d) $\frac{19}{36}$

76. If $\int_0^{\pi}\frac{dz}{(a^2\cos^2 z+b^2\sin^2 z)^2}=\frac{\pi^2}{2}\cdot\left(\frac{a^2+b^2}{a^3b^3}\right)$, then

$$\int_{3n\pi}^{\left(n+\frac{1}{n}\right)3\pi}\frac{4x\,dx}{\left[(a^2+b^2)+(a^2-b^2)\cos\frac{2nx}{3}\right]^2},$$ where $a, b > 0$

equals
(a) $\frac{9(2n^2+1)\pi^3}{4n^2}\left(\frac{a^2+b^2}{a^3b^3}\right)$ (b) $\left(\frac{2n^2+1}{n^2}\right)\frac{a^2+b^2}{a^3b^3}$
(c) $\frac{9\pi}{n^2}\frac{a^3+b^3}{a^2b^2}$ (d) None of these

77. If the numbers of different reflexive relations on a set A is equal to the number of different symmetric relations on set A, then the numbers of elements in A is
(a) 1 (b) 3 (c) 2 (d) 7

78. Let a smooth curve $y = f(x)$ be such that the slope of the tangent at any point (x, y) on it is directly proportional to $\left(\frac{-y}{x}\right)$. If the curve passes through the points (1, 2) and (8, 1), then $\left|y\left(\frac{1}{8}\right)\right|$ is equal to
(a) $2\log_e 2$ (b) 4 (c) 1 (d) $4\log_e 2$

79. Consider the statement, p : Joseph plays well and q : John studies well. Then the contrapositive of the implication $p \rightarrow q$ is
(a) If Joseph plays well, then John studies well.
(b) If John does not play well, then John does not study well.
(c) If John does not study well, then Joseph does not play well.
(d) None of these

80. The n^{th} term of the series $\frac{1^3}{1} + \frac{1^3+2^3}{1+3} + \frac{1^3+2^3+3^3}{1+3+5} + \ldots$ will be
(a) $n^2 + 2n + 1$ (b) $\frac{n^2+2n+1}{8}$
(c) $\frac{n^2+2n+1}{4}$ (d) $\frac{n^2-2n+1}{4}$

Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

81. $\lim\limits_{n\to\infty} \frac{[x]+[3x]+[5x]+\ldots+[(2n-1)x]}{n^2} = \lambda x$, where $\lambda =$ _____.

82. If the complex numbers z for which $\arg\left[\frac{3z-6-3i}{2z-8-6i}\right] = \frac{\pi}{4}$ and $|z - 3 + i| = 3$, are $\left(k - \frac{4}{\sqrt{5}}\right) + i\left(1 + \frac{2}{\sqrt{5}}\right)$ and $\left(k + \frac{4}{\sqrt{5}}\right) + i\left(1 - \frac{2}{\sqrt{5}}\right)$ then k must be equal to _____.

83. The integral value of α for which the point $(\alpha - 1, \alpha + 1)$ lies in the larger segment of the circle $x^2 + y^2 - x - y - 6 = 0$ made by the chord whose equation is $x + y - 2 = 0$ is _____.

84. Let λ be an integer. If the shortest distance between the lines $x - \lambda = 2y - 1 = -2z$ and $x = y + 2\lambda = z - \lambda$ is $\frac{\sqrt{7}}{2\sqrt{2}}$, then the value of $|\lambda|$ is _____.

85. Let S be the set of all integer solutions, (x, y, z), of the system of equations
$x - 2y + 5z = 0$; $-2x + 4y + z = 0$; $-3x + 6y + 7z = 0$
such that $25 \le x^2 + y^2 + z^2 \le 200$. Then, the number of elements in the set S is equal to _____.

86. If $\int \frac{\log_x e \cdot \log_{ex} e \cdot \log_{e^2 x} e}{x} dx = A \log_e \log_e x + B\log(1 + \log_e x) + C\log(2 + \log_e x) + \lambda$, then $(A + B + C)$ is equal to _____.

87. Each of m urns consisting 6 yellow and 8 black balls. The $(m + 1)^{th}$ urn consisting 7 green and 7 black balls. One of the $(m + 1)$ urns is selected randomly and two balls are drawn from it without replacement and found to be black. If the probability that $(m + 1)^{th}$ urn was selected to draw the ball is 1/17, then the value of m equal _____.

88. The number of integers greater than 6000 that can be formed by using the digits 3, 5, 6, 7 and 8 if digits are not repeated is _____.

89. A ray of light passing through the point P (2, 3) reflects on the x-axis at point A and the reflected ray passes through the point Q(5, 4). Let R be the point that divides the line segment AQ internally into the ratio 2 : 1. Let the co-ordinates of the foot of the perpendicular M from R on the bisector of the angle PAQ be (α, β). Then, the value of $7\alpha + 3\beta$ is equal to _____.

90. For $p > 0$, a vector $\vec{v}_2 = 2\hat{i} + (p+1)\hat{j}$ is obtained by rotating the vector $\vec{v}_1 = \sqrt{3}p\hat{i} + \hat{j}$ by an angle θ about origin in counter clockwise direction. If $\tan\theta = \frac{(\alpha\sqrt{3}-2)}{(4\sqrt{3}+3)}$, then the value of α is equal to _____.

SPACE FOR ROUGH WORK