

# Sankalp IIT

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IN JEE MAIN AND ADVANCED

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Time : 3 hrs.

Max. Marks: 360

### Topics covered in various subjects :

- Physics** : Mathematical Tools (Graphs & Vectors), Physics and Measurement, Kinematics, Laws of Motion
- Chemistry** : Some basic concepts of Chemistry, States of Matter (Gaseous & Liquid), Atomic Structure, Classification of Elements and Periodicity in Properties; Chemical Bonding and Molecular Structure
- Mathematics** : Sets, Relations, Functions, Trigonometric ratios and Identities, Trigonometric Equations, Inverse Trigonometric Functions, Heights and Distances

### Instructions:

- (i) Duration of Test is 3 hrs.
- (ii) The Test booklet consists of 90 questions. The maximum marks are 360.
- (iii) There are **three** parts in the question paper. Distribution of marks subjectwise in each part is as under for each correct response.
  - Part A – PHYSICS (120 marks)** – Questions No.1 to 30 consist **FOUR (4)** marks each for each correct response.
  - Part B – CHEMISTRY (120 marks)** – Questions No.31 to 60 consist **FOUR (4)** marks each for each correct response.
  - Part C – MATHEMATICS (120 marks)** – Questions No.61 to 90 consist **FOUR (4)** marks each for each correct response.
- (iv) One fourth ( $\frac{1}{4}$ ) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
- (v) **Pattern of the Question: Section – I : Multiple Type Objective Questions** (Straight Single Choice Multiple Type Questions); **Section – II: Assertion – Reason Type Questions**; **Section – III: Comprehension Type Questions** : (One Comprehension Type Question should have 3 questions - Multiple Concept Questions); **Section – IV: Straight Objective Questions**: (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

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## [ PART - A : PHYSICS ]

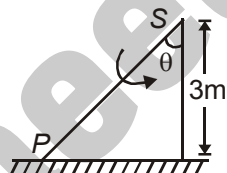
## SECTION - I

Straight Single Choice Multiple Type Questions /  
Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 1 to 16. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

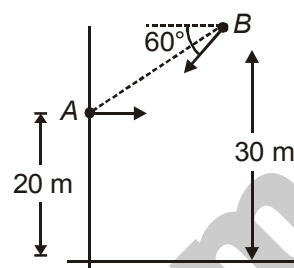
- In the equation  $\frac{2x}{\sqrt{2ax-x^2}} = a^n \sin^{-1}\left(\frac{x}{a}-1\right)$  the value of  $n$  is  
(1) 0 (2) 1  
(3) 2 (4) 3
- Linear momentum of a body is increased by 0.1% keeping mass of the body constant. Percentage increase in its kinetic energy is  
(1) 0.1% (2) 0.05%  
(3) 0.2% (4) 0.4%
- The volume of a body is  $2 \text{ m}^3$ . The volume of this body in a system in which unit of length is  $x \text{ m}$  will be  
(1)  $2x^3$  (2)  $\frac{2}{x^3}$   
(3)  $2x$  (4)  $\frac{2}{x}$
- The volume of a sphere is  $2.44 \text{ cm}^3$ . The volume of 16 such spheres taking into account the significant figure is  
(1) 38 (2) 39.0  
(3) 38.88 (4) 38.8
- Spotlight  $S$  rotates in a horizontal plane with constant angular velocity. The spot of light  $P$  moves with speed  $0.6 \text{ m/s}$  along the wall at a distance of  $3 \text{ m}$  when  $\theta = 60^\circ$ . The angular velocity of spotlight is



- 0.3 rad/s
  - 0.2 rad/s
  - 0.4 rad/s
  - 0.05 rad/s
- A body is thrown vertically upward with a speed of  $40 \text{ m/s}$  at  $t = 0$  and another body of same mass is projected with same velocity at  $t = 3 \text{ s}$ . Time  $t$  at which they will collide is  
(1) 4.5 s (2) 5.5 s

- 3.5 s
- 6.5 s

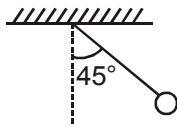
- An object  $A$  of mass  $m$  is thrown from point  $A$  horizontally with a velocity of  $10 \text{ m/s}$ . Simultaneously another object of mass  $2m$  is from  $B$  at an angle of  $60^\circ$  with the horizontal towards with the same magnitude of initial velocity as that of the first object. The two objects move in the same vertical plane. Choose the incorrect statement.



- Relative acceleration between them is zero
  - For collision relative velocity of  $B$  w.r.t.  $A$  should be along  $BA$
  - Relative motion between them will be non-uniform
  - Initial horizontal components of  $A$  and  $B$  are different
- $ABCDEF$  is a regular hexagon and its centre is at  $O$ . The vector sum  $\vec{OA} + \vec{OB} + \vec{OC} + \vec{OD} + \vec{OE}$  is  
(1)  $\vec{OA}$  (2)  $\vec{OB}$   
(3)  $\vec{OC}$  (4) Zero
  - A cart is moving along  $x$ -direction with a velocity  $3 \text{ m/s}$ . A person on the cart throws a stone with a velocity of  $6 \text{ m/s}$  relative to himself. In the frame of reference of the cart, the stone is thrown in  $y-z$  plane making an angle of  $30^\circ$  with vertical  $z$ -axis. The velocity of projection of the stone (with respect to ground) is  
(1)  $3\hat{i} + 3\hat{j} + 3\sqrt{3}\hat{k}$   
(2)  $3\hat{i} + 4\hat{j} + 3\sqrt{3}\hat{k}$   
(3)  $3\sqrt{3}\hat{i} + 4\hat{j} + 3\hat{k}$   
(4)  $3\sqrt{3}\hat{i} + 3\hat{j} + 4\hat{k}$
  - The initial velocity of a body is  $11 \text{ m/s}$  towards north and its acceleration is  $2 \text{ m/s}^2$  towards south. The distance travelled by the body in  $6^{\text{th}}$  second is  
(1) 1 m (2) 0.5 m  
(3) 0.25 m (4) Zero
  - A car is moving in a circular horizontal track of radius  $100 \text{ m}$  with a constant speed. A bob is suspended from the roof of the car by a light and small rigid rod.

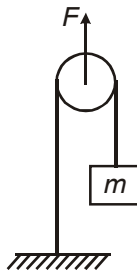
Class (XII)

The angle made by the rod with reference to its initial vertical line is  $45^\circ$  as shown in figure. The speed of the car is



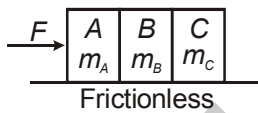
- (1) 5 m/s (2)  $10\sqrt{10}\text{ms}^{-1}$   
 (3) 15 m/s (4) 20 m/s

12. In the arrangement shown the pulley is massless and frictionless. The acceleration of the pulley is



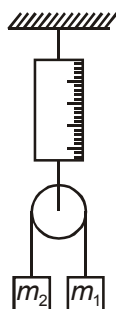
- (1)  $\frac{F - 2mg}{m}$  (2)  $\frac{F - 2mg}{2m}$   
 (3)  $\frac{F - 2mg}{4m}$  (4)  $\frac{F - 2mg}{8m}$

13. In the arrangement shown if B exerts a force  $f$  on C then the force  $F$  acting on A is



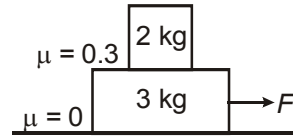
- (1)  $f \left[ \frac{m_A + m_B}{m_C} + 1 \right]$  (2)  $f \left[ \frac{m_A + m_C}{m_B} + 1 \right]$   
 (3)  $f \left[ \frac{m_B + m_C}{m_A} + 1 \right]$  (4)  $f \left[ \frac{m_A}{m_B + m_C} + 1 \right]$

14. In the arrangement shown pulley is massless and frictionless and spring balance is light. The reading of spring balance is



- (1)  $= (m_1 + m_2)g$  (2)  $< (m_1 + m_2)g$   
 (3)  $> (m_1 + m_2)g$  (4)  $\leq (m_1 + m_2)g$

15. In the arrangement the maximum value of  $F$  for which both the blocks move together is



- (1) 10 N (2) 15 N  
 (3) 20 N (4) 25 N

16. If the coefficient of friction between tyres and road is 1 then the minimum time taken by the car starting from rest to travel through 500 m is

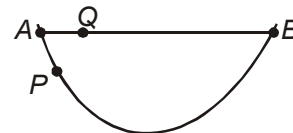
- (1) 5 s (2) 10 s  
 (3) 15 s (4) 20 s

SECTION - II

Assertion – Reason Type Questions

**Directions :** Questions number 17 to 21 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

17. A particle Q is projected at  $t = 0$  along the horizontal string with speed  $v$  from point A



Particle P is sliding down a frictionless hemispherical bowl such that horizontal component of its velocity is  $v$  when passes the point A at  $t = 0$ .

Statement-1 : Time taken by the particle P will be less than, time taken by the particle Q to reach B.

and

Statement-2 : Horizontal displacement for both the particles are equal.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1  
 (2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1  
 (3) Statement-1 is True, Statement-2 is False  
 (4) Statement-1 is False, Statement-2 is True
18. Statement-1 : The magnitude of relative velocity of A with respect to B is lesser than the speed of either, when they are moving in same direction.

Class (XII)

and

Statement-2 : If velocity of A is  $V_A$ , velocity of B is  $V_B$  then velocity of A with reference to B is given by

$$\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$$

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
- (3) Statement-1 is True, Statement-2 is False
- (4) Statement-1 is False, Statement-2 is True
19. Statement-1 : Earth is a non-inertial frame because the earth is revolving round the sun.

and

Statement-2 : Accelerated frame is a non-inertial frame of reference.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
- (3) Statement-1 is True, Statement-2 is False
- (4) Statement-1 is False, Statement-2 is True
20. Statement-1 : For one dimensional motion the angle between acceleration and velocity will be either zero or  $180^\circ$ .

and

Statement-2 : If velocity of a particle is always perpendicular to acceleration then the particle must be moving on a circular path.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
- (3) Statement-1 is True, Statement-2 is False
- (4) Statement-1 is False, Statement-2 is True
21. Statement-1 : Newton's second law of motion is valid in inertial frame only.

and

Statement-2 : Newton's first and third law are contained in second law.

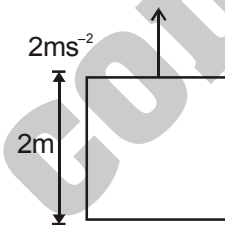
- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
- (3) Statement-1 is True, Statement-2 is False
- (4) Statement-1 is False, Statement-2 is True

## SECTION - III

## Comprehension Type Questions

**Directions :** Question No. 22 to 24 are based on the following paragraph.

A lift starts from rest at  $t = 0$  sec and ascends with constant acceleration of  $a = 2\text{ms}^{-2}$ . At  $t = 2$  sec, A loose bolt separates from the ceiling of lift. The height of lift is 2 m.



22. After what time, will the bolt (after being loosen) strike with the floor of lift
- (1) 1.9 sec (2)  $\frac{1}{2}$  sec
- (3)  $\frac{1}{\sqrt{3}}$  sec (4) 1.5 sec
23. The displacement of bolt (after being loosen) till it strikes with floor
- (1)  $\frac{1}{\sqrt{3}}$  m (2)  $\frac{5}{3}$  m
- (3)  $\left(\frac{4}{\sqrt{3}} - \frac{5}{3}\right)$  m (4)  $\frac{4}{\sqrt{3}}$  m
24. The speed with which bolt strikes with floor of lift
- (1)  $\left(4 - \frac{10}{\sqrt{3}}\right)\text{ms}^{-1}$  (2)  $\left(4 + \frac{10}{\sqrt{3}}\right)\text{ms}^{-1}$
- (3)  $\frac{10}{\sqrt{3}}\text{ms}^{-1}$  (4)  $\left(2 + \frac{10}{\sqrt{3}}\right)\text{ms}^{-1}$

## SECTION - IV

## Straight Objective Questions

**Directions :** Question No. 25 to 30 are based on the following Multiple concept questions and/or difficulty/lengthy calculations & application based questions.

Class (XII)

25. A block slides down an inclined plane with constant velocity. It is then projected up the same plane, with an initial velocity  $V_0$ . It will move before coming to rest is

( $\theta \rightarrow$  angle which the inclined plane makes with vertical)

- (1)  $\frac{V_0^2}{2g \cos \theta}$
- (2)  $\frac{V_0^2}{2g \sin \theta}$
- (3)  $\frac{V_0^2}{4g \cos \theta}$
- (4)  $\frac{V_0^2}{4g \sin \theta}$
26. A cylinder mounted on an horizontal axle. A massless string wound on it two and half turn and connected to two masses  $m$  and  $3m$ . If the system is in limiting equilibrium, the coefficient of friction between the string and the pulley surface is
- (1)  $\frac{1}{5\pi} \ln(3)$                       (2)  $\frac{1}{\pi} \ln(3)$
- (3)  $\frac{1}{2\pi} \ln(5)$                       (4)  $\frac{1}{\pi} \ln(5)$
27. The coordinates of a particle moving in a plane are given by  $x(t) = a \cos(pt)$  and  $y(t) = b \sin(pt)$ , where  $a$ ,  $b (< a)$  and  $p$  are positive constant of appropriate dimensions, displacement of the particle from

$$t = 0 \text{ to } t = \frac{\pi}{2p}$$

- (1)  $a + b$
- (2)  $2a + b$
- (3)  $\frac{\sqrt{a^2 + b^2}}{2}$
- (4)  $\sqrt{a^2 + b^2}$

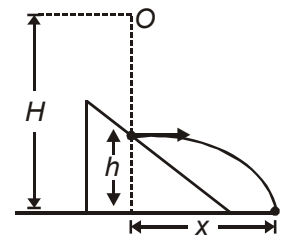
28. A body released from a given height  $H$  hits a fixed inclined plane in its path at a height  $h$ . As a result of this impact the direction of the velocity of the body becomes horizontal. Total flight time of the body is (Assume that collision is elastic)

(1)  $\sqrt{\frac{2}{g}} (\sqrt{H-h} + \sqrt{h})$

(2)  $\sqrt{\frac{2}{g}} (\sqrt{H-h} - \sqrt{h})$

(3)  $\sqrt{\frac{1}{g}} (\sqrt{H-h} + \sqrt{h})$

(4)  $\sqrt{\frac{1}{g}} (\sqrt{H-h} - \sqrt{h})$

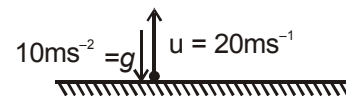


29. A particle is moving on a circular path of radius  $r = 2\text{m}$ . The speed of particle is increasing at the constant rate of  $4.5 \text{ ms}^{-2}$ . At the instant when speed of the particle is  $3 \text{ ms}^{-1}$ , the angle ' $\alpha$ ' between direction of total acceleration and tangential direction, will be

- (1)  $45^\circ$
- (2)  $30^\circ$
- (3)  $60^\circ$

(4)  $\tan^{-1} \left( \frac{1}{2} \right)$

30. A particle is vertically projected with initial speed of  $20 \text{ ms}^{-1}$ , freely under gravity. The time interval between the incidents when the particle will be at the height of  $10\text{m}$  above the point of projection, is



- (1)  $4\sqrt{2} \text{ sec}$
- (2)  $2 \text{ sec}$
- (3)  $2\sqrt{2} \text{ sec}$
- (4)  $\sqrt{2} \text{ sec}$

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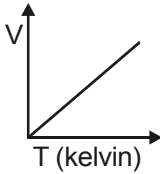
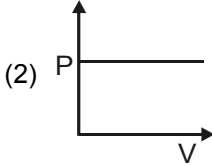
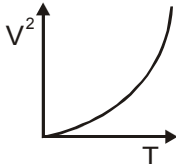
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## [ PART - B : CHEMISTRY ]

## SECTION - I

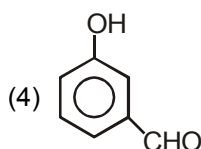
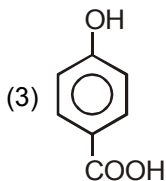
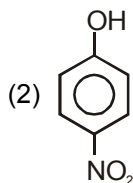
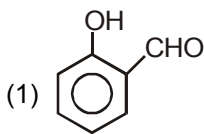
Straight Single Choice Multiple Type Questions /  
Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 31 to 46. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

31. The hybridisation of N & C in  $\text{CH}_2-\text{NH}_2^+$  are respectively
- (1)  $sp^3, sp^2$  (2)  $sp^2, sp^2$   
(3)  $sp^2, sp^3$  (4)  $sp^2, sp$
32. Which of the following has highest electron affinity?
- (1) F (2) B  
(3) Cl (4) O
33. In a container having movable piston, 1 mole  $\text{CO}_2$  gas is filled. If at same temperature one mole  $\text{CO}_2$  is further introduced, the density of gas will be (assuming ideal behavior)
- (1) Unchanged (2) Doubled  
(3) Halved (4) Unpredictable
34. Same number of atoms as 4 gram  $\text{H}_2$  gas are present in
- (1) 64 gram  $\text{SO}_2$  gas (2) 56 gram  $\text{N}_2$  gas  
(3) 40 gram  $\text{SO}_3$  gas (4) Both (2) & (3)
35. The equivalent weight of HCl when it is treated with  $\text{K}_2\text{Cr}_2\text{O}_7$  is (M is molar mass of HCl)
- (1)  $\frac{M}{6}$  (2)  $\frac{5M}{3}$   
(3)  $\frac{7M}{3}$  (4)  $\frac{7M}{6}$
36. For which of the following gas molar volume at N.T.P. will be greater than 22.4L?
- (1)  $\text{CO}_2$   
(2) He  
(3)  $\text{N}_2$   
(4) No such gas is possible
37. Vapour pressure inside a container is 1 atm at  $100^\circ\text{C}$ . If at same temperature volume of container becomes half, the final vapour pressure will be
- (1) 1 atm (2) 2 atm  
(3) 0.5 atm (4) 0.75 atm
38. In which of the following electron transition in  $\text{Li}^{+2}$  same wavelength is observed as  $4 \rightarrow 2$  transition of  $\text{He}^{+}$ ?
- (1)  $4 \rightarrow 3$   
(2)  $6 \rightarrow 4$   
(3)  $6 \rightarrow 3$   
(4) No transition is possible
39. Which of the following is correct relationship?
- (1) Radius of orbit  $\propto \frac{n^2}{Z^2}$   
(2) K.E.  $\propto \frac{Z^2}{n}$   
(3) Force of attraction  $\propto \frac{Z^3}{n^3}$   
(4) Time of revolution  $\propto \frac{n^3}{Z^2}$
40. Which of the following has different number of radial nodes?
- (1) 4 d (2) 3 p  
(3) 2 s (4) 3 d
41. If Aufbau principle is not allowed the maximum number of elements in 4<sup>th</sup> period of periodic table will be
- (1) 8 (2) 18  
(3) 32 (4) 50
42. Which of the following is correct about Charles' law ?
- (1)  (2)   
(3)  (4) All of these
43. In Bohr's atomic model which of the following properties related to an orbit is independent to mass of electron?
- (1) Velocity (2) Time of revolution  
(3) Kinetic energy (4) Radius

Class (XII)

44. Which has maximum vapour pressure at a given temperature?



45. A gas can be liquified
- (1) above its critical temperature
  - (2) at its critical temperature
  - (3) below its critical temperature
  - (4) at any temperature
46. How many grams of  $H_2O$  can be formed by 8 grams of each  $H_2$  and  $O_2$  gases?
- (1) 9 g
  - (2) 16 g
  - (3) 18 g
  - (4) 12 g

### SECTION - II

#### Assertion – Reason Type Questions

**Directions :** Questions number 47 to 51 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

47. Statement-1 : If one mole acetic acid is completely neutralised by NaOH,  $-13.7$  kcal heat is released.

and

Statement-2 : Acetic acid is a weak acid.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
  - (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
  - (3) Statement-1 is True, Statement-2 is False
  - (4) Statement-1 is False, Statement-2 is True
48. Statement-1 : In selection of acidic medium for  $K_2Cr_2O_7$ , HCl can not be used as acid.

and

Statement-2 : HCl reacts with  $K_2Cr_2O_7$  & reduces it.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
  - (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
  - (3) Statement-1 is True, Statement-2 is False
  - (4) Statement-1 is False, Statement-2 is True
49. Statement-1 : For hypothetical g subshell, value of azimuthal quantum no. will be 4.

and

Statement-2 : For g subshell the minimum value of principal quantum number will be 5.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
  - (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
  - (3) Statement-1 is True, Statement-2 is False
  - (4) Statement-1 is False, Statement-2 is True
50. Statement-1 : According to M.O. theory,  $O_2^+$  possess paramagnetic character

and

Statement-2 : The stability of  $O_2^+$  greater than  $O_2$ .

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
  - (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
  - (3) Statement-1 is True, Statement-2 is False
  - (4) Statement-1 is False, Statement-2 is True
51. Statement-1 : The energy of an electron is largely determined by its principal quantum number

and

Statement-2 : The principal quantum number is a measure of the most possible distance of binding the electron around the nucleus

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- (2) Statement-1 is True, Statement-2 is True; Statement-2 is **NOT** a correct explanation for Statement-1
- (3) Statement-1 is True, Statement-2 is False
- (4) Statement-1 is False, Statement-2 is True



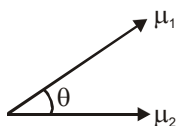
## SECTION - III

## Comprehension Type Questions

**Directions :** Question No. 52 to 54 are based on the following paragraph.

The resultant bond moments is called dipole moment. The bond moment can be calculated as  $\mu = q \times d$

For calculation of dipole moment for two bond moment  $\mu_1$  &  $\mu_2$ .



$$\mu = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2 \cos \theta}$$

52. If dipole moment of bromobenzene  $x$  debye, the dipole moment of 1, 2, 3, 5-tetrabromo-benzene is

- (1)  $x$  debye (2)  $2x$  debye  
(3)  $5x$  debye (4)  $\frac{\sqrt{5}}{2} x$  debye

53. Which of the following has maximum dipole moment?

- (1) o-chlorotoluene (2) m-chlorotoluene  
(3) p-chlorotoluene (4) Same in all of these

54. The net dipole moment is zero in

- (1)  $\text{PBr}_2\text{Cl}_3$  (2)  $\text{PBr}_3\text{Cl}_2$   
(3)  $\text{SF}_4$  (4)  $\text{ICl}_5^\ominus$

## SECTION - IV

## Straight Objective Question

**Directions :** Question No. 55 to 60 are based on (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

55. Which type of bond is not present in  $\text{HNO}_2$  molecule?  
(1) Covalent  
(2) Co-ordinate  
(3) Ionic  
(4) Ionic as well as co-ordinate
56. Among the following the molecule with the highest dipole moment is  
(1)  $\text{CH}_3\text{Cl}$  (2)  $\text{CH}_2\text{Cl}_2$   
(3)  $\text{CHCl}_3$  (4)  $\text{CCl}_4$
57. 0.3 mole Zn, 0.5 mole Fe & 1.1 mole S are mixed to form maximum amount of  $\text{Zn}(\text{FeS}_2)_2$ . Which of the following statements are correct?  
(i) Fe is limiting reagent  
(ii) 0.25 mole  $\text{Zn}(\text{FeS}_2)_2$  is formed  
(iii) Zn is completely consumed  
(1) I & III (2) II & III  
(3) I & II (4) I, II & III
58. No. of resonating structure & bond order of  $\text{PO}_4^{3-}$  are respectively  
(1) 4, 2 (2) 5, 2.5  
(3) 5, 1.25 (4) 4, 1.25
59. The magnetic moment of  $\text{Mn}^{+n}$  is 4.9 B.M. The number of unpaired  $e^-$  and value of  $x$  are respectively  
(1) 4, 1 (2) 5, 3  
(3) 4, 3 (4) 5, 1
60. The moles of  $\text{KMnO}_4$  required in alkaline medium to convert 1 mole  $\text{Sb}_2\text{S}_3$  in  $\text{SbO}_4^{3-}$  and  $\text{SO}_2$  gas are  
(1) 4.4  
(2) 22  
(3) 20  
(4) 4

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## [ PART - C : MATHEMATICS ]

## SECTION - I

Straight Single Choice Multiple Type Questions /  
Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 61 to 76. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

61. If  $3^{\sin 2x + 2\cos^2 x} + 3^{1 - \sin 2x + 2\sin^2 x} = 28$ , then the numerical value of  $\tan x$  can be

- (1) -1 (2) 1  
(3) 0 (4) Non-existent

62. If  $2\sin\alpha \cdot \cos\beta \sin\gamma = \sin\beta \sin(\alpha + \gamma)$ , where

$\alpha, \beta, \gamma \neq \frac{n\pi}{2}, n \in \mathbb{Z}$ , then  $\tan\alpha, \tan\beta, \tan\gamma$  are in

- (1) A.P.  
(2) G.P.  
(3) H.P.  
(4) A.G.P. with common ratio greater than 1

63. functions

If  $2\tan^2 x - 5\sec x = 1$  has exactly 7 distinct roots in the

interval  $x \in \left[0, \frac{n\pi}{2}\right], n \in \mathbb{N}$ , then the least value of  $n$  is

- (1) 13 (2) 15  
(3) 11 (4) 9

64. Let  $A = \{1, 2, 3\}$  and  $B = \{1, 2, 3, 4, 5, 6\}$  be two given sets. A function  $f$  from  $A$  to  $B$  is defined such that  $f(i) \geq f(j)$  for  $i > j$ . The total number of such possible functions is

- (1) 50 (2) 71  
(3) 65 (4) 56

65. The set of values of  $k$  for which the inequality  $x^2 - kx + \sin^{-1}(\sin 4) > 0$  holds good is

- (1)  $\phi$  (2)  $R$   
(3)  $(-2, 2)$  (4)  $R^+$

66. The function  $f$  defined as  $f(x) = \cos^2 x + \sin^2 x$

- (1) Has fundamental period  $\frac{\pi}{2}$   
(2) Has fundamental period  $\pi$   
(3) Is not a periodic function  
(4) Is a periodic function, having no fundamental period

67. The number of possible solution(s) of the equation

$\frac{x}{\tan^{-1} x} + \frac{y}{\tan^{-1} y} + \frac{z}{\tan^{-1} z} = 3$  will be (where  $x, y$  and

$z$  are three distinct non zero real numbers)

- (1) Zero (2) One  
(3) Three (4) Infinite

68. The numerical value of the expression  $\tan^6 20^\circ - 33 \tan^4 20^\circ + 27 \tan^2 20^\circ$  is

- (1) 0 (2) 3  
(3) 1 (4) 2

69. Let  $a$  and  $b$  be two real numbers such that

$$\sin a + \sin b = \frac{\sqrt{2}}{2}$$

$$\cos a + \cos b = \frac{\sqrt{6}}{2}$$

then  $(a + b)$  may be equal to

- (1)  $\frac{\pi}{6}$  (2)  $\frac{\pi}{4}$   
(3)  $\frac{\pi}{3}$  (4)  $\frac{\pi}{2}$

70. Period of  $\sin\left(\frac{2\pi x}{10!}\right) + \cos\left(\frac{\pi x}{9!}\right)$  is equal to

- (1)  $9.9!$  (2)  $\frac{10!}{2}$   
(3)  $10!$  (4)  $2.10!$

71. If  $\tan 35^\circ = a$ , then the value of

$\frac{\tan(215^\circ) - \tan(125^\circ)}{\tan(235^\circ) + \tan(325^\circ)}$  in terms of  $a$  is

- (1)  $\frac{a^2 + 1}{a^2 - 1}$  (2)  $\frac{a^2 + 1}{1 - a^2}$   
(3)  $\frac{1 - a^2}{1 + a^2}$  (4)  $\frac{a^2 - 1}{a^2 + 1}$

72. Let a function  $f : \mathbb{R} \rightarrow (-\infty, 1)$  is given by  $f(x) = 1 - 2^{-x}$ , then its inverse is

- (1)  $1 + \log_2(-x)$  (2)  $1 - \log_2(-x)$   
(3)  $\log_2(1 - x)$  (4)  $-\log_2(1 - x)$

73. Range of the function  $f(x) = \log(x^2 + 4x + 5)$  is

- (1)  $(\log 2, \infty)$  (2)  $(-\infty, \infty)$   
(3)  $[\log 5, \infty]$  (4)  $[0, \infty)$

74. If  $\tan \alpha = 3$  and  $\alpha \in \left(\pi, \frac{3\pi}{2}\right)$ , then the value of the

expression  $\frac{\cos^2 \alpha}{\sin^4 \alpha + \cos^4 \alpha}$  is

(1)  $\frac{3}{41}$  (2)  $\frac{2}{41}$

(3)  $\frac{1}{41}$  (4)  $\frac{5}{41}$

75. Number of solutions of  $y = 2x$  and  $y = \tan x$  for  $x$  lying in  $[0, 4\pi]$  is

(1) 3 (2) 4

(3) 2 (4) 5

76. The interval of  $a$  for which  $f : R \rightarrow R$  given as  $f(x) = ax^3 + x^2 + 2x + 3$  is one-one function is

(1)  $(0, \infty)$  (2)  $(-\infty, \infty)$

(3)  $\left(\frac{1}{6}, \infty\right)$  (4)  $(6, \infty)$

## SECTION - II

### Assertion – Reason Type Questions

**Directions :** Questions number 77 to 81 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

77. Statement-1 : A function  $f, f : R \rightarrow R$ , defined as  $f(x) = 3x + \cos x$  is an invertible function

and

Statement-2 : A function is an invertible function if and only if, it is one-one as well as onto function.

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

78. Statement-1 : The complete solution set of  $[\cot^{-1}x]^2 - 6[\cot^{-1}x] + 9 \leq 0$ , where  $[\cdot]$  denotes greatest integer function is  $[\cot 3, \infty)$ .

and

Statement-2 : The range of  $f(x) = \cot^{-1}x$  is  $(0, \pi)$ .

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

79. Statement-1 :  $\tan^{-1}(1/2) + \tan^{-1}(2) = \pi/2$

and

Statement-2 :  $\tan^{-1}(1/x) + \tan^{-1}(x) = \pi/2, \forall x \in R - \{0\}$

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

80. Let  $f(x) = 1 + x^2, g(x) = 4, \forall x \in R$

Statement-1 :  $(f \circ g)(x) = 17$

and

Statement-2 : Range of  $g$  lies in domain of  $f$ .

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

81. Let  $f : R \rightarrow R$  given by

$$f(x) = ax^5 + bx^2 + c, a, b, c \in R$$

Statement-1 : ' $f$ ' is onto function

and

Statement-2 : Odd degree polynomials are onto functions for  $x \in R$

(1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

## SECTION - III

## Comprehension Type Questions

**Directions :** Question No. 82 to 84 are based on the following paragraph.

Let  $\cos\theta_1, \cos\theta_2, \cos\theta_3$  are roots of the equation  $6x^3 - 11x^2 + 6x - 1 = 0$

82. Value of  $\cos^2 \frac{\theta_1}{2} + \cos^2 \frac{\theta_2}{2} + \cos^2 \frac{\theta_3}{2}$  is equal to

(1)  $\frac{4}{5}$  (2)  $\frac{2}{3}$

(3) 0 (4)  $\frac{29}{12}$

83. Value of  $\cos^3\theta_1 + \cos^3\theta_2 + \cos^3\theta_3$  is equal to

(1)  $\frac{1321}{216}$  (2)  $\frac{1241}{216}$

(3) 0 (4)  $\frac{58}{216}$

84. Value of  $\cos 2\theta_1 + \cos 2\theta_2 + \cos 2\theta_3$  is equal to

(1)  $\frac{5}{18}$  (2)  $\frac{1}{6}$

(3)  $\frac{1}{9}$  (4)  $-\frac{5}{18}$

## SECTION - IV

## Straight Objective Question

**Directions :** Question No. 85 to 90 are based on (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

85. Let  $R = \{(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)\}$  on set  $A = \{1, 2, 3, 4\}$ . Minimum number of ordered pairs to be added in  $R$  such that extended relation is an equivalence relation is

(1) 1 (2) 9  
(3) 12 (4) 11

86. If  $2f(x) + 3f(1/x) = x^2 - 1$ , then  $f(x)$  is

- (1) a periodic function  
(2) an even function  
(3) an odd function  
(4) even and odd both

87. If  $\theta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ , then the number of solution(s) of the equation

$$(1 - \tan\theta)(1 + \tan\theta) \cdot \sec^2\theta + 2^{\tan^2\theta} = 0$$
 will be

- (1) Two (2) Zero  
(3) Four (4) Infinite

88. If  $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \pi$ , then

$x\sqrt{1-x^2} + y\sqrt{1-y^2} + z\sqrt{1-z^2}$ , when simplified reduces to

- (1)  $4xyz$  (2)  $2xyz$   
(3)  $xyz$  (4)  $6xyz$

89. If  $x \in [0, 10\pi]$  and  $y \in \mathbb{R}$ , then the number of solutions of the equation

$$12 \sin x + 5 \cos x = 2y^2 - 8y + 21$$
 will be

- (1) 10 (2) 5  
(3) 15 (4) Zero

90. The value of

$$\tan^{-1}(1) + \tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{1}{7}\right) + \tan^{-1}\left(\frac{1}{13}\right) \dots \dots 10$$

terms is

- (1)  $\cot^{-1}(10)$  (2)  $\tan^{-1}(10)$   
(3)  $\tan^{-1}(11)$  (4)  $\cot^{-1}(11)$

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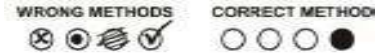
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5. Circles should be darkened completely and properly.
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