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LACHIT-35 SCHOLARSHIP TEST : Test – 3 (Objective)
 (for PCST - 2023)

Time : 1 Hr.



LACHIT-35 SCHOLARSHIP TEST

Instructions :

- (i) **WRITE YOUR NAME AND PHONE NUMBER IN THE ANSWER SHEET** and Use Blue/Black ball point pen only to WRITE THE CORRECT OPTIONS.
- (ii) Attempt **only 8 questions from PHYSICS AND CHEMISTRY & 9 questions from MATHS**
- (iii) Rough work must not be done on the Answer sheet and do not use **white-fluid** or any other **rubbing material** on Answer sheet.
- (vi) Each question carries 4 marks. For every wrong response 1 mark shall be deducted from total score.

PHYSICS
Choose the correct answer :

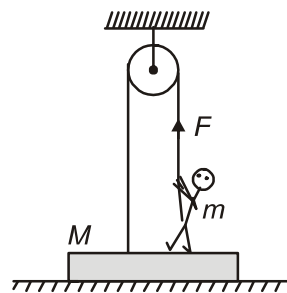
1. A uranium-238 nucleus, initially at rest, emits an $\alpha({}_2^4\text{He})$ particle with energy E . The recoil speed of residual nucleus thorium-234 is (Masses are same as their mass number)
2. A man of mass m is standing on a board and pulling the board of mass m up with force F by the pulley system as shown. Normal reaction between man and board is

(1) $\frac{\sqrt{2E}}{234}$

(2) $\frac{\sqrt{E}}{234}$

(3) $\frac{\sqrt{2E}}{117}$

(4) $\frac{\sqrt{E}}{117}$



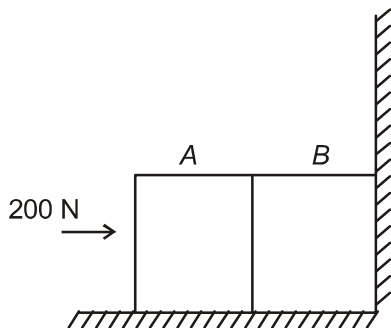
(1) $mg - F$

(2) $mg + F$

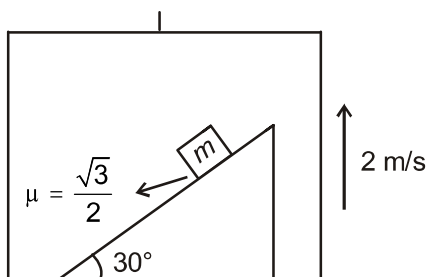
(3) $(m + M)g + F$

(4) $(m - M)g - F$

3. Two bodies A and B of mass 5 kg and 10 kg in contact with each other rest on a table against a rigid wall. The coefficient of friction between the bodies and the table is 0.2, when the force of 200 N is applied horizontally on A. Which of the following is correct?



- (1) The reaction of wall is 200 N
 (2) The action reaction force between A and B is more than reaction of wall
 (3) The action reaction force between A and B is less than reaction of wall
 (4) Both (1) and (3) are correct
4. In a tug of war contest, two groups of people pull on a horizontal rope from the two ends. (Assume mass-less rope)
- (1) The winning group will be one which exerts greater force on the rope
 (2) The winning group will be one which exerts greater force on the ground
 (3) The winning group will be one which exerts a force on rope, greater than its breaking strength
 (4) The tension in the rope will be more on the side of winning group
5. Three forces are acting on a particle that moves with a constant velocity $\vec{v} = 2\hat{i} - 7\hat{j}$ (m/s). Two of the forces are $\vec{F}_1 = 2\hat{i} + 3\hat{j} - 2\hat{k}$ and $\vec{F}_2 = -5\hat{i} + 8\hat{j} - 2\hat{k}$. What is the third force?
- (1) $-3\hat{i} + 11\hat{j} - 4\hat{k}$ (2) $3\hat{i} - 11\hat{j} + 4\hat{k}$
 (3) $8\hat{i} - 11\hat{j} + 14\hat{k}$ (4) $3\hat{i} - 11\hat{j} - 4\hat{k}$
6. A block of mass 1 kg is placed on a rough wedge which is fixed on an elevator moving upward with constant velocity 2 m/s. The block m is at rest w.r.t. wedge. Net reaction force on the block is

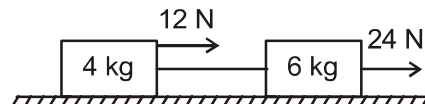


- (1) 5 N (2) 10 N
 (3) 7.5 N (4) 12 N

7. A block of mass 4 kg is placed on a rough horizontal plane. A time dependent horizontal force $F = 2t$ (N) acts on the block. The frictional force between the block and plane at time $t = 2$ s is ($\mu = 0.2$)

- (1) 4 N (2) 8 N
 (3) 10 N (4) 12 N

8. 4 kg block and 6 kg block are connected by a string of negligible mass. If the forces of 12 N and 24 N act on 4 kg and 6 kg blocks respectively in same direction, then the tension in the string is



- (1) Zero (2) 2.4 N
 (3) 3.6 N (4) 1.8 N

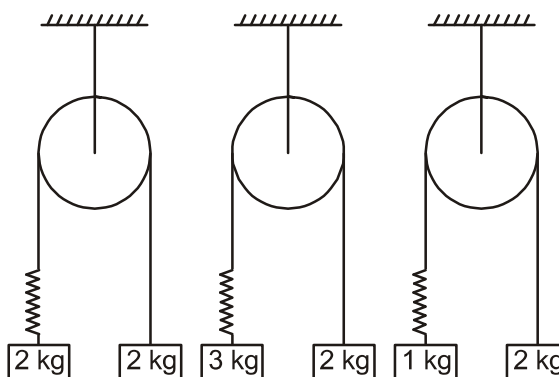
9. A force gives an object of m_1 an acceleration of 12 m/s^2 and an object of mass m_2 an acceleration of 10 m/s^2 . The ratio of accelerations the force would give to an object of mass $m_2 - m_1$ and $m_2 + m_1$.

- (1) 4 : 1 (2) 2 : 1
 (3) 10 : 1 (4) 11 : 1

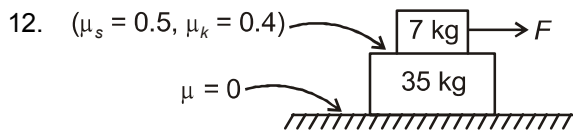
10. A batsman deflects a ball by an angle of 60° without changing its initial speed which is equal to 108 km h^{-1} . Find the impulse imparted to the ball. (mass of ball = 100 g)

- (1) $2\sqrt{3} \text{ kg ms}^{-1}$ (2) $3\sqrt{3} \text{ kg ms}^{-1}$
 (3) $4\sqrt{3} \text{ kg ms}^{-1}$ (4) $\sqrt{3} \text{ kg ms}^{-1}$

11. Same spring is attached with 2 kg, 3 kg and 1 kg blocks in three different cases. If x_1 , x_2 , x_3 be the extensions in the three cases, then



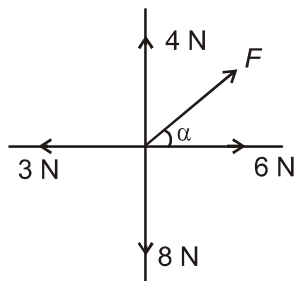
- (1) $x_1 > x_2 > x_3$ (2) $x_2 > x_1 > x_3$
 (3) $x_3 > x_2 > x_1$ (4) $x_1 = 0, x_3 > x_2$



If a force F of 100 N is applied to block of mass 7 kg, then acceleration of 35 kg mass will be

- (1) 2.4 ms^{-2} (2) 1 ms^{-2}
 (3) 0.4 ms^{-2} (4) 0.8 ms^{-2}

13. Five concurrent forces are acting on a body. For the body to remain in equilibrium under these five forces, which of the following is correct?

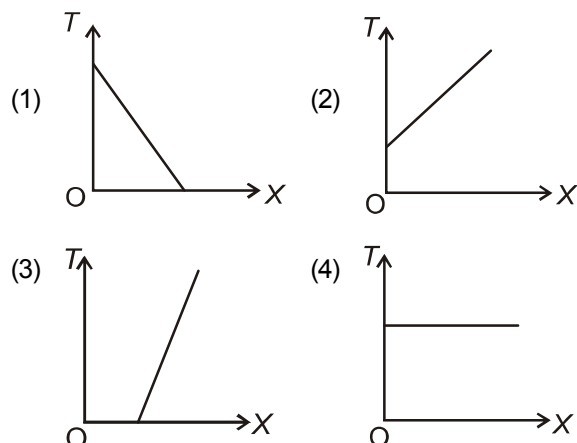
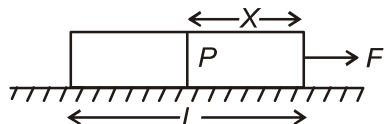


- (1) $F = 10 \text{ N}, 90^\circ < \alpha < 180^\circ$
 (2) $F = 10 \text{ N}, 180^\circ < \alpha < 270^\circ$
 (3) $F = 5 \text{ N}, 90^\circ < \alpha < 180^\circ$
 (4) $F = 5 \text{ N}, 180^\circ < \alpha < 270^\circ$

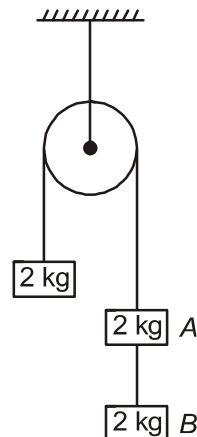
14. An open carriage in a goods train is moving with a uniform velocity of 10 ms^{-1} . If the rain adds water with zero velocity at the rate of 5 kg s^{-1} , then the additional force applied by the engine to maintain the same velocity of the train is

- (1) 0.5 N (2) 2 N
 (3) 50 N (4) 25 N

15. A uniform rod of mass M pulled by force F on smooth surface. The value of tension T in the rod varies with the distance X from the force end is according to the graph



16. Three equal weights of mass 2 kg each are hanging on a string passing over a fixed frictionless pulley. The tension in the string AB is nearly

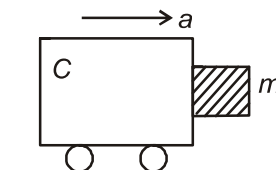


- (1) Zero (2) 13 N
 (3) 15 N (4) 20 N

17. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m/s. A bob is suspended from the roof of the car by string of length 1m. The angle made by the string with the vertical is

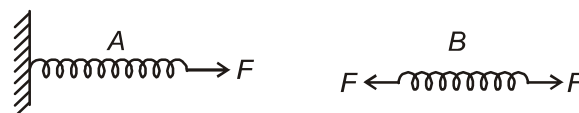
- (1) Zero (2) 30°
 (3) 45° (4) 60°

18. A block of mass m is in contact with the cart. The coefficient of static friction between the block and the cart is μ . The acceleration a of the cart that prevent the block from falling will be



- (1) $a > \frac{mg}{\mu}$
 (2) $a > \frac{g}{\mu m}$
 (3) $a \geq \frac{g}{\mu}$
 (4) $a < \frac{g}{\mu}$

19. Find the ratio of the extension shown by massless identical springs A and B in two given conditions.

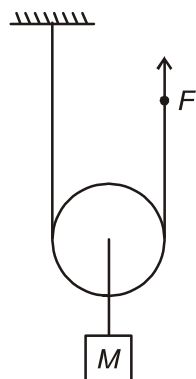


- (1) $\frac{1}{2}$ (2) 2
 (3) 1 (4) Infinity

20. A frame of reference which moves with constant velocity with respect to a stationary frame of reference is called

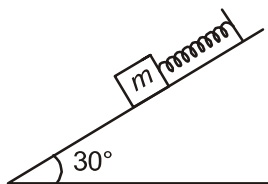
- (1) Inertial frame of reference
- (2) Non-inertial frame of reference
- (3) Ideal frame of reference
- (4) Absolute frame of reference

21. The force F needed to keep the block at equilibrium in given figure is (pulley and string are massless)



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

22. A block of mass 2 kg is attached to a spring of stiffness constant 5 N/cm. The system is placed on a smooth incline of angle 30° . Find maximum extension in spring if the block is released from rest such that initially spring is in natural length.



- (1) 4 cm
- (2) 5 cm
- (3) 3 cm
- (4) 6 cm

23. A particle of mass 500 g is moving in a circle of radius 1 m with speed v (m/s) $= 4t^2$. The rate of work done on the particle at $t = 2$ s is

- (1) Zero
- (2) 128 J/s
- (3) 64 J/s
- (4) 32 J/s

24. A sand bag of mass M is suspended by rope. A bullet of mass m is fired at it with speed v and the bullet gets embedded in it. The loss of kinetic energy in the collision is

- (1) $\frac{Mmv^2}{2(M+m)}$
- (2) $\frac{Mv^2}{2(M+m)}$
- (3) $\frac{m^2v^2}{2(M+m)}$
- (4) $\frac{1}{2}(M+m)v^2$

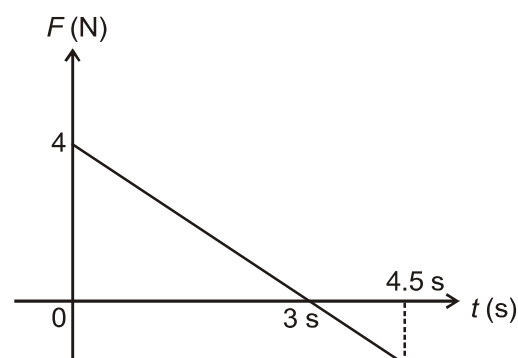
25. A bullet of mass 10 g travelling at a speed of 500 ms^{-1} strikes a block of mass 2 kg, which is suspended by a string of length 5 m. The centre of gravity of the block is found to rise a vertical distance of 0.2 m. What is the speed of the bullet after it emerges from the block?

- (1) 100 m/s
- (2) 150 m/s
- (3) 50 m/s
- (4) 250 m/s

26. A particle of mass 100 g is thrown vertically upwards with a speed of 5 ms^{-1} . The work done by the force of gravity during the time the particle goes up is

- (1) 0.5 J
- (2) -0.5 J
- (3) -1.25 J
- (4) 1.25 J

27. A block of mass 4.5 kg is free to move along the x-axis. It is at rest at $t = 0$. If the force on the particle varies with time, then its kinetic energy at $t = 4.5$ s is

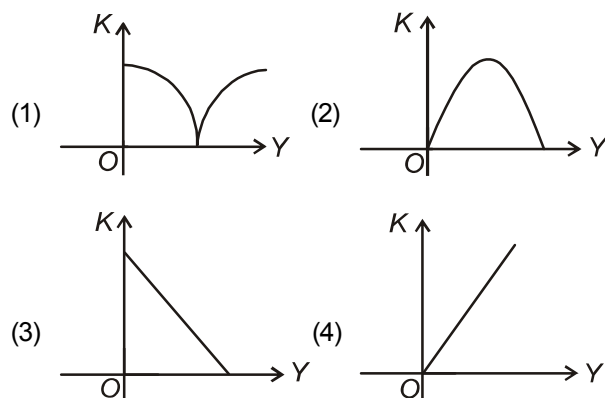


- (1) 2.25 J
- (2) 1.25 J
- (3) 5 J
- (4) Zero

28. A running man has the same kinetic energy as that of a boy of half his mass. The man speeds up by 2 ms^{-1} and the boy changes his speed by $x \text{ ms}^{-1}$ so that the kinetic energies of the boy and the man are again equal. Then x in ms^{-1} is

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

29. A ball of mass m thrown from the ground with speed u at angle θ with horizontal. Kinetic energy K of the ball varies with height Y according to the graph.



30. A body of mass m starts from rest with a constant power. If velocity of the body at displacements s is v , then the correct relation is

- (1) $s \propto v$
(2) $s \propto v^2$
(3) $s \propto v^3$
(4) $s \propto v^4$

31. A uniform chain of mass 4 kg and length 2 m. Overhangs a smooth table with its one third part lying on the table. Find the speed of the chain as it completely slips off the table.

- (1) $\frac{10}{3} \text{ m/s}$ (2) 2 m/s
(3) $\frac{2}{3} \text{ m/s}$ (4) $\frac{4}{3} \text{ m/s}$

32. A gas molecule of mass m moves towards a piston of large mass with speed v along the normal to the piston. The speed of piston is u towards the molecule. The speed of the molecule after an elastic collision with the piston is

- (1) $u + v$
(2) $u - v$
(3) $2u + v$
(4) $v - 2u$

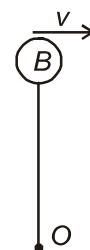
33. A pendulum bob has been pulled aside from the equilibrium position through an angle θ and then released. If l is the length of the pendulum, then the bob will reach the equilibrium position with a speed of

- (1) $\sqrt{2gl}$ (2) $\sqrt{2gl \cos \theta}$
(3) $\sqrt{2gl(1 - \cos \theta)}$ (4) $\sqrt{2gl(1 - \sin \theta)}$

34. Two springs A and B ($K_A = 2K_B$) are stretched by applying force of equal magnitudes. If the energy stored in A is E , then energy stored in B is

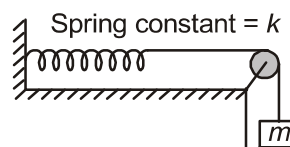
- (1) $\frac{E}{2}$ (2) $2E$
(3) E (4) $\frac{E}{4}$

35. A small bob B of mass m is attached to a light inextensible string of length l , hinged at other end at O. What minimum horizontal velocity should be given to bob in the highest position shown in figure such that the trajectory of particle is circle?



- (1) $\sqrt{lg}$ (2) $\sqrt{3lg}$
(3) $\sqrt{5lg}$ (4) $2\sqrt{lg}$

36. Initially the spring is relaxed. If the mass m is slowly released, then the elongation produced in the spring is

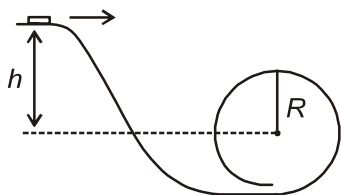


- (1) $\frac{mg}{k}$ (2) $\frac{mg}{2k}$
(3) $\frac{2mg}{k}$ (4) $\frac{mg}{4k}$

37. A water pump lifts water from a level 10 m below the ground. Water is pumped at a rate of 30 kg/minute with negligible velocity. What should be the power (in h.p.) of engine to do this?

- (1) 6.7×10^{-3} (2) 6.7×10^{-2}
(3) 2.3×10^{-1} (4) 3.2×10^{-2}

38. A toy car C starts from a platform at a height h from the centre of loop of radius R . Find the minimum value of h for successful looping in the vertical circle of radius R as shown in figure. (Neglect friction)



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

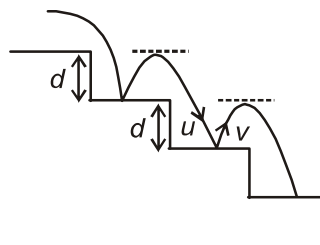
39. A point mass is bound to a fixed point at a distance r from the centre of the force. The potential energy of the point mass is given by $U = \frac{a}{r^2} - \frac{b}{r}$ (a, b are positive constants). Find the value of r at which the particle is in the state of unstable equilibrium.

- (1) $\frac{2a}{b}$
 (2) $\frac{b}{2a}$
 (3) $\frac{b}{a}$
 (4) Value doesn't exist

40. A particle moves under an attractive force $F = -\frac{k}{r^2}$ in a circle of radius r . The total energy of revolving particle is

- (1) $-\frac{k}{r}$ (2) $\frac{k}{r}$
 (3) $-\frac{k}{2r}$ (4) $\frac{k}{2r}$

41. A tennis ball bounces down a flight of stairs, striking each step in turn and rebounding to the height of the step above. If the height of each step is d , the coefficient of restitution is



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

42. If the kinetic energy of a body is increased by 69 %, then its momentum increased by

- (1) 35 % (2) 34.5 %
 (3) 30 % (4) 40 %

43. A ball hits the floor and rebounds after an inelastic collision. In this case.

- (1) The momentum of the ball just after the collision is the same as that just before the collision.
 (2) The mechanical energy of the ball remain the same in the collision.
 (3) The total momentum of the ball and the earth is conserved.
 (4) The mechanical energy of the ball and the earth is conserved.

44. A gardener waters plants by a pipe of cross section 1 mm^2 . The water comes out at the rate of 100 cc/s . The reactionary force exerted on the hand of the gardener is

- (1) 10 N (2) 100 N
 (3) 1000 N (4) 500 N

45. In a conical pendulum, the length of string is l and θ is the angle of string with horizontal. The time period of revolution is proportional to

- (1) $\sqrt{\cos \theta}$
 (2) $\sqrt{\sin \theta}$
 (3) $\frac{1}{\sqrt{\cos \theta}}$
 (4) $\frac{1}{\sqrt{\sin \theta}}$

CHEMISTRY

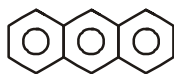
46. Match the column :

Column I	Column II
Species	Hybridisation
a. XeOF_2	(i) sp^3d
b. XeO_4	(ii) sp^3
c. XeF_6	(iii) sp^3d^3

Choose the correct match :

- (1) a(i), b(ii), c(iii) (2) a(iii), b(ii), c(i)
 (3) a(ii), b(i), c(iii) (4) a(ii), b(iii), c(iii)

47. The total number of π and σ -bonds present in the following compound respectively is



- (1) 9 and 18 (2) 8 and 22
 (3) 7 and 26 (4) 8 and 24

48. Identify the pair of compounds having similar shape

- (1) XeF_4 & CH_4 (2) SOF_2 & NH_3
 (3) SF_6 & XeF_6 (4) CO_2 & SiO_2

49. Select the correct set of elements containing only metalloids

- (1) Ge, As, Sn (2) Sb, Ga, C
 (3) Ge, As, Sb (4) B, Po, Bi

50. $d\pi$ - $p\pi$ -bond absent in

- (1) CO_3^{2-} (2) ClO_3^-
 (3) SO_2 (4) XeO_3

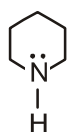
51. Identify the isostructural pairs of the chemical species

- (1) $\text{N}_3^{(-)}$ and $\text{NO}_2^{(+)}$ (2) $\text{CN}_2^{2(-)}$ and $\text{NO}_2^{(-)}$
 (3) $\text{NO}_3^{(-)}$ and $\text{SO}_3^{2(-)}$ (4) XeO_3 and $\text{CO}_3^{2(-)}$

52. The non-polar molecule is

- (1) PF_3Br_2 (2) NF_3
 (3) SF_4 (4) SF_6

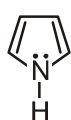
53. Hybridisation of nitrogen in the following chemical species is respectively



(I)



(II)



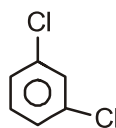
(III)

- (1) sp^3 , sp^2 , sp^2 (2) sp , sp^2 , sp^3
 (3) sp^3 , sp , sp^3 (4) sp^2 , sp , sp^3

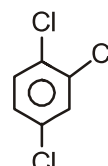
54. Choose the correct statement(s)

- (1) NF_3 is more polar than NH_3
 (2) CO_2 is gas but SiO_2 is solid at room temperature
 (3) $\text{I}_3^{(-)}$ is linear but XeF_2 is bent
 (4) All are correct

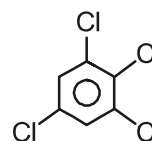
55. Dipole moment of is approximately equal to



(I)



(II)



(III)

- (1) II only (2) I & II only
 (3) II & III only (4) I, II & III

56. Total possible number of square planes in SF_6 is

- (1) 2 (2) 3
 (3) 4 (4) Infinite

57. The molecule which does not exist under normal condition is

- (1) PH_5 (2) PCl_5
 (3) PF_3 (4) PH_3

58. Identify the paramagnetic chemical species

- (1) H_2O_2 (2) KO_2
 (3) Na_2O (4) All of these

59. Number of P-O single bond in P_4O_{10} is

- (1) 12 (2) 6
 (3) 4 (4) 10

60. Choose the incorrect match.

- (1) XeF_4 : Planar shape
 (2) BF_3 : Back bonding
 (3) $\text{NO}_2^{(-)}$: Diamagnetic
 (4) O_3 : Paramagnetic

61. The correct order of covalent character is

- (1) $\text{NaN}_3 > \text{Mg}_3\text{N}_2 > \text{AlN}$
 (2) $\text{Na}_2\text{O} < \text{MgO} < \text{Al}_2\text{O}_3$
 (3) $\text{NaF} > \text{NaCl} > \text{NaBr}$
 (4) All are correct

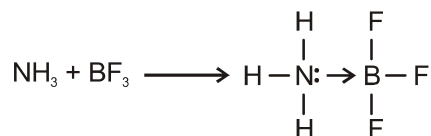
62. Consider the following statements

- I. BeCl_2 in vapour phase is electron deficient molecule
- II. Hydration energy of $\text{Be}^{2(+)}$ is more than that of $\text{Li}^{(+)}$
- III. PCl_5 does not exist but NCl_5 exist

Select the correct statement(s)

- (1) I & II only
- (2) II only
- (3) I, II & III
- (4) II & III only

63. Consider the following chemical reaction



Choose the correct statement

- (1) Hybridisation of N-changes from sp^2 to sp^3
- (2) Shape of BF_3 is non-planar
- (3) Hybridisation of boron changes from sp^2 to sp^3
- (4) All are correct

64. Choose the incorrect statement :

- (1) Nitrogen gas is highly inert in nature
- (2) π -bond is weaker than σ -bond
- (3) All P-Cl bonds are equal in PCl_5
- (4) XeF_4 has planar shape

65. The pair of chemical species having fractional bond order according to molecular orbital theory is

- (1) NO
- (2) CO
- (3) $\text{CN}^{(-)}$
- (4) O_2

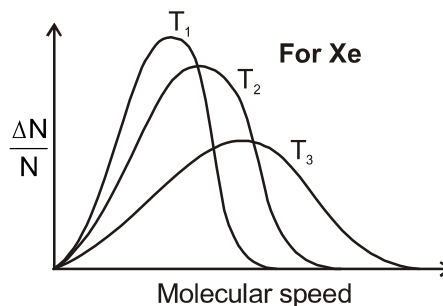
66. If the ratio of the rates of diffusion of the two gases X & Y is 9 : 1, the ratio of their densities is

- (1) 3 : 1
- (2) 81 : 1
- (3) 1 : 81
- (4) 1 : 3

67. The ratio of molecular speed of a gas molecules at 27°C to that at 927°C is

- (1) 3 : 4
- (2) 1 : 4
- (3) 1 : 2
- (4) 2 : 3

68.



Choose the correct order :

- (1) $T_1 > T_2 > T_3$
- (2) $T_3 > T_2 > T_1$
- (3) $T_1 = T_2 = T_3$
- (4) $T_1 \times T_2 = T_2 \times T_3$

69. Choose the correct relation

- (1) $T_c = \frac{8a}{27b^2}$
- (2) $P_c = \frac{a}{27Rb}$
- (3) $V_c = 3b$
- (4) All are correct

70. The pressure of a mixture of equal weight of two gases of mol. wt. 4 and 40 is 1.1 atm. The partial pressure of the lighter gas in this mixture is

- (1) 0.55 atm
- (2) 0.11 atm
- (3) 1 atm
- (4) 0.1 atm

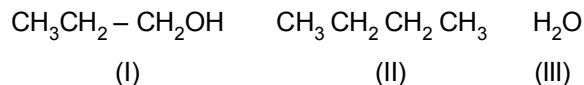
71. O_2 molecule is paramagnetic because of

- (1) Its bond order is 2
- (2) Bonding electrons are more than the antibonding electrons
- (3) Two electrons in π -MO
- (4) Two unpaired electrons in antibonding MO.

72. Two litre of gas are maintained at 25°C and two atmospheric pressure. If the pressure is doubled and absolute temperature is halved, the gas will now occupy

- (1) 2.0 L
- (2) 4.0 L
- (3) 0.5 L
- (4) 1.0 L

73. Consider the following compounds :



What is the correct order of boiling point?

- (1) $\text{I} > \text{II} > \text{III}$
- (2) $\text{III} > \text{II} > \text{I}$
- (3) $\text{III} > \text{I} > \text{II}$
- (4) $\text{I} > \text{III} > \text{II}$

74. The formal charge on P atom in orthophosphoric acid molecule is

- (1) + 1
- (2) + 3
- (3) + 5
- (4) 0

75. The ratio between root mean square velocity of H_2 at 50 K and that of O_2 at 800 K is
- (1) 4 : 1 (2) 2 : 3
(3) 1 : 1 (4) 1 : 4
76. Air contains 79% N_2 and 21% O_2 by volume. The percentage by mass of nitrogen gas in the air
- (1) 76.6%
(2) 24%
(3) 29%
(4) 48%
77. Which of the following orbital in F_2 would have maximum energy?
- (1) σ^*2s (2) σ^*2p_z
(3) π^*2p_x (4) $\sigma 2p_z$
78. The relation put forwarded by Moseley showing that, atomic number(Z) the more fundamental property of an element than atomic weight is
- (1) $\sqrt{v} = a(z - b)$
(2) $v = a(z - b)^2$
(3) $\sqrt{v} = a^2(z - b)$
(4) $v = a^2(z^2 + b)$
79. The group number and block of the element, Ac(Z = 89) is
- (1) 3 and d
(2) 4 and f
(3) 13 and d
(4) 14 and f
80. If an element having the following valence shell configuration : $4s^2 4p^3$, then choose the correct statement :
- (1) The element belong to p-block
(2) The group number of the element is 5.
(3) The next inert gas to the element is Xe.
(4) All are correct
81. Which of the following element would have largest **atomic radius**?
- (1) K (2) Kr
(3) Ca (4) Br
82. The correct order of atomic size is
- (1) $N < P < Si$ (2) $Cs > Ba > Tl$
(3) $Na < K < Rb$ (4) All are correct
83. The element having maximum electron affinity of the 5th period is
- (1) F (2) Cl
(3) Br (4) I
84. Most electronegative element of group 16.
- (1) Oxygen (2) Sulphur
(3) Selenium (4) Tellurium
85. Choose the incorrect match.
- (1) As_2O_5 : Acidic (2) BeO : Amphoteric
(3) N_2O : Neutral (4) P_4O_{10} : Basic
86. There is diagonal relationship between
- (1) Li-Al (2) Be-Al
(3) Be-Mg (4) C-N
87. The correct order of negative electron gain enthalpy is
- (1) $S > Br > O > I$ (2) $Br > I > S > O$
(3) $S > O > Br > I$ (4) $Br > S > I > O$
88. The element having maximum value for its 3rd ionisation enthalpy is
- (1) Be (2) Li
(3) N (4) B
89. The number of elements present in 6th period of the periodic table is
- (1) 18 (2) 30
(3) 32 (4) 36
90. The filling of electron in transition element takes place in
- (1) nd orbitals
(2) (n-1)d orbitals
(3) (n-1)d, ns, np orbitals
(4) ns, nd orbitals

PART - III (MATHEMATICS)

SECTION - 1

Only One Option Correct Type

This section contains **10 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE Option is correct**.

41. The value of $\frac{\tan^2 \frac{A}{2} + \tan^2 \frac{C}{2} + 2 \tan \frac{A}{2} \tan \frac{C}{2}}{\cot^2 \frac{B}{2}}$, if sides a, b, c of a triangle ABC are in arithmetic progression is
- (A) $\frac{2}{3}$ (B) $\frac{1}{3}$
(C) $\frac{4}{9}$ (D) $\frac{1}{9}$
42. If the domain of $f(2x - 1)$ is $[3, 21]$ and the domain of $g\left(\frac{x-1}{3}\right)$ is $[1, 3]$ then domain of $f(x) + g(x) + \sqrt{x-3} + \sqrt{7-x}$ is equal to
- (A) $[3, 7]$ (B) $[4, 10]$
(C) $[2, 10]$ (D) $[4, 7]$
43. Number of solutions of the equation $3\left|\cos \frac{\pi}{4}x\right| = |x-1| + |x+1|$ is
- (A) 1 (B) 2
(C) 3 (D) 4
44. Number of solution(s) of the equation $\left\{\tan \frac{\pi}{3}x\right\} = x^2 + 2x + 2$, where $\{.\}$ denotes fractional part of x , is
- (A) 0 (B) 1
(C) 2 (D) 3
45. If $|x-10| + |20-x| = 10$, then maximum number of integral values of x is
- (A) 10 (B) 11
(C) 20 (D) 21
46. Domain of the function $f(x) = \log_{10} |\log_{10} |x-1|| + \sqrt{2 + \sin x - \sin^2 x}$
- (A) $[0, \pi]$ (B) $[0, \pi] - \{0, 1, 2\}$
(C) $R - \{0, 1, 2\}$ (D) $[0, 2]$
47. Let $\sin\theta, \cos\theta$ are the roots of the equation $px^2 + qx + r = 0$, then (maximum value of $\frac{q}{p}$) + 3 (minimum value of $\frac{r}{p}$) is equal to
- (A) $\frac{5}{2}$ (B) $\sqrt{2} - \frac{3}{2}$
(C) $\sqrt{2} + \frac{3}{2}$ (D) $\sqrt{2} - \frac{5}{2}$

48. Let roots of the equation $x^2 - 2kx + 9 = 0$ be positive integers, then minimum value of k , is
 (A) 0 (B) 2
 (C) 3 (D) 4
49. The number of integral roots of the equation $|\sin 2\pi x| = \cos^4\left(\frac{\pi \cdot x}{2}\right)$ in the interval $[-10, 30]$ is
 (A) 10 (B) 20
 (C) 30 (D) 40
50. If in a triangle ABC , $2\cos^2\frac{A}{2} + 2\cos^2\frac{B}{2} - 2\sin^2\frac{A}{2} - 2\sin^2\frac{B}{2} + 2\cos C - 3 = 0$, always holds, then number of such triangle having all sides different is
 (A) 0 (B) 1
 (C) 2 (D) 3

SECTION - 2

Comprehension Type (Only One Option Correct)

This section contains **3 paragraphs**, each describing theory, experiments, data etc. **six questions related to the three paragraphs with two questions on each paragraph**. Each question has only one correct answer among the four given options (A), (B), (C) and (D).

Paragraph For Questions 51 and 52

There are two function $f(x) = \sin 2x$ and $g(x) = \frac{e^x - 1}{e^x + 1}$

51. Number of solution of $|f(x)| = g(x)$ in the interval $[-\pi, \pi]$
 (A) 2 (B) 3
 (C) 4 (D) 6
52. Number of solution of $|f(x)| = g(x) + 1$ in the interval $[-\pi, \pi]$ is
 (A) 2 (B) 3
 (C) 4 (D) 8

Paragraph For Questions 53 and 54

Let $f(\theta) = \frac{\sin^2 2\theta}{\cos 2\theta \cdot (\sin 2\theta - \cos 2\theta)} + \frac{\cos^2 2\theta}{\sin 2\theta \cdot (\cos 2\theta - \sin 2\theta)}$,

53. The set of all values of θ for which $f(\theta)$ is not defined is

- (A) $\left\{\frac{n\pi}{2}\right\}, n \in \mathbb{Z}$ (B) $\left\{\frac{n\pi}{3}\right\}, n \in \mathbb{Z}$
 (C) $\left\{\frac{n\pi}{4}\right\}, n \in \mathbb{Z}$ (D) $\left\{\frac{n\pi}{4}\right\} \cup \left\{\frac{n\pi}{2} + \frac{\pi}{8}\right\}, n \in \mathbb{Z}$

54. Range of $f(\theta)$ is

- (A) $\mathbb{R}$ (B) $[-1, 1]$
 (C) $\mathbb{R} - [-1, 3]$ (D) $[0, \infty)$

Paragraph For Questions 55 and 56

Let $f: \mathbb{R} \rightarrow [0, \infty)$ is a function, as $f(x) = |x^2 - 4|$

55. Number of solution of $f(x) = k^2 - 8k + 11$ is 4. Then k is

- (A) $[4, \infty)$ (B) $[0, 4]$
 (C) $(1, 4 - \sqrt{5}) \cup (4 + \sqrt{5}, 7)$ (D) $[1, 7]$

56. Number of solution of $f(x) = k^2 - 5k + 4$ is 2. Then the value of k is
- (A) $[0, 5]$ (B) $(-\infty, 0) \cup (5, \infty) \cup \{1, 4\}$
 (C) $(0, 5) \cup \{1, 4\}$ (D) $(-\infty, 0) \cup (1, \infty)$

SECTION - 3

Matching List Type (Only One Option Correct)

This section contains **4 questions**, each having two matching lists. Choice for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D), out of which one is correct.

57. Match the answers of list-I into list-II

List I	List II
(P) If $ \sin^2 x + 10 - x^2 = 9 - x^2 $ + $2 \sin^2 x + \cos^2 x$, then x is	(1) One - one
(Q) The value of $8 \sin \frac{A}{2} \sin \frac{B}{2} \sin \frac{C}{2}$ is always less than and equal to (A, B, C are the angles of a Δ)	(2) $[-3, 3]$
(R) Number of reflexive relations on $A = \{1, 2, 3\}$ is	(3) 1
(S) Let the function $f : R \rightarrow R$ be defined as $f(x) = x + \sin x$ for $x \in R$ then f is	(4) 64

Codes :

P	Q	R	S
(A) 2	4	1	3
(B) 2	3	4	1
(C) 4	1	2	3
(D) 4	1	3	2

58. Let us consider a triangle ABC having $BC = 10$ cm, $CA = 8$ cm, $AB = 6$ cm, D, E are the points on BC such that $BD = DE = EC$, $\angle CAE = \theta$. Match the answer of list-I into list-II

List I	List II
(P) The value of AE^2 is	(1) $\frac{3}{8}$
(Q) $\tan \theta$ is equal to	(2) $\frac{731}{584}$
(R) $\tan \theta + \cos^2 \theta$ is equal to	(3) $\frac{292}{9}$
(S) $\operatorname{cosec}^2 \theta + \tan \theta$ is equal to	(4) $\frac{611}{72}$

Codes :

P	Q	R	S
(A) 1	2	4	3
(B) 1	2	3	4
(C) 3	1	2	4
(D) 3	1	4	2

59. If $\cos \alpha = 7 \sin \alpha$, $\operatorname{cosec} \beta = \sqrt{10}$, $\left(0 < \alpha, \beta < \frac{\pi}{2}\right)$, then match the answer of list-I into list-II

List I

(P) $\tan(\alpha + \beta)$ is equal to

(Q) $\tan(\alpha + 2\beta)$ is equal to

(R) β is equal to

(S) α is equal to

List II

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

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

(3) 1

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

Codes :

	P	Q	R	S
(A)	2	1	4	3
(B)	2	1	3	4
(C)	4	1	2	3
(D)	4	3	2	1

60. Match the answers of list-I into list-II

List I

(P) Let A and B are two sets $A = \{1, 2\}$ and $B = \{3, 4\}$
 $R = (a, b)$ is a relation such that $a \in A$ and $b \in B$, then number of relations is

(Q) Let A is a set $A = \{1, 2, 3\}$ R is a relation $R = \{(a, b) \mid a, b \in A\}$, then number of symmetric relations is

(R) A and B are two sets such that $n(A \Delta B) = 8$
 $n(B^c) = 5$, $n(A^c) = 7$, then the value of $n(A - B)$ is

(S) A and B are two sets such that $n(A - B) = 5$, $n(A \cup B \cup C) = 10$, $n(B^c) = 7$, then the value of $n(A \cup B \cup C)^c$ is

List II

(1) 16

(2) 3

(3) 64

(4) 2

Codes :

	P	Q	R	S
(A)	1	3	4	2
(B)	1	3	2	4
(C)	2	1	3	4
(D)	2	1	4	3

