





<u>M.M. 300</u>

# **ALL INDIA SKY TEST SERIES**

## XI – IIT JEE (SAMARATH BATCH)

## Date: 17/09/2023

## **SYLLABUS**

PHYSICS	CHEMISTRY	MATHEMATICS
Previous + NLM + Friction	Atomic Structure + Periodic table	Previous, Trigonometric equation, P.M.I.

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

#### **INSTRUCTIONS:**

1. This Question paper is divided in to three parts Physics, Chemistry and Mathematics each part is further divided into two sections.

Section -A Contains 20 Questions Section B contains 10 questions. Please ensure that the Questions paper you have received contains ALL THE QUESTIONS in each Part.

In Section A all the 20 Questions are compulsory and Section B Contain 2. 10 Question, out of these 10 Questions, candidates can choose to attempt any 5 Questions. Each Question has four choices (A), (B), (C), (D) out of which only one is correct & Carry 4 marks each 1 mark will be deducted for each wrong answer.

#### **GENERAL INSTRUCTION**

- Use only **blue/black pen (avoid gel pen)** for darkening the bubble. 1.
- 2. Indicate the correct answer for each question by filling appropriate bubble in your OMR answer sheet.
- 3. The answer sheet will be checked through computer hence, the answer of the question must be marked by -shading the circles against the question by dark blue/black pen
- 4. Blank papers, Clipboards, Log tables, Slide Rule, Calculator, Cellular Phones Papers and Electronic Gadgets in any form are **not** allowed to be carried inside the examination hall.

Name of the candidate:

Signature of the candidate: \_\_\_\_\_\_Signature of the invigilator: \_\_\_\_

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#### PHYSICS

#### Section - A

#### Single Choice Question

- The momentum p (in kg-ms<sup>-1</sup>) of a particle is varying with time t (in second) as p = 2+ 3t<sup>2</sup>. The force acting on the particle at t = 3 s will be

   (a) 18 N
   (b) 54 N
   (c) 9 N
   (d) 15 N
- A ball of mass m is moving towards a player with velocity v. If player stopped it, then impulse applied by the player is

   (a) -mv
   (b) + mv
   (c) -2mv
   (d) + 2mv
- 3. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle  $\theta$  should be



- 4. A body is under the action of two mutually perpendicular forces of 3 N and 4N. The resultant force acting on the body is
  (a) 7 N (b) 1 N (c) 5 N (d) zero
- 5. Three forces acting on a body are shown in the figure. To have the resultant only along the y-direction, the magnitude of the minimum additional force needed is



 $\label{eq:theta} \begin{array}{ll} \text{ f.} & \text{ The surface is frictionless, the ratio between $T_1$} \\ & \text{ and $T_2$ is} \end{array}$ 



 Three blocks are placed at rest on a smooth inclined plane with force acting on m<sub>1</sub> parallel to the inclined plane. Find the contact force between m<sub>2</sub> and m<sub>3</sub>.



8. A light string going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by



9. Two blocks, each having a mass M, rest on frictionless surfaces as shown in the figure. If the pulleys are light and frictionless and M on the incline is allowed to move down, then the tension in the string will be



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- 10. The limiting value of static friction between two surfaces in contact is
  - (a) proportional to normal force between the surfaces in contact
  - (b) independent of area of contact
  - (c depends on the microscopic area of constant magnitude
  - (d) All of the above

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- The coefficient of friction between the tyres 11. and road is 0.4. The minimum distance covered before attaining а speed of 8*ms*<sup>-1</sup> starting from rest nearly is (Take,  $g = 10 m s^{-2}$ ) (a) 8 m (b) 4 m (c) 10 m (d) 16 m
- 12. A block of weight 5 N is pushed against a vertical wall by a force 12 N. The coefficient of friction between the wall and block is 0.6. The magnitude of the force exerted by the wall on the block is



13. A rope of length L and mass M is hanging from a rigid support. The tension in the rope at a distance x from the rigid support is

(a) Mg (b)  $\left(\frac{L-x}{L}\right)$  Mg (c)  $\left(\frac{L}{L-x}\right)$  Mg (d)  $\frac{x}{L}$  Mg

14. A man of mass m has fallen into a ditch of width d. Two of his friends are slowly pulling him out using a light rope and two fixed pulleys as shown in figure. Both the friends exert force of equal magnitudes F. When the man is at a depth h, the value of F is



15. A mass M is hung with a light inextensible string as shown in the figure. Find the tension of the horizontal string.



(a) 
$$\sqrt{2}$$
 Mg (b)  $\sqrt{3}$  Mg (c) 2 Mg (d) 3 Mg

16. A balloon with mass m is descending down with an acceleration a (where, a > g). How much mass should be removed from it, so that it starts moving up with an acceleration a?



17. A system consists of three masses  $m_1$ ,  $m_2$  and  $m_3$  connected by as string passing over a pulley P. The mass  $m_1$  hangs freely and  $m_2$  and  $m_3$  are on a rough horizontal table (the coefficient of friction =  $\mu$ ). The pulley is frictionless and of negligible mass. The downward acceleration of mass  $m_1$  is (Assume,  $m_1 = m_2 = m_3 = m$ )



18. A 3 kg block is placed over a 10 kg block and both are placed on a smooth horizontal surface. The coefficient of friction between the blocks is 0.2. If a horizontal force of 20 N is applied to 3 kg block, acceleration of the two blocks (in ms<sup>-2</sup>) are (Take, g = 10 ms<sup>-2</sup>)

$$\mu = 0.2 \quad \boxed{3 \text{ kg}} \rightarrow 20 \text{ N}$$

$$\boxed{10 \text{ kg}}$$

(a) 
$$\frac{13}{4}$$
, 0.6 (b)  $\frac{14}{4}$ , 3  
(c)  $\frac{13}{4}$ , 3 (d)  $\frac{14}{3}$ , 0.6

- 19. If a coin is dropped in a lift it takes  $t_1$  time to reach the floor and takes  $t_2$  time when lift is moving up with constant acceleration, then which one of the following relation is correct ? (a)  $t_1 = t_2$  (b)  $t_1 > t_2$ (c)  $t_2 > t_1$  (d)  $t_1 >> t_2$
- 20. Four blocks of same mass connected by strings are pulled by a force F on a smooth horizontal surface as shown in figure.

The tension  $T_1$ ,  $T_2$  and  $T_3$  will be

(a) 
$$T_1 = \frac{1}{4}F$$
,  $T_2 = \frac{3}{2}F$ ,  $T_3 = \frac{1}{4}F$   
(b)  $T_1 = \frac{1}{4}F$ ,  $T_2 = \frac{1}{2}F$ ,  $T_3 = \frac{1}{2}F$   
(c)  $T_1 = \frac{3}{4}F$ ,  $T_2 = \frac{1}{2}F$ ,  $T_3 = \frac{1}{4}F$   
(d)  $T_1 = \frac{3}{4}F$ ,  $T_2 = \frac{1}{2}F$ ,  $T_3 = \frac{1}{2}F$ 

#### Section - B

### **Integer Type Questions**

21. If  $t = \sqrt{x} + 4$ , then  $\left(\frac{dx}{dt}\right)_{t=4}$  is :

22. The distance travelled by a particle is related to time t as  $x = 4t^2$ . The velocity of the particle at t = 5s is. (in m/s)

- 23. A person moves towards east for 3 m, then towards north for 4 m and then moves towards for 5 m. What is his distance now from the starting point? (in m)
- 24. A 150 m long train is moving with a uniform velocity of 45 kmh<sup>-1</sup>. The time taken by the train to cross a bridge of length 850 m is (in sec)
- 25. A particle starts with a velocity of 2 ms<sup>-1</sup> and moves in a straight line with a retardation of 0.1 ms<sup>-2</sup>. The first time at which the particle is 15 m from the starting point is (in sec)
- 26. A body dropped from the top of a tower covers a distance 7x in the last second of its journey, where x is the distance covered in first second. How much time does it take to reach the ground? (in sec)
- 27. A point initially at rest moves along X-axis. Its acceleration varies with time as  $a = (6t+5)ms^{-2}$ . If it starts from origin, then the distance covered in 2 s is (in m)
- 28. A stone is projected with speed of 50 ms<sup>-1</sup> at an angle of 60<sup>o</sup> with the horizontal. The speed of the stone at highest point of trajectory is (in m/s)
- 29. A body is projected with an angle  $\theta$ . The maximum height reached is h. If the time of flight is 4 s and g = 10 ms<sup>-2</sup>, then value of h is (in m)
- 30. A ball is dropped from the top of a building 100 m high. At the same instant, another ball is thrown upwards with a velocity of 40 ms<sup>-1</sup> from the bottom of the building. The two balls will meet after (in sec)

## CHEMISTRY

#### Section - A

#### Single Choice Question

- 31. The work function of a metal is 4.0 eV. If the metal irradiated with radiation of wavelength 200 mm, then the maximum kinetic energy of the photoelectrons would be about.
  - (a)  $6.4 \times 10^{-19} J$  (b)  $3.5 \times 10^{-19} J$ (c)  $1.0 \times 10^{-18} J$  (d)  $2.0 \times 10^{-19} J$
- 32. The velocity of electron in the ground state hydrogen atom is  $2.18 \times 10^6$  m/s. Its velocity in the second orbit would be

(a) 
$$1.09 \times 10^6$$
 m/s (b)  $4.38 \times 10^6$  m/s  
(c)  $5.5 \times 10^5$  m/s (d)  $8.76 \times 10^6$  m/s

- 33. If velocity of an electron in first Bohr's orbit of hydrogen atom is x, its velocity in third orbit will be.
  - (a)  $\frac{x}{3}$  (b) 3x (c) 9x (d)  $\frac{x}{9}$
- 34. Which transition in the hydrogen spectrum have same wavelength as Balmer transition, n = 4 to n = 2, of He<sup>+</sup> spectrum?

(a) 
$$n_1 = 1, n_2 = 2$$
 (b)  $n_1 = 1, n_2 = 3$   
(c)  $n_1 = 3, n_2 = 4$  (d)  $n_1 = 2, n_2 = 4$ 

35. A monoelectronic species in energy level with energy X was provided with excess of energy so that it jumps to higher energy level with energy Y. If it can emit six wavelength originated from all possible transition between these group levels, then which of the following relation is correct?

(a) 
$$\sqrt{\frac{X}{Y}} = 1 + \frac{3}{n}$$
 (b)  $\frac{X}{Y} = \frac{n}{6}$   
(c)  $\frac{X}{Y} = (n-1)^2$  (d)  $\frac{X}{Y} = 1 + \frac{3}{n}$ 

36. Which of the following sets of quantum number are not possible?

(a) 
$$n=3, l=2, m=0, s=-1/2$$
  
(b)  $n=3, l=2, m=-2, s=-1/2$   
(c)  $n=3, l=3, m=-3, s=+1/2$   
(d)  $n=3, l=1, m=0, s=+1/2$ 

- 37. In which of the following case would the probability of finding an electron residing in a  $d_{xy}$  orbital be zero?
  - (a) xy and yz planes
  - (b) xy and xz planes
  - (c) xz and yz plalnes
  - (d) z direction, yz and xz planes
- 38. An electron in H atom in its ground states absorbs 1.5 times as much as energy as the minimum required for its escape from the atom.

 $H(g) \rightarrow H^+(g) + e^-$ ;  $\Delta H = 13.6 \text{ eV atom}^{-1}$ 

Thus, kinetic energy given to the emitted electron is

(a) -21.4 eV (b) 20.4 eV (c) 35 eV (d) 21.4 eV

39. If the radius of the first Bohr orbit is x, then de Broglie wavelength of the electron in the third orbit is nearly.

(a) 
$$3\pi x$$
 (b)  $6x$  (c)  $6\pi x$  (d)  $\frac{x}{2}$ 

40. Photoelectric emission is observed from a surface for frequencies  $V_1$  and  $V_2$  of incident radiations ( $V_1 > V_2$ ). If the maximum KE of photoelectrons in two cases are in the ratio of 2 : 1, then threshold frequency  $v_0$  is given by:

(a) 
$$\frac{V_2 - V_1}{2}$$
 (b)  $\frac{2V_1 - V_2}{(2 - 1)}$   
(c)  $\frac{2V_2 - V_1}{(2 - 1)}$  (d)  $V_2 - V_1$ 

41. Which block of the periodic table contains elements with the general electronic configuration

$$(n-2)f^{1-14}(n-1)d^{0-1}ns^2$$
?  
(a) s - block (b) p - block  
(c) d - block (d) f - block

- 42. To which group, an element with atomic number 88 will belong?
  (a) Group 12
  (b) Group 17
  (c) Group 10
  (d) Group 2
- 43. An element has the electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$ What will be its position in the periodic table? (a) Period 4, Group 10 (b) Period 2, Group 2 (c) Period 4, Group 2 (d) Period 2, Group 8

44.	In the long form of periodic table, the non – metal are placed in (a) s – block (b) p – block (c) d – block (d) $f$ – block	53.	When $4f$ level is completely filled with electrons, the next electron will enter into a subshell whose (n + l) is equal to.
45.	An element X has atomic number 19. What will be the formula of its oxide? (a) $X_2O$ (b) $XO$ (c) $XO_2$ (d) $X_2O_2$	54.	Electrons of $Be^{3+}$ ion is present in an orbital which has 2 angular nodes and 2 radial nodes. Calculate sum of $(n+l)$ for orbital in which electron is present. (Given: In this question <i>n</i> is principal
46.	Which of the following transitions will involve maximum amount of energy? (a) $M \rightarrow M^+ + e^-$ (b) $M^- \rightarrow M^+ + 2e^-$		quantum number and <i>l</i> is azimuthal quantum number.
	(c) $M^{2+} \to M^{3+} + e^-$ (d) $M^+ \to M^{2+} + e^-$	55.	If an electron is moving with velocity 600 ms <sup>-1</sup> , which is accurate up to 0.005% then
47.	What is the order of successive ionization enthalpies?		uncertainty in its position is $x \times 10^{-3}$ then value of x is
	(a) $IE_{III} > IE_{II} > IE_{I}$ (b) $IE_{I} > IE_{II} > IE_{III}$ (c) $IE_{II} > IE_{I} > IE_{III}$ (d) $IE_{III} > IE_{I} > IE_{III}$		$[h = 6.63 \times 10^{-34} \text{ J-s}, \text{ mass of electron}$ = $9.1 \times 10^{-31} \text{ kg}$ ]
48.	Which is the most non – metallic element among the following? (a) $1s^2 2s^2 2p^6 3s^1$ (b) $1s^2 2s^2 2p^5$ (c) $1s^2 2s^2 2p^6 3s^2$ (d) $1s^2 2s^2 2p^3$	56.	Among the following, the number of elements showing only one non – zero oxidation state is O, Cl, F, N, P, Sn, TI, Na, Ti
49.	The first ionization enthalpy of the elements are in the order of. (a) C < N < Si < P (b) N < Si < C < P (c) Si < P < C < N (d) P < Si < N < C	57.	The period table consists of 18 groups. An isotope of copper, on bombardment with protons, undergoes a nuclear reaction yielding element X as shown below. To which group, element X belong in the periodic table?
50.	Ionization enthalpy of nitrogen is more than		${}^{63}_{29}Cu + {}^{1}_{1}H \to 6 {}^{0}_{0}n + \alpha + 2 {}^{1}_{1}H + X$
	<ul><li>(a) Extra stability of half filled orbital</li><li>(b) More number of energy levels</li></ul>	58.	Based on VSEPR theory, the number of 90 degree F – Br – F angles in $BrF_5$ is
	<ul><li>(c) Less number of valence electrons</li><li>(d) Smaller size</li></ul>	59.	A list of species having the formula $XZ_4$ is given below $XeF_4$ , $SF_4$ , $SiF_4$ , $BrF_4$ .
	Section - B		$[Cu(NH_3)_4]^{2+}$ , $[FeCl_4]^2$ , $[CoCl_4]^{2-}$ and
51.	<b>Integer Type Questions</b> The wave function $(\psi)$ of 2s – orbital is given by		$[PtCl_4]^{2-}$ . Define shape on the basis of the location of X and Z atoms, the total number of species having a square planar shape is
	$\psi_{2s} = \frac{1}{2\sqrt{32\pi}} \left[ \frac{1}{a_o} \right]^{r} \left[ 2 - \frac{r}{a_o} \right] e^{-r/2a_o}$ At $r = r_o$ radial node is formed. The ratio of $r : a$ is	60.	The total number of lone pairs of electrons in $N_2O_3$ is
50	A = 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2		
52.	A neutral atom of an element has 2K, 8L, 9M and 2N electrons. The sum of atomic no., total no. of s electrons, total no. of p electrons, total no. of d electrons and no. of electrons and no. of unpaired electrons is.		

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	MATHEMATICS	69.	$7^{2\log_7 5}$ is equal to
	MATHEMATICS		(a) $\log_7 35$ (b) 5
	Section - A		(c) $25$ (d) $\log_7 25$
61.	Single Choice Question Let $A = [x : x \in R,  x  < 1];$ $B = [x : x \in R,  x  > 1]$ and $A = B = B$ . D	70.	If $x = \log_3 5$ , $y = \log_{17} 25$ , which one of the following is correct
	$D = [x : x \in K,  x - 1  \ge 1] \text{ and } A \cup B = K - D,$ then the set D is (a) $[x : 1 < x \le 2]$ (b) $[x : 1 \le x < 2]$		(a) $x < y$ (b) $x = y$ (c) $x > y$ (d) None of these
	(c) $[x:1 \le x \le 2]$ (d) None of these	71.	If $\tan \alpha = \frac{m}{m+1}$ and $\tan \beta = \frac{1}{2m+1}$ , then
62.	If the sets A and B are defined as $A = \{(x, y) : y = e^x, x \in R\};$		$\alpha + \beta = \pi$
	$B = \{(x, y) : y = x, x \in R\}, \text{ then}$		(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$
	(c) $A \cap B = \phi$ (d) $A \cup B = A$		(c) $\frac{\pi}{6}$ (d) None of these
63.	If $X = \{4^n - 3n - 1 : n \in N\}$ and	72.	If $\sin A = \frac{4}{5}$ and $\cos B = -\frac{12}{13}$ , where A and B lie
	$Y = \{9(n-1): n \in N\}, \text{ then } X \cup Y \text{ is equal to}$ (a) X (b) Y (c) N (d) None of these		in first and third quadrant respectively, then $\cos(A+B) =$
64	The relation R defined in N as aRb $\longrightarrow$ h is		(a) $\frac{56}{65}$ (b) $-\frac{56}{65}$ (c) $\frac{16}{65}$ (d) $-\frac{16}{65}$
01.	divisible by a is (a) Reflexive but not symmetric	73.	The value of $\cos 15^0 - \sin 15^0$ is equal to
	<ul><li>(b) Symmetric and not transitive</li><li>(c) Symmetric and transitive</li><li>(d) None of these</li></ul>		(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2}$ (c) $-\frac{1}{\sqrt{2}}$ (d) 0
65.	Let R <sub>1</sub> be a relation defined by	74.	$\frac{\sec 8A - 1}{\sec 4A - 1} =$
	$R_1 = \{(a,b)   a \ge b, a, b \in R\}$ . Then $R_1$ is (a) An equivalence relation on R		(a) $\frac{\tan 2A}{\tan 8A}$ (b) $\frac{\tan 8A}{\tan 2A}$
	<ul><li>(b) Reflexive, transitive but not symmetric</li><li>(c) Symmetric, Transitive but not reflexive</li><li>(d) Neither transitive not reflexive but</li></ul>		(c) $\frac{\cot 8A}{\cot 2A}$ (d) None of these
	symmetric	75.	If $\sin x + \cos x = \frac{1}{5}$ , then $\tan 2x$ is
66.	If $n(A) = 5$ and $n(B) = 7$ , then the number of relations on $A \times B$ is (a) $2^{35}$ (b) $2^{49}$ (c) $2^{25}$ (d) $2^{70}$		(a) $\frac{25}{17}$ (b) $\frac{7}{25}$ (c) $\frac{25}{7}$ (d) $\frac{24}{7}$
67.	Sets A and B have 3 and 6 elements	76.	If $\cos\theta = \frac{3}{5}$ and $\cos\phi = \frac{4}{5}$ , where $\theta$ and $\phi$ are
	respectively. What can be the minimum number of elements in $A \cup B$		positive acute angles, then $\cos\frac{\theta-\phi}{2}$ =
(9)	(a) 3 (b) 6 (c) 9 (d) 18		(a) $\frac{7}{\sqrt{2}}$ (b) $\frac{7}{5\sqrt{2}}$ (c) $\frac{7}{\sqrt{5}}$ (d) $\frac{7}{2\sqrt{5}}$
68.	II $A = 10g_2 \log_2 \log_4 256 + 2\log_{\sqrt{2}} 2$ , then A is		
	(a) 2 (b) 3 (c) 5 (d) 7	77.	If $5\tan\theta = 4$ , then $\frac{5\sin\theta - 3\cos\theta}{5\sin\theta + 2\cos\theta} =$
			(a) 0 (b) 1 (c) $1/6$ (d) 6

79. If 
$$\cos(\alpha + \beta) = \frac{4}{5}$$
,  $\sin(\alpha - \beta) = \frac{5}{13}$  and  $\alpha, \beta$  lie between 0 and  $\pi$  then  $\tan 2\alpha = 1$ 

between 0 and  $\frac{\pi}{4}$ , then  $\tan 2\alpha =$ 

(a)  $\frac{16}{63}$  (b)  $\frac{56}{33}$ (c)  $\frac{28}{33}$  (d) None of these

80. The value of 
$$\sin \frac{\pi}{16} \sin \frac{3\pi}{16} \sin \frac{5\pi}{6} \sin \frac{7\pi}{16}$$
 is  
(a)  $\frac{1}{16}$  (b)  $\frac{\sqrt{2}}{16}$  (c)  $\frac{1}{8}$  (d)  $\frac{\sqrt{2}}{8}$ 

#### Section - B

### **Integer Type Questions**

- 81. If n(A) denotes the number of elements in set A and if n(A) = 4, n(B) = 5 and n(A  $\cap$  B) = 3, then n[(A×B) $\cap$ (B×A)]=
- 82. Of the members of three athletic teams in a school 21 are in the cricket team, 26 are in the hockey team and 29 are in the football team. Among them, 14 play hockey and cricket, 15 play hockey and football, and 12 play football and cricket. Eight play all the three games. The total number of members in the three athletic teams is

- 83. The value of  $(0.05)^{\log_{\sqrt{20}}(0.1+0.01+0.001+.....)}$  is 84.  $\tan 9^0 - \tan 27^0 - \tan 63^0 + \tan 81^0 =$
- 85. The value of  $2(\sin^6\theta + \cos^6\theta) - 3(\sin^4\theta + \cos^4\theta) + 1$  is

86. 
$$\frac{\cos 12^0 - \sin 12^0}{\cos 12^0 + \sin 12^0} + \frac{\sin 147^0}{147^0} =$$

87.  $\tan 20^{\circ} \tan 40^{\circ} \tan 60^{\circ} \tan 80^{\circ} =$ 

88. If 
$$\cos A = \frac{3}{4}$$
, then  $32\sin\left(\frac{A}{2}\right)\sin\left(\frac{5A}{2}\right) =$ 

- 89. The value of  $\sin \frac{\pi}{14} \sin \frac{3\pi}{14} \sin \frac{5\pi}{14} \sin \frac{7\pi}{14} \sin \frac{9\pi}{14} \sin \frac{11\pi}{14} \sin \frac{13\pi}{14} = \frac{1}{4k}$ then k is equal to.
- 90.  $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right) = \frac{k}{64}$  is equal to.