

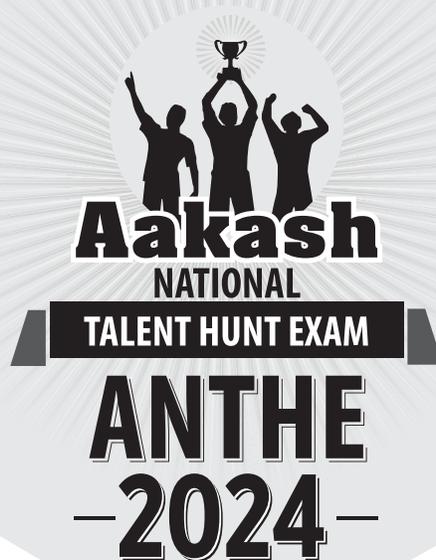
# Sample Paper

ENGINEERING



## Aakash

Medical | IIT-JEE | Foundations



**(Class XI Studying Moving to Class XII)**

## Physics, Chemistry & Mathematics

### INSTRUCTIONS FOR CANDIDATE

1. Duration of Test is 1 hr.
2. The Test Booklet consists of **40** questions. The maximum marks are **90**. There is **no negative marking** for wrong answer.
3. Pattern of the questions are as under:
  - (i) The question paper consists of three parts *i.e.*, **Physics, Chemistry and Mathematics**. Each part has **two sections**.
  - (ii) **Section-I:** This section contains **35** multiple choice questions, which have **only one** correct answer. Each question carries **+2 marks** for correct answer.
  - (iii) **Section-II:** This section contains **5** multiple choice questions, in which **one or more than one** choice(s) is(are) correct. Each question carries **+4 marks** for correct answer.



**Aakash National Talent Hunt Exam 2024****Sample Paper****(Class XI Studying Moving to Class XII)**

(The questions given in sample paper are indicative of the level and pattern of questions that will be asked in ANTHE-2024)

**Time : 1 Hour****PHYSICS****MM : 90****SECTION-I : SINGLE CORRECT ANSWER TYPE**

This section contains 11 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

- A physical quantity  $A$  is related to four observables  $a$ ,  $b$ ,  $c$  and  $d$  as follows,  $A = \frac{a^2 b^3}{c \sqrt{d}}$ , the percentage errors of measurement in  $a$ ,  $b$ ,  $c$  and  $d$  are 1%, 3%, 2% and 2% respectively. What is the percentage error in the quantity  $A$ ?  
(1) 12% (2) 7%  
(3) 5% (4) 14%
- The energy  $E$  of a system as a function of time  $t$  and is given by  $E(t) = \alpha t - \beta t^3$ , where  $\alpha$  and  $\beta$  are constants. The dimensions of  $\alpha$  and  $\beta$  are  
(1)  $[ML^2T^{-1}]$  and  $[ML^2T]$  (2)  $[LT^{-1}]$  and  $[LT]$   
(3)  $[ML^2T^{-3}]$  and  $[ML^2T^{-5}]$  (4)  $[MLT^{-1}]$  and  $[MLT]$
- A car is moving with an initial speed of 10 m/s. A constant braking force is applied and the car is brought to rest in a distance of 20 m. What is the average speed of the car during the deceleration process?  
(1) 4 m/s  
(2) 5 m/s  
(3) 10 m/s  
(4) 6 m/s

**Space for Rough Work**

4. Two cars  $A$  and  $B$  are travelling in the same direction with velocity  $2 \text{ m/s}$  and  $1 \text{ m/s}$  respectively. When the car  $A$  is at a distance  $S$  behind the car  $B$ , the driver of the car  $A$  applies the brakes producing a uniform retardation  $a = \frac{1}{2} \text{ m/s}^2$ . Find minimum possible value of  $S$  to avoid collision, between  $A$  and  $B$ .
- (1)  $\frac{1}{2} \text{ m}$  (2)  $1 \text{ m}$   
 (3)  $2 \text{ m}$  (4)  $\frac{2}{3} \text{ m}$
5. A projectile is thrown at a speed  $V$  and at an angle  $\theta$  with the vertical. If the speed at its maximum height is  $V/3$ , then the value of  $\tan\theta$  is
- (1)  $2\sqrt{2}$  (2)  $\sqrt{2}$   
 (3)  $\frac{1}{2\sqrt{2}}$  (4)  $\sqrt{3}$
6. A car travels with a speed of  $40 \text{ km h}^{-1}$ . Raindrops are falling at a constant speed vertically. The traces of the rain on the side windows of the car make an angle of  $30^\circ$  with the vertical. The magnitude of the velocity of the rain with respect to the car is
- (1)  $40\sqrt{3} \text{ km h}^{-1}$  (2)  $\frac{40}{\sqrt{3}} \text{ km h}^{-1}$   
 (3)  $80 \text{ km h}^{-1}$  (4)  $\frac{80}{\sqrt{3}} \text{ km h}^{-1}$
7. A bob of mass  $m$ , suspended from an inextensible string of length  $l$ , is given a velocity  $v = \sqrt{6gl}$  horizontally as shown. The tension in string when bob reaches the highest point, is

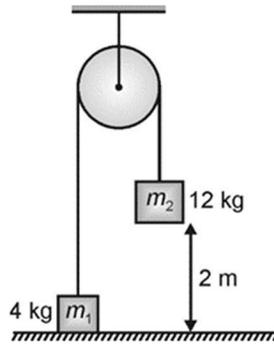


- (1) Zero (2)  $mg$   
 (3)  $2mg$  (4)  $\frac{mg}{2}$

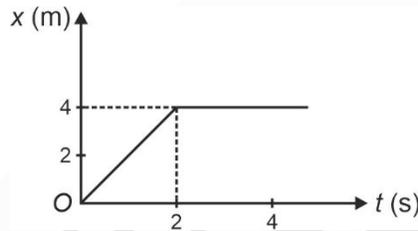
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Space for Rough Work

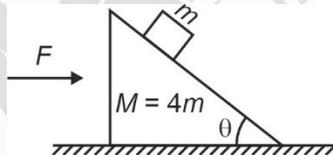
8. In the system shown, find the speed with which 12 kg block hits the ground when the system is released from rest.



- (1)  $\sqrt{5}$  m/s  
 (2)  $2\sqrt{5}$  m/s  
 (3)  $3\sqrt{5}$  m/s  
 (4)  $4\sqrt{5}$  m/s
9. The position-time graph of a particle of mass 1 kg is as shown in figure. The impulse at  $t = 2$  second is



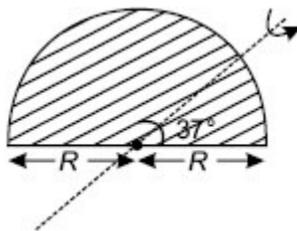
- (1)  $-3 \text{ kg ms}^{-1}$   
 (2)  $-2 \text{ kg ms}^{-1}$   
 (3)  $-10 \text{ kg ms}^{-1}$   
 (4)  $-4 \text{ kg ms}^{-1}$
10. In the figure shown, all surfaces are smooth. Find the value of ' $F$ ' for which ' $m$ ' may not slide on ' $M$ '.



- (1)  $5mg \cot\theta$   
 (2)  $5mg \tan\theta$   
 (3)  $\frac{5}{2}mg \cot\theta$   
 (4)  $\frac{5}{2}mg \tan\theta$

Space for Rough Work

11. Find moment of inertia of a solid semi circular disc of mass  $m$  and radius  $R$  about the shown axis. (Axis is in the plane of disc)



(1)  $\frac{4}{25}mR^2$

(2)  $\frac{mR^2}{4}$

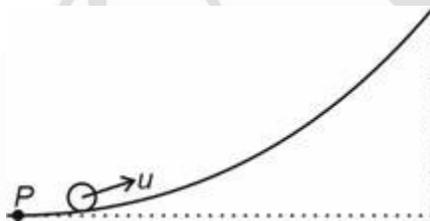
(3)  $\frac{mR^2}{2}$

(4)  $\frac{9}{100}mR^2$

### SECTION-II : ONE OR MORE THAN ONE CORRECT ANSWER TYPE

This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

12. A small uniform ring of mass  $m$  and radius  $R$  rolls up a curved surface with initial speed  $u$  at point  $P$ . Then



(1) Maximum height reached by ring with respect to initial position is  $\frac{u^2}{g}$

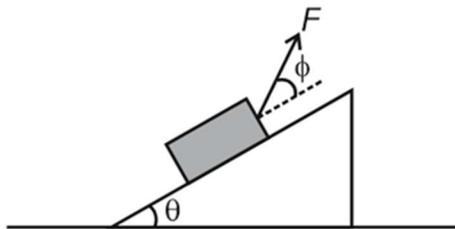
(2) Maximum height reached by ring with respect to initial position is  $\frac{3u^2}{4g}$

(3) Initial angular momentum about point  $P$  is  $\frac{1}{2}muR$

(4) Initial angular momentum about point  $P$  is  $2muR$

Space for Rough Work

13. On a fixed inclined surface of inclination  $\theta$ , a block of weight  $W$  is placed on its rough surface (friction coefficient  $\mu > \tan\theta$ ) as shown in the figure. A force  $F$  making angle  $\phi$  with inclined plane, applied to move the block up along the incline such that the magnitude of force  $F$  is minimum. Angle of friction  $\alpha$  is equal to  $\tan^{-1} \mu$ . Then (You can use Lami's theorem)



- (1) Magnitude of  $F$  in this case is  $W \sin(\theta + \alpha)$
- (2) Magnitude of contact force exerted by surface on the block is  $W \sin(\theta + 2\alpha)$
- (3) Angle  $\phi$  is equal to angle  $\alpha$
- (4) Magnitude of  $F$  in this case is  $W \cos(\theta + \alpha)$

## CHEMISTRY

### SECTION-I : SINGLE CORRECT ANSWER TYPE

This section contains 11 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

14.  $\text{CO}_2$  is iso-structural with
 

(1) $\text{H}_2\text{O}$	(2) $\text{SnCl}_2$
(3) $\text{C}_3\text{O}_2$	(4) $\text{AlCl}_3$
15. The frequency of radiation emitted when electron falls from  $n = 4$  to  $n = 1$  in a hydrogen atom will be [Given: Ionisation energy of H =  $2.18 \times 10^{-18} \text{ J atom}^{-1}$ ,  $h = 6.626 \times 10^{-34} \text{ Js}$ ]
 

(1) $1.54 \times 10^{15} \text{ s}^{-1}$	(2) $1.03 \times 10^{15} \text{ s}^{-1}$
(3) $3.08 \times 10^{15} \text{ s}^{-1}$	(4) $2 \times 10^{15} \text{ s}^{-1}$
16. Maximum angular nodes are present in
 

(1) $2s$	(2) $3p$
(3) $3d$	(4) $4f$

Space for Rough Work

17. The correct order of hybridisation of central atom in the following species,  $\text{NH}_3$ ,  $[\text{PtCl}_4]^{2-}$ ,  $\text{PCl}_5$  and  $\text{BCl}_3$  is respectively
- (1)  $dsp^2$ ,  $dsp^3$ ,  $sp^2$  and  $sp^3$  (2)  $sp^3$ ,  $dsp^2$ ,  $sp^3d$  and  $sp^2$   
(3)  $dsp^2$ ,  $sp^2$ ,  $sp^3$  and  $dsp^3$  (4)  $dsp^2$ ,  $sp^3$ ,  $sp^2$  and  $dsp^3$
18. Which of the following has largest size (Ionic radius)?
- (1)  $\text{Rb}^+$  (2)  $\text{K}^{\oplus}$   
(3)  $\text{Sr}^{+2}$  (4)  $\text{Ba}^{+2}$
19. The formula of metal halide if successive ionisation energies of metal are 5 eV, 25 eV, 48 eV, 90 eV and 180 eV is
- (1)  $\text{MX}$  (2)  $\text{MX}_2$   
(3)  $\text{M}_2\text{X}_3$  (4)  $\text{MX}_4$
20. Which element has the highest first ionization potential?
- (1) N (2) Ne  
(3) He (4) H
21. Which option contain the extensive parameter?
- (1) Specific heat capacity (2) Internal energy  
(3) Molar volume (4) Conductivity
22. The molecule which has zero dipole moment is
- (1)  $\text{CH}_2\text{Cl}_2$  (2)  $\text{BF}_3$   
(3)  $\text{NF}_3$  (4)  $\text{ClO}_2$
23. A sample of  $\text{KClO}_3$  of 60% purity on decomposition produces 8.96 L of  $\text{O}_2$  (at STP). The initial mass of impure sample (in g) taken is [Atomic mass : Cl = 35.5, K = 39]
- (1) 54.4 g (2) 62.9 g  
(3) 49.2 g (4) 36.6 g
24. Number of pairs of antibonding electrons in  $\text{N}_2$  on the basis of molecular orbital theory is
- (1) 5  
(2) 4  
(3) 6  
(4) 2

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Space for Rough Work

**SECTION-II : ONE OR MORE THAN ONE CORRECT ANSWER TYPE**

This section contains 2 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

25. Consider the % ionic character in HF molecule and % covalent character in HCl molecule and choose the correct statement(s). [Electronegativity on Pauling's scale are F = 4.0, H = 2.1, Cl = 2.5]
- (1) HF is 43% ionic in nature (2) HCl is almost 7% ionic in nature  
 (3) HF is 50% ionic in nature (4)  $\frac{\% \text{ Ionic character in HF}}{\% \text{ Covalent character in HCl}} = 0.46$
26. One mole of a non-linear triatomic ideal gas is expanded adiabatically at 300 K from 16 atm to 1 atm under following conditions :
- I. Expansion is carried out reversibly.  
 II. Expansion is free.
- Select the correct statement(s).
- (1) Total entropy change of the universe in condition I is zero  
 (2)  $\Delta S_{\text{surr}}$  in both the conditions (I and II) is zero  
 (3)  $\Delta S_{\text{sys}}$  under condition I is zero but non-zero under condition II  
 (4) Total change in entropy under condition II is zero as there is no heat exchange between system and surrounding

**MATHEMATICS****SECTION-I : SINGLE CORRECT ANSWER TYPE**

This section contains 13 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which **ONLY ONE** choice is correct.

27. If  $A$ ,  $B$  and  $C$  are non-empty sets, then  $(A - B) \cup (B - A)$  equals
- (1)  $(A \cup B) - B$  (2)  $A - (A \cap B)$   
 (3)  $(A \cup B) - (A \cap B)$  (4)  $(A \cap B) \cup (A \cup B)$
28. If the roots of the quadratic equation  $x^2 + 6x + b = 0$  are real and distinct and they differ by 4, then the value of  $b$  is
- (1) 3 (2) 5  
 (3) 6 (4) 9

Space for Rough Work

29. The set of exhaustive values of  $x$  satisfying  $|1 - x| \leq 4$  is
- (1)  $[-3, 6]$  (2)  $[-4, 4]$   
(3)  $[-3, 5]$  (4)  $[-2, 6]$
30.  $\cos^2\left(\frac{\pi}{16}\right) + \cos^2\left(\frac{3\pi}{16}\right) + \cos^2\left(\frac{5\pi}{16}\right) + \cos^2\left(\frac{7\pi}{16}\right)$  is equal to
- (1) 0 (2) 1  
(3) 2 (4) 3
31. If geometric mean of two numbers  $a$  and  $b$  is 18 and arithmetic mean of  $a$  and  $b$  is 27, then harmonic mean of  $a$  and  $b$  is
- (1)  $\frac{1}{18}$  (2)  $\frac{1}{12}$   
(3) 12 (4)  $9\sqrt{6}$
32. The difference of greatest and least value of  $|z_1 + z_2|$  if  $|z_1| = 9$  and  $z_2 = 5 + 12i$ , is (where  $i = \sqrt{-1}$ )
- (1) 18 (2) 22  
(3) 26 (4) 14
33. The total number of ways to arrange the letters of the word 'JUNIOR' with vowels in alphabetical order, is
- (1) 120 (2) 720  
(3) 600 (4) 540
34.  $\cot x - \tan x =$
- (1)  $\cot 2x$  (2)  $2 \cot^2 x$   
(3)  $2 \cot 2x$  (4)  $\cot^2 2x$
35. If  $n(U) = 35$ ,  $n(A') = 10$ ,  $n(B') = 15$  and  $n(A \cap B) = 15$ , then  $n(A \cup B)$  equals
- (1) 20 (2) 25  
(3) 30 (4) 35
36. If both the roots of the quadratic equation  $x^2 - mx + 4 = 0$  are real and distinct and they lie in the interval  $[1, 5]$ , then  $m$  lies in the interval
- (1)  $(-5, -4)$  (2)  $(3, 4)$   
(3)  $(4, 5)$  (4)  $(5, 6)$

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Space for Rough Work

37. A box contain 3 white, 4 black and 2 red balls. The number of ways of drawing 3 balls from the box, if atleast one black ball is included is
- (1) 74 (2) 62  
(3) 66 (4) 54
38. If the first term of an A.P. be 10, last term is 50 and the sum of all the terms is 300, then the number of terms is
- (1) 5 (2) 8  
(3) 10 (4) 15
39. The real values of  $x$  satisfying  $\left| \frac{x^2}{x-1} \right| \leq 1$
- (1)  $(-\infty, 0)$  (2)  $(2, \infty)$   
(3)  $\left[ \frac{-1-\sqrt{5}}{2}, \frac{-1+\sqrt{5}}{2} \right]$  (4) 0

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**SECTION-II : ONE OR MORE THAN ONE CORRECT ANSWER TYPE**

This section contains 1 multiple choice question, which has 4 choices (1), (2), (3) and (4) out of which **ONE OR MORE THAN ONE** choice(s) is(are) correct.

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40. If  $\arg\left(\frac{z-4}{z+4}\right) = \frac{\pi}{4}$ , then
- (1)  $\max |z+i| = 5+4\sqrt{2}$  (2)  $\min |z+i| = \sqrt{17}$   
(3)  $\min |z-i| = 4\sqrt{2}-5$  (4)  $\max |z-2-2i| = 6\sqrt{2}$

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Space for Rough Work

# 35 Years Old Legacy of Delivering Outstanding Results



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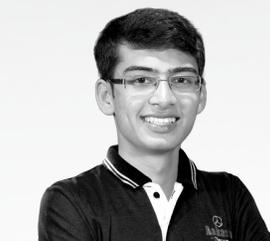
and many more...

## Aakashians Create History in International Olympiads (Classroom Students)

### IBO 2023



**Gold Medalists**



**Dhruv Advani**



**Rohit Panda**



**Chirag Falor**



International Olympiad on Astronomy & Astrophysics



**Dhiren Bhardwaj**



32<sup>nd</sup> International Biology Olympiad



**Anshul**



32<sup>nd</sup> International Biology Olympiad



**Amritansh Nigam**



33<sup>rd</sup> International Biology Olympiad



**Prachi Jindal**



33<sup>rd</sup> International Biology Olympiad



**Tanishka Kabra**



54<sup>th</sup> International Chemistry Olympiad