FIITJEE (JEE-Advanced)

BATCHES – NWCM2024O1S & NWCM2024O2S

PHYSICS, CHEMISTRY & MATHEMATICS

QP Code:

Common Test- 1

Time Allotted: 3 Hours **Maximum Marks: 198**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Three Parts**: **Part-A, B & Part-C** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Part-A (01-06) –** Contains seven (06) multiple choice questions which have **One or More** correct answer.
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
Zero Marks: **0** If none of the bubbles is darkened.
***Negative Marks*: –1 In all other cases.**
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

(ii) **Part-B (07-12)** contains Six (06) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive) and each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(iii) **Part-C (13-18)** contains Six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+4 marks** for correct answer and **there will be no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION-1 : PHYSICS

PART – A

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. If $\vec{A} = 2\hat{i} + 3\hat{j}$ and $\vec{B} = 2\hat{i} - 3\hat{j} + \hat{k}$ then

   (A) $\vec{A}.\vec{B} = -5$ (B) $\vec{A}.\vec{B} = 5$

   (C) $\left|\vec{A} \times \vec{B}\right| = \sqrt{157}$ (D) $\left|\vec{A} \times \vec{B}\right| = -\sqrt{157}$

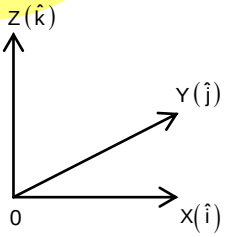
1. **AC**

2. A particle leaves the origin with an initial velocity $\vec{v} = \left(3\hat{i}\right)$ m/s and a constant acceleration $\vec{a} = \left(-1.0\hat{i} - 0.5\hat{j}\right)$ m/s^2. Its velocity $\vec{v}$ and position vector $\vec{r}$ when it reaches its maximum x-co-ordinate are

   (A) $\vec{v} = -2\hat{j}$ (B) $\vec{v} = \left(-1.5\hat{j}\right)$ m/s (C) $\vec{r} = \left(4.5\hat{i} - 2.25\hat{j}\right)$ (D) $\vec{r} = \left(3\hat{i} - 2\hat{j}\right)$ m

2. **BC**

3. A particle is projected from origin with velocity $\vec{u} = \left(\hat{j} + \sqrt{2}\hat{k}\right)$ m/s. Horizontal surface lies in X – Y plane, then (take g = 10 m/sec^2)



   (A) Time of flight = $\frac{\sqrt{2}}{5}$ sec

   (B) horizontal range = $\frac{2}{5}$ m

   (C) Maximum height $\frac{1}{10}$ m

   (D) Maximum height = $\frac{1}{5}$ m

3. **AC**

4. A man who can swim at a speed v relative to the water wants to cross a river of width d, flowing with a speed u. The point opposite him across the river is P.

   (A) The minimum time in which he can cross the river is $\frac{d}{v}$.

   (B) He can reach the point P in time $\frac{d}{v}$.

   (C) He can reach the point P in time $\frac{d}{\sqrt{v^2 - u^2}}$

   (D) He cannot reach P if u > v.

4. **ACD**

5. From the top of a tower of height 40 m, a ball is projected upwards with a speed of 20 ms^{-1} at an angle of elevation of 30^0. The total time taken by the ball to hit the ground is T and the time taken to come back to the same elevation is t. The horizontal distance covered by the ball is *x*. If g = 10 ms^{-2}, then

(A) $\frac{T}{t}=2$ (B) $\frac{T}{t}=\sqrt{2}$

(C) $x=40\sqrt{2}$ m (D) $x=40\sqrt{3}$ m

5. **AD**

6. If $\vec{r}_1=2\hat{i}+\hat{J}$ & $\vec{r}_2=\hat{i}-2\hat{j}+3\hat{k}$ and angle between $\vec{r}_1$ & $\vec{r}_2$ is θ, then which of the following is correct?

(A) $\theta = 0°$ (B) $\theta = 90°$

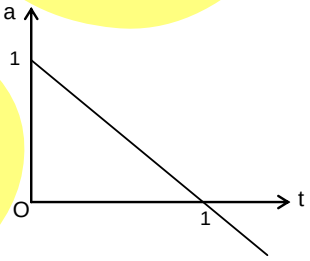
(C) $\vec{r}_1\cdot\vec{r}_2=0$ (D) $\left|\vec{r}_1\times\vec{r}_2\right|=\sqrt{70}$

6. **BCD**

PART – B
Integer Answer Type

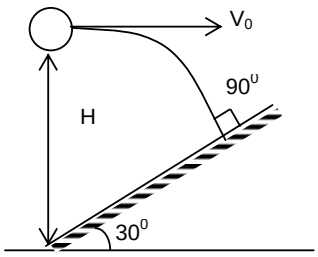
This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. A particle starting from rest moves in a straight line with acceleration as shown in the a–t graph. Find the distance travelled by the particle in the first four seconds from start of its motion.



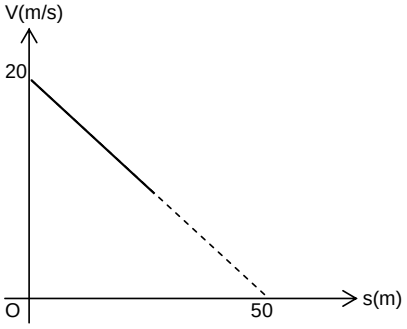
7. **4**

8. In the given figure, the angle of inclination of the inclined plane is 30^0. Find the horizontal velocity V_0 (in m/s) so that the particle hits the inclined plane perpendicularly. Given, H = 4m, g = 10 m/s^2



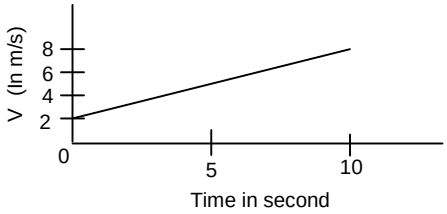
8. **4**

9. Referring to v –s diagram, find magnitude of acceleration of the particle when its velocity becomes half of the initial velocity



9. **4**

10. Figure shows the graph of velocity versus time for a particle going along the X-axis. The distance travelled in 0 to 10 sec is (N × 10). Find 'N'.



10. **5**

11. Given two vectors $\bar{A} = 2\hat{i} + 3\hat{j}$ and $\bar{B} = \hat{i} + \hat{j}$. The component of vector $\bar{A}$ along vector $\bar{B}$ is $\frac{x}{\sqrt{2}}$. Find the value of 'x'.

11. **5**

12. Velocity of a particle at any instant is given by the equation $\vec{V} = (3\hat{i} + 2t^2\hat{j})m/s$. Tangential acceleration of the particle at t = 2s is 4.1 K m/s^2. Find the value of K.

12. **2**

PART – C
(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. A man is going up in an air balloon going up with an acceleration 2 m/s^2. When he reaches to a ht. 100 m from ground, he drops a ball. The time taken by the ball to reach the ground is x. Value of 'x' is

13. **6.89 (range: 6.85 to 6.92)**

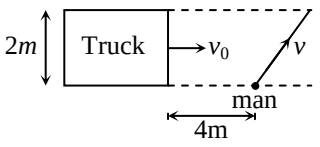
14. Two seconds after the projection, a projectile is moving in a direction at 30° to the horizontal. After one more second, it is moving horizontally. The magnitude of the initial velocity is gy. Find the value of y.

14. **3.46 (range: 3.40 to 3.50)**

15. If $\vec{A}\cdot\vec{B} = |\vec{A}\times\vec{B}|$ and $|\vec{A}|$ & $|\vec{B}|$ are $2\sqrt{2}$ and 3 respectively, determine $\frac{|\vec{A}\times\vec{B}|}{4}$.

15. **1.50**

16. A 2m wide truck is moving with a uniform speed v_0 = 8 m/s along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed v when the truck is 4 m away from him. The minimum value of velocity so that he can cross the road safely is v then the value of 'v' is



16. **3.58 (range: 3.55 to 3.60)**

17. If the sum of two unit vectors is a unit vector, find the magnitude of their difference.

17. **1.732**

18. A particle starts with initial velocity 10 m/s along positive x direction with an acceleration 5 m/s^2 along negative x direction. Find the displacement (in meters) of the particle in 5 seconds.

18. **–12.5**

SECTION-2 : CHEMISTRY

PART – A

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

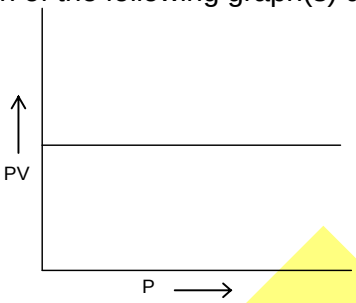
1. $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

Choose correct statement(s) regarding above reaction.
(A) Mn^{4+} is reduced to Mn^{2+} and Cl^- is oxidized to Cl(0).
(B) Oxygen and hydrogen undergo no change in oxidation number.
(C) The equivalent mass of Cl_2 is M/2 (M = Molar mass of Cl_2)
(D) It is a disproportionation reaction

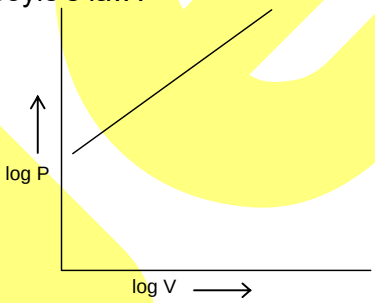
1. ABC

2. Which of the following graph(s) do/does explain Boyle's law?

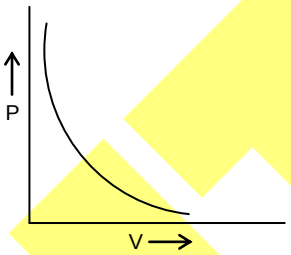
(A)



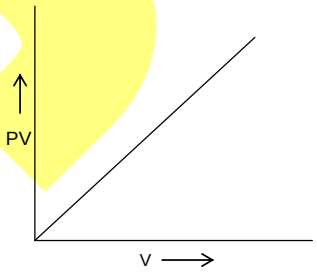
(B)



(C)



(D)

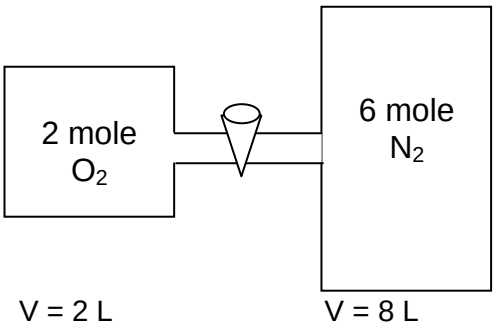


2. AC

3. For the reaction, $NH_4NO_3 \longrightarrow N_2O + 2H_2O$

(A) Number of gram equivalent of NH_4NO_3 = N_2O = H_2O = 4
(B) Percentage of water loss in this reaction is 45%
(C) Equivalent mass of NH_4NO_3 in this reaction is 20. So the equivalent mass of NH_4NO_3 in $NH_4NO_3 \longrightarrow NH_4^+ + NO_3^-$ is also 20
(D) In the reaction $E_{NH_4NO_3} = E_{NH_4^+} + E_{NO_3^-}$

3. ABD

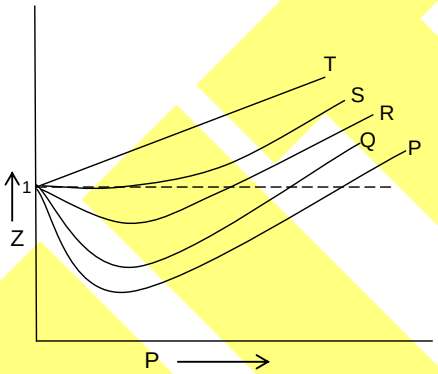
4. 

(A) When the stop cock is opened 0.4 mole of O_2 will pass into the larger vessel at constant temperature.
(B) After opening the stop cock for a long time, the density of the gas mixture can be expressed as $d_{mix} = \left(\frac{29P}{RT}\right) g/L$
(C) Rate of effusion of both gases will be same at constant temperature
(D) At constant temperature, the rms velocity of N_2 will be higher than that of O_2

4. ABD

5. 200 mL of 0.5 M HCl solution
(A) will require 400 mL of 0.25 M NaOH for complete neutralization
(B) contains 0.1 mole of HCl
(C) if diluted to one litre by adding 800 mL water, the normality of the solution will be 0.1 N
(D) can neutralize 10.6 g of Na_2CO_3 with phenolphthalein indicator

5. ABCD

6. 

Choose correct statement(s)
(A) gas P has the highest value of 'a'(van der Waal's constant)
(B) gas 'T' is most difficult to liquefy
(C) gas 'S' shows ideal behaviour at low pressure region
(D) 'Q' has the highest value of 'a'

6. ABC

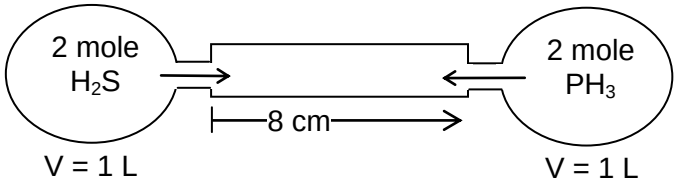
PART – B

Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. What will be the maximum n-factor of H_2SO_4 in acid-base reaction?

7. 2

8. 

At what distance in cm unit from H_2S end the two gases will mix with each other? (Both the gases are ideal and they are effused from both ends of the pipe)

8. 4

9. $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O$
How many moles of $C_2O_4^{2-}$ ions can be completely oxidized by two moles of MnO_4^- ions?

9. 5

10. An impure sample of $CaCO_3$ was dissolved in 500 mL of 0.5 M HCl solution. After complete reaction, 300 mL of 0.5 M NaOH was added to neutralize the excess acid. How many gram of $CaCO_3$ is present in the sample?

10. 5

11. Equal mass of H_2 and He gases are present in a container. The partial pressure of H_2 in the container is 6 atm. What is the total pressure in atm, which is produced by both gases?

11. 9

12. 400 mL of 0.2 N acidified $Cr_2O_7^{2-}$ solution oxidizes 0.02 moles of MSO_4 into higher oxidation state. If the oxidation state of the metal ion after oxidation is +x, what is the value of x?

12. 6

PART – C
(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

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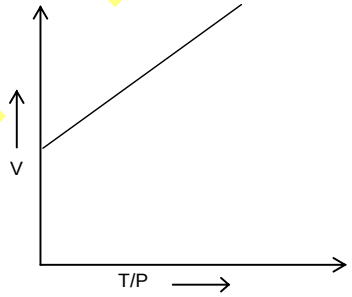
13. The volume of a molecule of a non-ideal monoatomic gas is 4×10^{-30} L. If the excluded volume(b) of the molecule is $y \times 10^{-30}$ L. What is the value of 'y'?

13. 16

14. The van der Waal's equation for one mole of a real gas is given below
$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$
At extremely high pressure, this equation is modified to another form. The modified form has been represented in the graph given below.



If the intercept of the graph is 0.04 L. What is the value of 'b' (the van der Waal's constant) in L mol^{-1} unit?

14. 0.04

15. How much total volume in mL of 0.2 M acidified $KMnO_4$ is required to oxidize completely.
(i) 200 mL of 0.5 M $FeSO_4$ solution to $Fe_2(SO_4)_3$
(ii) 400 mL of 0.5 M $SnCl_2$ solution to $SnCl_4$

15. 500

16. An open vessel contains air at 400 K. If the mole percentage of air will be left in the vessel after it is heated to 1000 K is x%, what is the value of x?

16. 40

17. A hydrated salt of $MgCl_2$ undergoes 48.64% of mass loss upon heating and becomes unhydrous. How many water molecule(s) is/are present in one molecule of the hydrated salt?

17. 5

18. The root mean square velocity of CH_4 at 400 K is equal to it's most probable velocity at TK. What is the value of T?

18. 600

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Let x, y, z be real numbers with $x \geq y \geq z \geq \frac{\pi}{12}$ such that $x+y+z=\frac{\pi}{2}$. Then, for the product $\cos x \cdot \sin y \cdot \cos z$

(A) Maximum value is $\frac{2+\sqrt{3}}{8}$ (B) Maximum value is $\frac{3}{8}$

(C) Minimum value is $\frac{1}{8}$ (D) Minimum value is $\frac{\sqrt{3}-1}{8}$

1. AC

2. In ΔABC, we have $3\sin A+4\cos B=6$ and $4\sin B+3\cos A=1$. Then the possible values of $\angle C$ are

(A) $30°$ (B) $60°$

(C) $120°$ (D) $150°$

2. A

3. Let $y=\sqrt{x+\sqrt{x+\sqrt{x+\cdots\infty}}}$. Then $\frac{dy}{dx}$ is equal to

(A) $\frac{1}{2y-1}$ (B) $\frac{x}{x-2y}$

(C) $\frac{1}{\sqrt{1+4x}}$ (D) $\frac{y}{2x+y}$

3. ACD

4. If $P_n=\sin^n\frac{\pi}{7}$, $Q_n=\cos^n\frac{\pi}{7}$ and $T_n=P_n+Q_n$, then

(A) $\frac{T_3-T_5}{T_1}=\frac{T_5-T_7}{T_3}$ (B) $2T_6-3T_4+1=0$

(C) $6T_{10}-15T_8+10T_6=1$ (D) $\frac{P_2}{Q_2}$ satisfies the eq^n $x^3-21x^2+35x=7$

4. ABCD

5. In ΔABC, which of the following is CORRECT?

(A) $\sin A+\sin B+\sin C\leq\frac{3\sqrt{3}}{2}$ (B) $\cos A\cos B\cos C\leq\frac{1}{8}$

(C) $\cot A+\cot B+\cot C\geq\sqrt{3}$ (D) $\cos A+\cos B+\cos C\leq\frac{3}{2}$

5. ABCD

6. The value of $\int \frac{\sin 2x}{\sin 5x \cdot \sin 3x} dx$ is equal to

(A) $\int \tan 3x - \tan 5x \, dx$

(B) $\frac{1}{3}\ln|\sin 3x| - \frac{1}{5}\ln|\sin 5x| + c$

(C) $\int \cot 3x - \cot 5x \, dx$

(D) $\frac{1}{3}\ln|3\sin 3x| - \frac{1}{5}\ln|5\sin 5x| + c$

6. BCD

PART – B

Integer Answer Type

This section contains **6 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

7. Let α, β be acute angles such that $\sin^2\alpha + \sin^2\beta = \sin(\alpha+\beta)$. Find the value of $\frac{2\pi}{\alpha+\beta}$.

7. 4

8. The minimum value of $|\sin x + \cos x + \tan x + \cot x + \sec x + \operatorname{cosec} x|$ for all real numbers x is equal to $\sqrt{k}-1$, $k \in N$. The value of k is

8. 8

9. The value of $\tan 6° + \tan 36° + \tan 66° - \tan 72°$ is equal to

9. 0

10. The value of $\lim\limits_{x\to 2} \frac{2^x + 2^{3-x} - 6}{2^{-\frac{x}{2}} - 2^{1-x}}$ is

10. 8

11. If $a, b \in R$ satisfy $\log_{10}(1+a^2) - \log_{10} a - 2\log_{10} 2 = 1 - \log_{10}(100+b^2) + \log_{10} b$, then the value of $|a-b|$ is

11. 9

12. Let $P = \tan 10° - \tan 50° + \tan 70°$ and $Q = \frac{2\cos 40° - \cos 20°}{\sin 20°}$. Find the value of $\frac{P}{Q}$.

12. 1

PART – C
(Numerical based)

This section contains **6 questions**, numerical based questions, (answer of which maybe positive or negative numbers or decimals).

13. If $\int\left(\sqrt{\sin^4 x+4\cos^2 x}-\sqrt{\cos^4 x+4\sin^2 x}\right)dx=f(x)+c$, such that $f(0)=0$, then find the value of $f\left(\frac{\pi}{12}\right)$.

13. 0.25

14. The value of $\left(\frac{\sec 5^\circ}{\left(1-4\sin^2 5^\circ\right)}+\frac{\operatorname{cosec} 5^\circ}{\left(4\cos^2 5^\circ-1\right)}\right)^2$ is equal to

14. 24

15. Let $f(x)=\lim\limits_{n\to\infty}\sum\limits_{k=1}^{n}\frac{1}{2^k}\tan\left(\frac{x}{2^n}\right)$ and $g(x)=f(x)+\cot x$. Evaluate $\lim\limits_{x\to\infty} g(x)$.

15. 0

16. The value of $\sin^4\frac{\pi}{16}+\sin^4\frac{3\pi}{16}+\sin^4\frac{5\pi}{16}+\sin^4\frac{7\pi}{16}$ is equal to

16. 1.5

17. If $f(x)=\prod\limits_{n=1}^{100}(x-n)^{n(101-n)}$, then the value of $\frac{f'(101)}{f(101)}$ is equal to

17. 5050

18. Find the sum of real values of x satisfying $\log_{(x+1)}\left(x^2+x-6\right)^2=4$.

18. 1

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B