

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1

QP Code: 100055

PAPER - 1

Time Allotted: 3 Hours

Maximum Marks: 183

- 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 **Two Parts: Part-A & B** 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 Two Parts.

- (i) **Part-A (01-07)** – Contains seven (07) 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.
- (i) **Part-A (08-13)** – Contains six (06) multiple choice questions which have **ONLY ONE CORRECT** answer
Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.
- (ii) **Part-B (01-05)** contains five (05) Numerical based questions, the answer of which maybe positive or negative numbers or decimals to **Two decimal places** (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer and **there will be no negative marking**.

Name of the Candidate : _____

Batch : _____ Date of Examination : _____

Enrolment Number : _____

BATCH – NWCMPA223A1_PT1

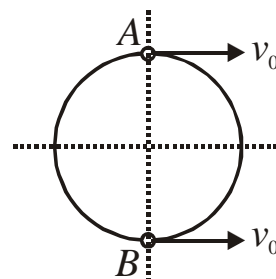
6. A particle of mass m moved on the x -axis as follows: it starts from rest $t = 0$ from the point $x = 0$, and comes to rest at $t = 1$ at the point $x = 1$. No other information is available about its motion at intermediate times ($0 < t < 1$). If α denotes the instantaneous acceleration of the particle, then
- (A) α cannot remain positive for all t in the interval $0 \leq t \leq 1$
- (B) $|\alpha|$ cannot exceed 2 at any point in its path
- (C) $|\alpha|$ must be ≥ 4 at some point or points in its path
- (D) α must change sign during the motion, but no other assertion can be made with the information given
7. Which of the following statement is/are correct?
- (A) Average speed of a particle in a given time period is never less than magnitude of average velocity
- (B) It is possible to have situations in which $\left| \frac{d\vec{v}}{dt} \right| \neq 0$, but $\frac{d|\vec{v}|}{dt} = 0$
- (C) It is possible to have situations in which $\frac{d|\vec{v}|}{dt} \neq 0$ but $\left| \frac{d\vec{v}}{dt} \right| = 0$
- (D) It is possible that the average velocity of a particle is zero in a time interval but the instantaneous velocity is never zero in the interval

(Single Correct Choice Type)

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

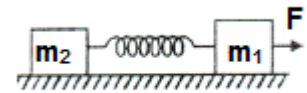
8. A fixed ring of mass m has two beads A, B of mass m each; both being able to slide on the ring without friction. Initially the ring lies on a frictionless horizontal table and the beads are given velocities v_0 , relative to the ring, in the same direction. The initial relative acceleration of the beads (w.r.t. each other)

- (A) zero
- (B) $\frac{v_0^2}{R}$
- (C) $\frac{2v_0^2}{R}$
- (D) $\frac{v_0^2}{2R}$
- (where R is the radius of the ring)

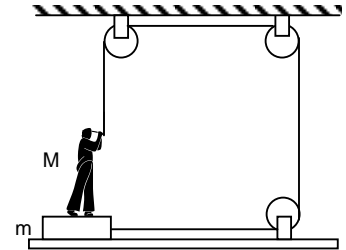


Space For Rough Work

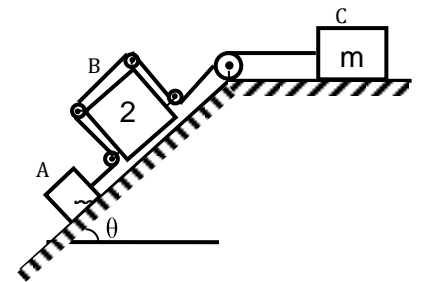
9. Two blocks of masses $m_1 = 1\text{kg}$ and $m_2 = 2\text{kg}$ are connected by a non-deformed light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4. What minimum constant force F has to be applied in horizontal direction to the block of mass m_1 order to move the other block? ($g = 10\text{ m/s}^2$)
- (A) 8N (B) 15N
(C) 10N (D) 25N



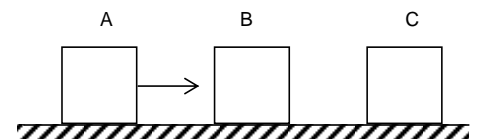
10. The friction coefficient between the board and the floor shown in figure is μ . The maximum force that the man can exert on the rope so that the board does not slip on the floor is



- (A) $\frac{\mu}{1+\mu} (M+m)g$ (B) $\frac{\mu}{1+\mu} (M-m)g$
(C) $\mu \frac{M}{m} g$ (D) $\mu \frac{m}{M} g$
11. All surfaces are frictionless ratio of acceleration of block B and acceleration of block A. Masses of blocks A, B, C are respectively 1kg, 2kg, 1kg. $\frac{a_B}{a_A}$ is

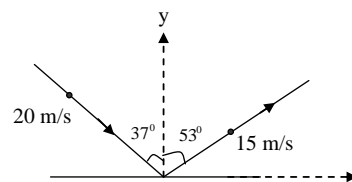


- (A) 1 (B) $\frac{1}{2}$
(C) 3 (D) 2
12. Three identical blocks A, B and C are placed on horizontal frictionless surface. The blocks B and C are at rest. But A is approaching towards B with a speed 10 m/s. The coefficient of restitution for all collisions is 0.5. The speed of the block C just after collision is
- (A) 5.6 m/s
(B) 6 m/s
(C) 8 m/s
(D) 10 m/s



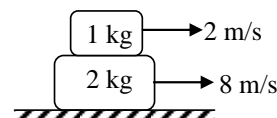
Space For Rough Work

13. A ball of mass 2 kg strikes a floor as shown in figure. For this situation mark the correct statement
- (A) The impulse experienced by ball during the collision is acting along the +ve y – direction and is having a magnitude of 40 N – S .
- (B) The coefficient of restitution between the floor and the ball is $\frac{3}{4}$.
- (C) Coefficient of restitution between floor and ball is $\frac{9}{16}$
- (D) The direction of impulse experienced by ball during the collision is along some where between the y axis and –ve x-axis.

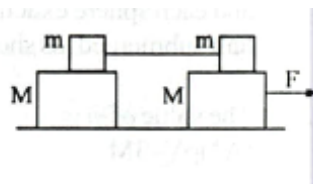


PART – B (Numerical based)

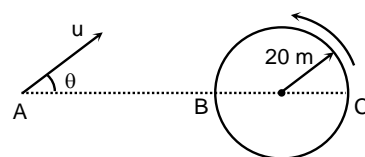
1. Coefficient of friction between two blocks shown in figure is $\mu = 0.4$. Floor is smooth. The blocks are given velocities of 2 m/s and 8 m/s in the directions shown in figure at $t = 0$. The time when relative motion between them will stop is (in sec.)



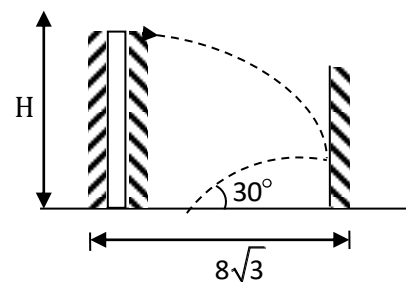
2. Four blocks are arranged on a smooth horizontal surface as shown. The masses of the blocks are given (see the diagram). The coefficient of static friction between the top and the bottom blocks is μ_s . What is the maximum value of the horizontal force F , applied to one of the bottom blocks as shown, that makes all four blocks move with the same acceleration?
 $\mu_s = 0.25$, $m = 1\text{ kg}$, $M = 3\text{ kg}$



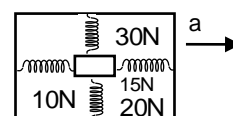
3. A particle is moving along a vertical circle of radius $R = 20\text{ m}$ with a constant speed $v = 31.4\text{ m/s}$ as shown in the figure. Straight line ABC is horizontal and passes through the centre of the circle. A shell is fired from point A at the instant when particle is at C. The distance AB is $20\sqrt{3}\text{ m}$ and shell collides with the particle at B, if smallest possible value of the angle of projection in degree.



4. A ball is thrown horizontally from the top of a tower of unknown height. Ball strikes a vertical wall whose plane is normal to the plane of motion of ball. Collision is elastic and ball falls on ground at midpoint between tower and wall. Ball strikes the ground at angle of 30° with horizontal. The height of tower is.



5. A bus is moving with constant acceleration along a horizontal stretch of highway towards right. Inside the bus, a block of unknown mass is suspended using two horizontal and two vertical springs as shown. The force of each spring is given in the diagram, one of the horizontal and one of the vertical spring is compressed. The block remains at rest w.r.t. bus. Find acceleration (in m/s^2) of the bus.



Space For Rough Work

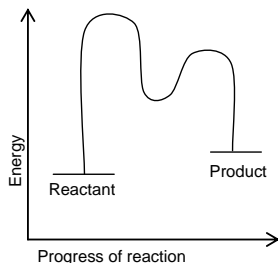
SECTION-2 : CHEMISTRY

PART – A

(Multi Correct Choice Type)

This section contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1.



Choose the correct statement(s) for the reaction which energy profile is given above?

- (A) It is an elementary reaction
(B) It is an endothermic reaction
(C) A catalyst must be used
(D) A reaction intermediate is formed
2. Which of the following quantum number(s) is/are used to express the wave function of an atomic orbital?
(A) Principal quantum number
(B) Azimuthal quantum number
(C) Magnetic quantum number
(D) Spin quantum number
3. In which of the following the electronegativity of phosphorus is higher than that in PCl_3 ?
(A) PCl_5
(B) PH_3
(C) POCl_3
(D) PF_5
4. Which of the following compound(s) is/are more covalent than BeCl_2 ?
(A) MgCl_2
(B) BCl_3
(C) BeBr_2
(D) BI_3
5. Which of the following substance(s) increase(s) the solubility of aluminium sulphide according to the following reaction?

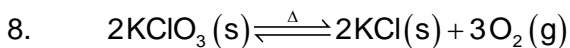
$$\text{Al}_2\text{S}_3(\text{aq}) \rightleftharpoons 2\text{Al}^{3+}(\text{aq}) + 3\text{S}^{2-}(\text{aq})$$
 (A) $\text{Pb}(\text{NO}_3)_2$
(B) HCl
(C) AlCl_3
(D) Na_2S
6. The activation energy (E_a) which is required to start a chemical reaction depends on
(A) the kinetic energy of the reactant
(B) catalyst
(C) orientation of the reactant molecules
(D) no. of collision between the reactant molecules

Space For Rough Work

7. The correct statement(s) regarding SF_6 molecule is/are
 (A) it is an octahedral molecule
 (B) sulphur undergoes sp^3d^2 hybridization
 (C) it's dipole moment is zero
 (D) all the S – F bonds do not have identical bond length

(Single Correct Choice Type)

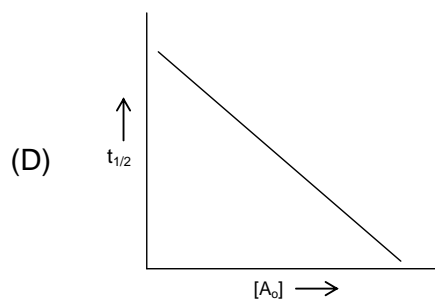
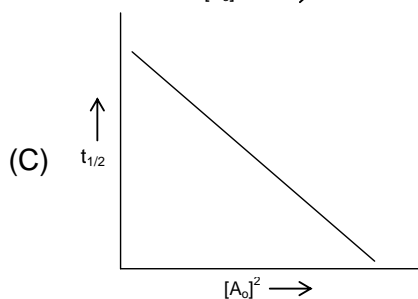
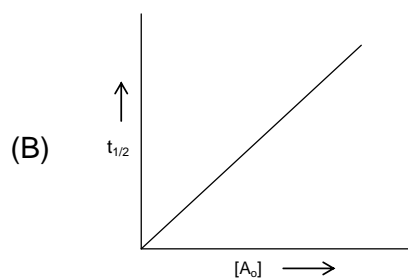
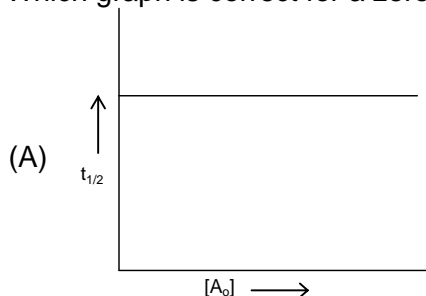
This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.



The equilibrium constant K_P of above reaction is 8 atm^3 at 400 K. What is the equilibrium pressure of the system?

- (A) 8 atm (B) 2 atm
 (C) 6 atm (D) 4 atm

9. Which graph is correct for a zero order reaction?



10. The solubility product of CuCl at 25°C is x , what is the molarity of the saturated solution of CuCl ?

- (A) $x \text{ M}$ (B) $\sqrt{x} \text{ M}$
 (C) $x^2 \text{ M}$ (D) $2x \text{ M}$

11. K_{sp} of a base MOH is 1×10^{-4} . What is the pH of its saturated solution?

- (A) 2 (B) 12
 (C) 4 (D) 10

Space For Rough Work

12. The half-life of a chemical reaction does not change if the reaction starts with any concentration of the reactant? What is the order of the reaction?
(A) Zero (B) First
(C) Second (D) Third
13. Which of the following two compounds cannot be distinguished by the action of heat?
(A) Na_2CO_3 and Li_2CO_3 (B) NaNO_3 and LiNO_3
(C) MgCO_3 and CaCO_3 (D) $\text{Mg}(\text{NO}_3)_2$ and MgCO_3

PART – B
(Numerical based)

1. How many minimum number of electrons of iron ($Z = 26$) will have $n + \ell = 4$?
2. What is the value of $\frac{t_{99.99\%}}{2 \times t_{1/2}}$ of a first order reaction?
 $t_{99.99\%}$ = Time needed for 99.99% completion of the reaction
 $t_{1/2}$ = Half-life period of the reaction
3. $\text{NH}_4\text{Cl}(\text{s}) \rightleftharpoons \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$
Above reaction attains equilibrium at 6 atm and T K. The equilibrium constant K_P of the reaction in atm^2 unit is:
4. A buffer solution contains CH_3COOH and CH_3COONa in the molar ratio of 10 : 1. What is the pH of the buffer? [K_a of $\text{CH}_3\text{COOH} = 10^{-5}$]
5. How many electron(s) is/are present in the outermost antibonding molecular orbitals of peroxide (O^{2-}) ion?

Space For Rough Work

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

1. Let $h(x) = f(x) - (f(x))^2 + (f(x))^3$ for every real number x , then
 - (A) h is increasing when even f is increasing
 - (B) h is increasing when ever f is decreasing
 - (C) h is decreasing whenever f is decreasing
 - (D) nothing can be said general

2. If $\lim_{x \rightarrow \infty} 4x \left(\frac{\pi}{4} - \tan^{-1} \frac{x+1}{x+2} \right) = y^2 + 4y + 5$, then y can be equal to

(A) 1	(B) -1
(C) -4	(D) -3

3. Which of the following functions is (are) injective (one-one)

(A) $f(x) = x+1 , x \in [-1, \infty)$	(B) $f(x) = x + \frac{1}{x}, x \in (0, \infty)$
(C) $f(x) = x^2 + 4x - 5, x \in (0, \infty)$	(D) $f(x) = e^{-x}, x \in [0, \infty)$

4. The function $f(x) = \begin{cases} 5x-4 & \text{for } 0 < x \leq 1 \\ 4x^2-3x & \text{for } 1 < x < 2 \\ 3x+4 & \text{for } x \geq 2 \end{cases}$
 - (A) continuous at $x=1$ and $x=2$
 - (B) continuous at $x=1$ but not derivable at $x=2$
 - (C) continuous at $x=2$ but not derivable at $x=1$
 - (D) continuous at $x=1$ and 2 but not derivable at $x=1$ and $x=2$

5. If $f(x) = \begin{cases} -x - \frac{\pi}{2}, & x \leq -\frac{\pi}{2} \\ -\cos x, & -\frac{\pi}{2} < x \leq 0, \\ x-1, & 0 < x \leq 1 \\ \ln x, & x > 1 \end{cases}$ then

(A) $f(x)$ is continuous at $x = \frac{-\pi}{2}$	(B) $f(x)$ is not differentiable at $x = 0$
(C) $f(x)$ is differentiable at $x = 1$	(D) $f(x)$ is differentiable at $x = \frac{-3}{2}$

Space For Rough Work

6. Let $f(x) = x^4 - 4x^3 + 6x^2 - 4x + 1$, then
 (A) f increases on $[1, \infty)$ (B) f decreases on $[1, \infty)$
 (C) f has local minima at $x = 1$ (D) f has neither maximum nor minimum
7. If $y = \frac{x^4 + x^2 + 1}{x^2 - x + 1}$ such that $\frac{dy}{dx} = ax + b + c$ then
 (A) $a = 2$ (B) $b = 1$
 (C) $c = 0$ (D) $c \in \mathbb{R}$

(Single Correct Choice Type)

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

8. If $f(x) = x^3 + bx^2 + cx + d$ and $0 < b^2 < c$, then in $(-\infty, \infty)$ $f(x)$
 (A) is increasing (B) has local maxima
 (C) is decreasing (D) is bounded
9. If $0 < a < b$, then $\lim_{n \rightarrow \infty} (b^n + a^n)^{1/n}$ is equal to
 (A) e (B) a
 (C) b (D) none of these

10. If the function $f(x) = \begin{cases} \left(1 + |\sin x|^{\frac{a}{|\sin x|}}\right), & -\frac{\pi}{6} < x < 0 \\ b, & x = 0 \\ e^{\frac{\tan 2x}{\tan 3x}}, & 0 < x < \frac{\pi}{6} \end{cases}$ is continuous at $x = 0$, then
 (A) $a = \log_e b, a = \frac{2}{3}$ (B) $b = \log_e a, a = \frac{2}{3}$
 (C) $a = \log_e b, b = 2$ (D) none of these

11. If $f(x) = \frac{\sin([x]\pi)}{x^2 + x + 1}$, where $[.]$ denotes the greatest integer function, then
 (A) f is one – one (B) f is not one – one and non – constant
 (C) f is constant function (D) None of these

Space For Rough Work

12. If $f(x) = \frac{\tan\left(\frac{\pi}{4} - x\right)}{\cot 2x}$, $\left(x \neq \frac{\pi}{4}\right)$ is continuous at $x = \frac{\pi}{4}$, then the value of $f\left(\frac{\pi}{4}\right)$ is
- (A) 1 (B) $\frac{1}{2}$
 (C) $\frac{1}{3}$ (D) -1
13. The curves $4x^2 + 9y^2 = 72$ and $x^2 - y^2 = 5$ at (3, 2)
- (A) touch each other (B) cut orthogonally
 (C) intersect at 45° (D) intersect at 60°

PART – B
(Numerical based)

1. If the greatest value of $y = \frac{x}{\log x}$ on $[e, e^3]$ is u then $\frac{e^3}{u}$ is equal to _____
2. If $f(x)$ is a polynomial satisfying $f(x) \cdot f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$, and $f(3) = 28$, and $f(4)$ is given by K then $\frac{K}{13}$ equals to _____
3. If $I = \int \frac{x^5}{\sqrt{1+x^3}} dx$, then I is equal to $\frac{k}{9} \sqrt{1+x^3} (x^3 - k) + c$, where k is _____
4. The number of solutions of the equation $2[x] = x + 2\{x\}$ is _____
5. The maximum value of the function $f(x) = 2x^3 - 15x^2 + 36x - 48$ on the set $A = \{x \mid x^2 + 20 \leq 9x\}$ is _____

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES: NWCMPA223A1_PAPER-1
PHASE TEST – I

PHYSICS, CHEMISTRY & MATHEMATICS

ANSWER KEY

Paper Code
100055

SECTION-1 : PHYSICS

PART – A

- | | | | |
|---------|-------|--------|-------|
| 1. ABCD | 2. AC | 3. BC | 4. BC |
| 5. BCD | 6. AC | 7. ABD | 8. C |
| 9. A | 10. A | 11. D | 12. A |
| 13. C | | | |

PART – B

- | | | | |
|------|------|-------|------|
| 1. 1 | 2. 4 | 3. 30 | 4. 6 |
| 5. 5 | | | |

SECTION – 2 : CHEMISTRY

PART – A

- | | | | |
|-------|--------|--------|--------|
| 1. BD | 2. ABC | 3. ACD | 4. BCD |
| 5. AB | 6. AB | 7. ABC | 8. B |
| 9. B | 10. B | 11. B | 12. B |
| 13. C | | | |

PART – B

- | | | | |
|------|------|------|------|
| 1. 8 | 2. 5 | 3. 9 | 4. 4 |
| 5. 4 | | | |

SECTION – 3 : MATHEMATICS

PART – A

- | | | | |
|---------|-------|--------|-------|
| 1. AC | 2. BD | 3. ACD | 4. AB |
| 5. ABCD | 6. AC | 7. ABC | 8. C |
| 9. C | 10. A | 11. C | 12. B |
| 13. B | | | |

PART – B

- | | | | |
|------|------|------|------|
| 1. 3 | 2. 5 | 3. 2 | 4. 3 |
| 5. 7 | | | |