

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-1

QP Code:

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 (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 : _____

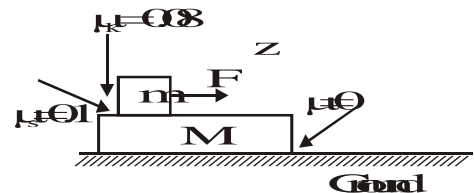
BATCHES – NWCM2022X1R, NWCM2022X1W, Y1W, Z1W _PT1

SECTION-1 : PHYSICS**PART – A****(Multi Correct Choice Type)**

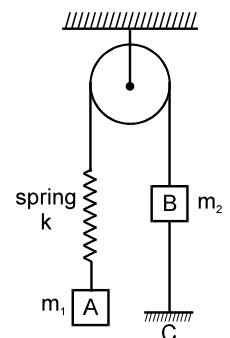
This section contains 7 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

- The kinetic energy of a particle continuously increases with time.
 - The resultant force on the particle must be parallel to the velocity at all instants.
 - The resultant force on the particle must be at an angle less than 90° with velocity all the time.
 - Its height above the ground level must continuously decrease.
 - The magnitude of its linear momentum is increasing continuously.
- A car moves along a horizontal circular road of radius r with velocity v . The coefficient of friction between the wheels and road is μ . Which of the following statement is true?
 - The car will slip if $v > \sqrt{\mu rg}$
 - The car will slip if $\mu < \frac{v^2}{rg}$
 - The car will slip if $r < \frac{v^2}{\mu g}$
 - The car will slip at a lower speed, if it moves with some tangential acceleration, than if it moves at constant speed.

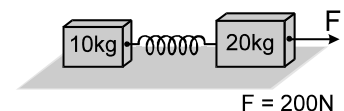
- In the figure, if $F = 4$ N, $m = 2$ kg, $M = 4$ kg then
 - the acceleration of m w.r.t. ground is $\frac{2}{3} \text{ m/s}^2$
 - the acceleration of m w.r.t. ground is 1.2 m/s^2
 - acceleration of M is 0.4 m/s^2
 - acceleration of m w.r.t. ground is $\frac{1}{3} \text{ m/s}^2$



- In the system shown in the figure $m_1 > m_2$. System is held at rest by thread BC. Just after the thread BC is burnt :
 - acceleration of m_2 will be upwards
 - magnitude of acceleration of both blocks will be equal to g
 - acceleration of m_1 will be equal to zero
 - magnitude of acceleration of both the blocks will zero.



- Two blocks of masses 10 kg and 20 kg are connected by a light spring as shown. A force of 200 N acts on the 20 kg mass as shown. At a certain instant the acceleration of 10 kg mass is 12 ms^{-2} .



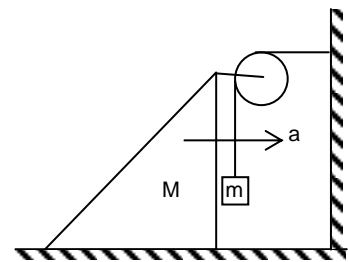
- At that instant the 20 kg mass has an acceleration of 12 ms^{-2} .
- At that instant the 20 kg mass has an acceleration of 4 ms^{-2} .
- The stretching force in the spring is 120 N.
- The collective system moves with a common acceleration of 30 ms^{-2} when the extension in the connecting spring is the maximum.

6. A particle moves along positive branch of the curve $y = \frac{x}{2}$ where $x = \frac{t^3}{3}$, x and y are measured in metres and t in seconds, then
- (A) the velocity of particle at $t = 1$ s is $\hat{i} + \frac{1}{2}\hat{j}$
- (B) the velocity of particle at $t = 1$ s is $\frac{1}{2}\hat{i} + \hat{j}$
- (C) the acceleration of particle at $t = 1$ s is $2\hat{i} + \hat{j}$
- (D) the acceleration of particle at $t = 2$ s is $\hat{i} + 2\hat{j}$
7. Two particles A and B are projected from the same point with the same speed of projection but at different angles α and β of projection, such that the maximum height of A is two-third of the horizontal range of B. Then which of the following relations are true :
- (A) range of A = maximum height of B
- (B) $3(1 - \cos 2\alpha) = 8 \sin 2\beta$
- (C) maximum value of β is $\sin^{-1}(3/4)$
- (D) maximum horizontal range of A = u^2/g and this occurs when $\beta = \frac{1}{2}\sin^{-1}\left(\frac{3}{8}\right)$

(Single Correct Choice Type)

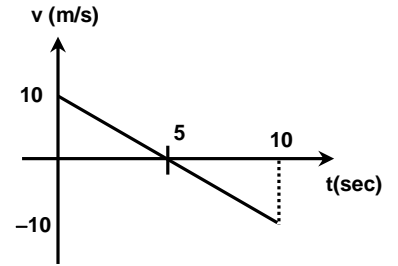
This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

8. If wedge is moving with acceleration a as shown in the figure then value of net force on m is
- (A) ma (B) $\sqrt{2} ma$
- (C) mg (D) zero



9. An object of mass m is hanging by a string from the ceiling of an elevator. The elevator is moving upward but slowing down. What is the tension in the string
- (A) less than mg (B) exactly mg
- (C) greater than mg (D) zero
10. A car is moving on circular path of radius 100 m such that its speed is increasing at the rate of 5m/s^2 . At $t = 0$ it starts from rest. The radial acceleration of car at the instant it makes one complete round trip
- (A) $10\pi \text{ m/s}^2$ (B) $20\pi \text{ m/s}^2$
- (C) $\pi/20 \text{ m/s}^2$ (D) $\pi/10 \text{ m/s}^2$
11. The vector $\vec{B} = 5\hat{i} + 2\hat{j} - x\hat{k}$ is perpendicular to the vector $\vec{A} = 3\hat{i} + \hat{j} + 2\hat{k}$ for x equals to
- (A) 1 (B) 4.7
- (C) 6.3 (D) 8.5
12. A particle moving in the positive x -direction has initial velocity v_0 . The particle undergoes retardation kv^2 , where v is its instantaneous velocity. The velocity of the particle as a function of time is given by
- (A) $v = v_0/(1 + kv_0t)$ (B) $v = \frac{2v_0}{1 + kt}$
- (C) $v = \frac{v_0}{kt}$ (D) $v = \frac{v_0}{(1 + k^2v_0^2t)}$

13. Velocity-time graph of a particle moving in a straight line is shown in the figure. Mass of the particle is 2 kg. Work done by all the forces acting on the particle in time interval $t = 0$ to $t = 10$ sec is
- (A) 300 J
(B) - 300 J
(C) zero
(D) - 400 J

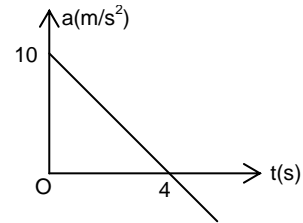


PART – B (Numerical based)

1. A ball is projected in upward direction with a speed of 20 m/s. Find the distance (in meter) travelled by it in last second of its ascending motion ($g = 10 \text{ m/s}^2$)
2. Two blocks of masses 20 kg and 50 kg are lying on a horizontal floor (coefficient of friction $\mu = 0.5$). Initially string is stretched and blocks are at rest. Now two forces 300 N and 150 N are applied on two blocks as shown in figure. The acceleration of 20 kg block is

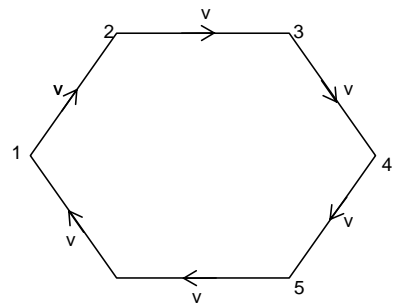


3. The acceleration-time graph of a particle moving along a straight line is as shown in figure. At what time (in sec) the particle acquires its initial velocity?



4. Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2} \text{ W}$. Here t in second. If velocity of particle at $t = 0$ is $v = 0$. If velocity at $t = 2$ sec is V , then $\frac{V}{4}$ is

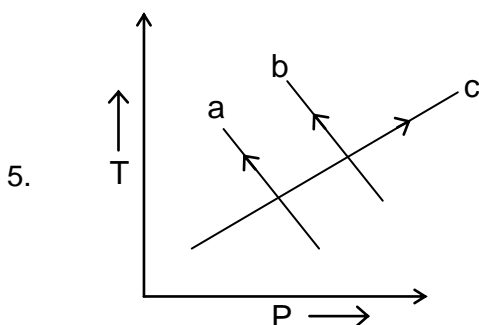
5. Six particles move in a cyclic manner along the sides of a regular hexagon of side ℓ as shown in the figure. Velocity of each particle is directed towards next particle at all time when the speed of each particle is V the particles lie always at the vertices of a hexagon. When will the side of the hexagon be halved? $\ell = 1 \text{ m}$, $v = 1 \text{ m/sec}$



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.

- Which of the following configuration produce(s) three exchange pair(s) electrons?
 (A) $2p^3$ (B) $2p^4$
 (C) $3d^4$ (D) $3d^3$
 1. ABD
- Which of the following molecule(s) has/have zero dipole moment?
 (A) BeF_2 (B) BF_3
 (C) CF_4 (D) XeF_4
 2. ABCD
- The electron affinities of which of the following element(s) is/are higher than that of oxygen?
 (A) Nitrogen (B) Sulphur
 (C) Fluorine (D) Boron
 3. BC
- 200 mL of HCl is mixed with 800 mL of NaOH for complete neutralization. What amount(s) of HCl and NaOH may be present in the solution?
 (A) HCl = 1 mole, NaOH = 0.25 mole
 (B) HCl = 18.25 g, NaOH = 5 g
 (C) HCl = 2 millimole, NaOH = 4 millimole
 (D) HCl = 1 milli equivalent, NaOH = 0.25 milli equivalent
 4. ABD



- In the above P-T graph, choose correct statement(s) regarding the lines represented by a, b and c at constant volume?
- 'c' follows Gay-Lussac's law
 - 'a' represents increase in density of an ideal gas
 - at constant temperature, gases represented by 'b' can easily deviate from ideal behaviour than that represented by 'a'
 - 'b' represents increase in average velocity of gases
- ACD
 - Which of the following substance(s) produce H_2 gas when reacts with water?
 (A) NaH (B) HI
 (C) KH (D) KHF_2
 6. AC

7. Which of the following compound(s) produce H_2O on heating?
 (A) LiOH (B) NaOH
 (C) $\text{Mg}(\text{OH})_2$ (D) KOH
7. AC

(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. The node(s) that are observed for a $4p_x$ orbital is/are
 (A) two radial nodes and one angular node
 (B) one radial node and two angular nodes
 (C) three radial nodes and one angular node
 (D) two radial nodes and two angular node
8. A
9. The decreasing order of back bonding strength for the molecules NCl_3 , BCl_3 and OCl_2 is
 (A) $\text{BCl}_3 > \text{NCl}_3 > \text{OCl}_2$ (B) $\text{BCl}_3 > \text{OCl}_2 > \text{NCl}_3$
 (C) $\text{OCl}_2 > \text{NCl}_3 > \text{BCl}_3$ (D) $\text{NCl}_3 > \text{BCl}_3 > \text{OCl}_2$
9. B
10. Maximum difference in I.E_1 and I.E_2 is observed in
 (A) Na (B) Mg
 (C) Al (D) B
10. A
11. Under which of the following condition ideal gas can most likely deviate from ideal behaviour?
 (A) 400 K and 2 atm (B) 420 K and 1 atm
 (C) 400 K and 3 atm (D) 420 K and 3 atm
11. C
12. $2\text{Cu} + \text{O}_2 + \text{CO}_2 + \text{H}_2\text{O} \longrightarrow \text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$
 Which species in above reaction has largest n-factor?
 (A) Cu (B) O_2
 (C) CO_2 (D) H_2O
12. B
13. Which of the following substance is prepared by electrolysis of aq. NaCl solution?
 (A) NaH (B) HCl
 (C) Cl_2O_3 (D) NaOH
13. D

PART – B
(Numerical based)

1. The root mean square velocity of one mole of an ideal gas NO at temperature TK is expressed as $(20\sqrt{831.4}) \text{ m/s}$. What is the kinetic energy of one mole of NO in Kcal mol^{-1} unit?
1. 1.2
2. How many equivalent(s) of iodine molecule can be completely titrated with 200 mL of 0.4 M sodium thiosulphate solution?
2. 0.08

3. The de-Broglie wavelength of an alpha particle is expressed as $\left(\frac{h}{24 \times 10^{-14}}\right)$ m. What is the kinetic energy of the alpha particle in Joule unit?
3. 4.5
4. 20 mL of a hydrocarbon upon combustion below 100°C with 80 mL of O₂ produces CO₂ and H₂O. The volume contraction is found to be 40 mL and also KOH absorbed 40 mL of certain product. What is the volume of unutilized O₂ in mL?
4. 20
5. A sample of hard water contains 48.8×10^{-5} g HCO₃⁻ per litre of solution. What is the degree of hardness of the sample in ppm unit?
5. 0.4

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. If one diagonal of a square is the portion of the line $\frac{x}{a} + \frac{y}{b} = 1$ intercepted by the axes, then the extremities of the other diagonal of the square are
- (A) $\left(\frac{a+b}{2}, \frac{a+b}{2}\right)$ (B) $\left(\frac{a-b}{2}, \frac{a+b}{2}\right)$
 (C) $\left(\frac{a-b}{2}, \frac{b-a}{2}\right)$ (D) $\left(\frac{a+b}{2}, \frac{b-a}{2}\right)$
1. **AC**
2. Which of the following, when simplified, reduces to unity?
- (A) $\log_{10} 5 \cdot \log_{10} 20 + (\log_{10} 2)^2$ (B) $\frac{2\log_{10} 2 + \log_{10} 3}{\log_{10} 48 - \log_{10} 4}$
 (C) $-\log_5 \log_3 \sqrt[5]{9}$ (D) $\frac{1}{6} \log_{\sqrt{3}} \left(\frac{64}{27}\right)$
2. **ABC**
3. Two particles start from the same point $(2, -1)$, one moving 2 units along the line $x + y = 1$ and the other 5 units along the line $x - 2y = 4$. If the particles move towards increasing y , then their new positions will be
- (A) $(2 - \sqrt{2}, \sqrt{2} - 1)$ (B) $(2\sqrt{5} + 2, \sqrt{5} - 1)$
 (C) $(2 + \sqrt{2}, \sqrt{2} + 1)$ (D) $(2\sqrt{5} - 2, \sqrt{5} - 1)$
3. **AB**
4. The inequation $(x - 1)(x - 2)^2(x - 3)^3(x - 4)^4 < 0$ has
- (A) infinite positive integral solutions (B) infinite negative integral solutions
 (C) no positive integral solution (D) no negative integral solution
4. **CD**
5. If $\cos(A - B) = \frac{3}{5}$ and $\tan A \tan B = 2$, then
- (A) $\cos A \cos B = \frac{1}{5}$ (B) $\sin A \sin B = -\frac{2}{5}$
 (C) $\cos(A + B) = -\frac{1}{5}$ (D) $\cos(A + B) = \frac{1}{5}$
5. **AC**
6. Let $y = \sqrt{x + \sqrt{x + \sqrt{x + \dots \infty}}}$ then $\frac{dy}{dx} =$
- (A) $\frac{1}{2y - 1}$ (B) $\frac{x}{x + 2y}$
 (C) $\frac{1}{\sqrt{1 + 4x}}$ (D) $\frac{y}{2x + y}$

6. ACD
7. If $6a^2 - 3b^2 - c^2 + 7ab - ac + 4bc = 0$, the family of lines $ax + by + c = 0$ passes through the fixed point:
 (A) (2, 3) (B) (-2, -3)
 (C) (3, -1) (D) (-3, 1)
7. BC

(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. The length of the median through the vertex A of a triangle having vertices $A(-1, 3)$, $B(1, -1)$ and $C(5, 1)$, is
 (A) 5 (B) 4
 (C) 1 (D) none of these
8. **A**
9. If p_1 and p_2 are the lengths of the perpendiculars from the origin to the straight lines $x \sec \theta + y \operatorname{cosec} \theta = a$ and $x \cos \theta - y \sin \theta = a \cos 2\theta$ respectively, then the value of $4p_1^2 + p_2^2$ is
 (A) $4a^2$ (B) $2a^2$
 (C) a^2 (D) none of these
9. **C**
10. A circle has radius 3 and its centre lies on the line $y = x - 1$. The equation of the circle, if it passes through the point (7, 3), is
 (A) $x^2 + y^2 + 8x - 6y + 16 = 0$ (B) $x^2 + y^2 - 8x + 6y + 16 = 0$
 (C) $x^2 + y^2 - 8x - 6y - 16 = 0$ (D) $x^2 + y^2 - 8x - 6y + 16 = 0$
10. **D**
11. The line joining (5, 0) and $(10 \cos \theta, 10 \sin \theta)$ is divided internally in the ratio 2 : 3 at the point P. If θ varies, the locus of P is
 (A) a pair of straight lines (B) a circle
 (C) a straight line (D) none of these
11. **B**
12. If $P_n = \cos^n x + \sin^n x$, then $2P_6 - 3P_4 + 1 =$
 (A) 2 (B) 3
 (C) 0 (D) 1
12. **C**
13. $\int \frac{dx}{x+1} =$
 (A) $\ln|x+1| + c$ (B) $\ln|x| + c$
 (C) $\ln|x-1| + c$ (D) None of these
13. **A**

PART – B
(Numerical based)

1. The value of $\frac{\sin 1^\circ + \sin 3^\circ + \sin 5^\circ + \sin 7^\circ}{\cos 1^\circ \cdot \cos 2^\circ \cdot \sin 4^\circ}$ is equal to
1. **4**
2. If $\log_{10} \sin x + \log_{10} \cos x = -1$ and $\log_{10} (\sin x + \cos x) = \frac{\log_{10} n - 1}{2}$, then the value of $\frac{n}{3}$ is equal to
2. **4**
3. The number of real solutions of the equation $|x|^2 - 3|x| + 2 = 0$ is equal to
3. **4**
4. The points $(p+1, 1)$, $(2p+1, 3)$ and $(2p+2, 2p)$, $p > 0$ are collinear if p is equal to
4. **2**
5. If $(\lambda, \lambda + 1)$ is an interior point of $\triangle ABC$, where $A = (0, 3)$, $B = (-2, 0)$ and $C = (6, 1)$, then the number of integral values of λ is equal to
5. **2**

ANSWERS

SECTION-1 : PHYSICS

PART – A

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

PART – B

- | | | | | | | | |
|----|---|----|------|----|---|----|------|
| 1. | 5 | 2. | 2.50 | 3. | 8 | 4. | 0.50 |
| 5. | 1 | | | | | | |

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B