

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 1

QP Code:

TEST - 3

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 **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 (01-06)** – 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-A (07-12)** – 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 option(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 (01-06)** 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 : _____

BATCHES – All 2123 batches (X & A – lot)

SECTION-1 : PHYSICS

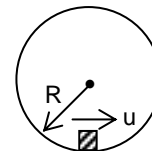
PART – A

(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**.

1. A particle is given an initial speed u inside a smooth spherical shell of radius $R = 1$ m that it is just able to complete the circle. Acceleration of the particle when its velocity is vertical is

- (A) $g\sqrt{10}$ (B) g
(C) $g\sqrt{2}$ (D) $g\sqrt{6}$



1. **A**

2. A point of application of a force $\vec{F} = 5\hat{i} - 3\hat{j} + 2\hat{k}$ is moved from $\vec{r}_1 = 2\hat{i} + 7\hat{j} + 4\hat{k}$ to $\vec{r}_2 = -5\hat{i} + 2\hat{j} + 3\hat{k}$. The work done is

- (A) -22 units (B) 22 units
(C) 11 units (D) zero

2. **A**

3. A body of mass m is falling freely through a height h from the top of a tower. The velocity just before touching the ground is $\sqrt{(3/2)gh}$. The work done by air drag is

- (A) $-\frac{mgh}{4}$ (B) $+\frac{mgh}{4}$ (C) zero (D) none of these

3. **A**

4. A particle free to move along the x -axis has potential energy given by $U(x) = k[1 - \exp(-x^2)]$ for $-\infty \leq x \leq +\infty$, where k is a positive constant of appropriate directions. Then

- (A) at point away from the origin, the particle is in unstable equilibrium.
(B) for any finite non-zero value of x , there is a force direction away from the origin.
(C) If its total mechanical energy is $k/2$, it has its minimum kinetic energy at the origin.
(D) for small displacements from $x = 0$, there is force direction towards the origin.

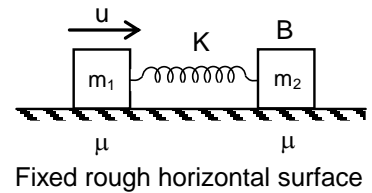
4. **D**

5. Under the action of a force, a 2 kg, body moves such that its position x as a function of time is given by $x = \frac{t^3}{3}$, then the average power generated by force in the first 2 sec is

- (A) 800 w (B) 8 w (C) 16 w (D) 1.6 w

5. **B**

6. The blocks of mass $m_1 = 1 \text{ kg}$ and $m_2 = 2 \text{ kg}$ are connected by a spring, rest on a rough horizontal surface. The spring is unstretched. The spring constant of spring is $K = 2 \text{ N/m}$. The coefficient of friction between blocks and horizontal surface is $\mu = \frac{1}{2}$. Now the left block is imparted a velocity u towards right as shown. Then what is the largest value of u such that the block of mass m_2 never moves. (Take $g = 10 \text{ m/s}^2$)
 (A) 8 m/s (B) 10 m/s
 (C) 12 m/s (D) 14 m/s

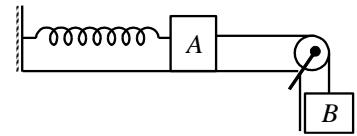


6. **B**

(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.

7. In the adjoining figure block A is of mass m and block B is of mass $2m$. The spring has a force constant k . All the surfaces are smooth and the system is released from rest with spring unstretched



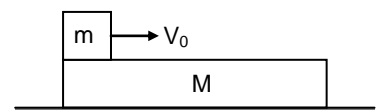
- (A) The maximum extension of the spring is $\frac{4mg}{k}$
 (B) The speed of block A when extension in spring is $\frac{2mg}{k}$, is $2g\sqrt{\frac{2m}{3k}}$
 (C) Net acceleration of block B when the extension in the spring is maximum, is $\frac{2}{3}g$.
 (D) Tension in the thread for extension of $\frac{2mg}{k}$ in spring is mg .

7. **AC**

8. A particle of mass 5 kg moving in the X - Y plane has its potential energy given by $U = (-7x + 24y) \text{ Joule}$. The particle is initially at origin and has velocity $\vec{u} = (14.4\hat{i} + 4.2\hat{j}) \text{ m/s}$
 (A) the particle has speed 25 m/s at $t = 4 \text{ sec}$
 (B) the particle has an acceleration 5 m/s^2
 (C) the acceleration of particle is normal to its initial velocity
 (D) none of these

8. **ABC**

9. The coefficient of friction between the block and plank is μ and its value is such that block becomes stationary with respect to plank before it reaches the other end. Then
 (A) the work done by friction on the block is negative.
 (B) the work done by friction on the plank is positive.
 (C) the net work done by friction is negative.
 (D) net work done by the friction is zero.

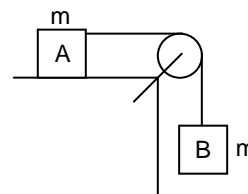


9. **ABC**

10. A particle of mass 'M' is attached to a light string of length ' ℓ ' the other end of which is fixed. Initially the string is kept horizontal and the particle is given an upward velocity 'u'. The particle is just able to complete a circle.
 (A) the string becomes slack when the particle reaches its highest point
 (B) the velocity of the particle becomes $\sqrt{g\ell}$ at the highest point
 (C) the velocity of the ball at the initial position is $\sqrt{4g\ell}$
 (D) the particle never passes again through the initial position

10. **AB**

11. In the shown arrangement the blocks are released from rest and allowed to move through a distance of h. There is no friction and the string is light. Then



- (A) total mechanical energy of the system is not conserved since besides gravity tension also does work on each of the blocks.
 (B) work done by tension on each block is separately zero.
 (C) work done by tension on block A is positive and on block B it is negative.
 (D) total mechanical energy is conserved.

11. **CD**

12. Kinetic energy of a particle moving in a straight line is proportional to the time t. The magnitude of the force acting on the particle is

- (A) directly proportional to the speed of the particle
 (B) inversely proportional to \sqrt{t}
 (C) inversely proportional to the speed of the particle
 (D) directly proportional to \sqrt{t}

12. **BC**

PART – B (Numerical based)

1. An object is displaced from point A (1m, 2.5m, 3m) to a point B (2m, 3m, 4m) under a constant force $\vec{F} = (2\hat{i} + 3\hat{j} + 4\hat{k})\text{N}$. Find the work done by this force in this process. (in joule)

1. **7.5**

2. If an ideal linear spring is stretched by x then energy stored in it is E and when it is stretched by a further 2x then energy stored adds a further kE. Find the value of k.

2. **8**

3. A locomotive of mass m starts moving so that its speed varies according to the law $v = a\sqrt{S}$ where a is a constant and S is the distance covered. If the total work performed by all the forces, which are acting on the locomotive during the first t seconds after the beginning of motion is $\frac{ma^4t^2}{x}$, then find the value 'x'.

3. **8**

-
4. Potential energy of a particle moving along x-axis is given by $U = \frac{x^3}{3} - \frac{9x^2}{2} + 20x$. Find out position of stable equilibrium state.
4. **5**
5. A uniform chain of length ℓ and mass m overhangs a smooth table with its two third part lying on the table. If the kinetic energy of the chain as it completely slips off the table is $x mg$, then find the value of 'x'.
5. **0.44**
6. The potential energy U in Joule of a particle due to certain gravitational system obeys the law $U = ax + 4y$, here x and y are in metres. Assume there are no other forces acting on the particle apart from these potential field forces. If mass of the particle is 1 kg and it is at rest at $(6m, 8m)$ at time $t = 0$, then work done by the forces on the particle from the initial positions to the instant it crosses the x axis is 50 J. Find the value of a (which is constant).
6. **3**

SECTION-2 : CHEMISTRY

PART – A

(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**.

1. The hybridization of N in NO_2^- , NH_4^+ and NO_2^+ is respectively
 (A) sp^2 , sp^3 , sp (B) sp^2 , sp^3 , sp^2
 (C) sp , sp^3 , sp^2 (D) sp^2 , sp^3 , sp^3

1. A

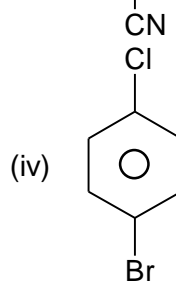
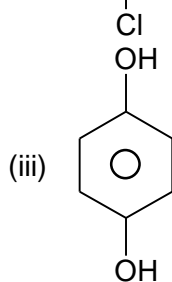
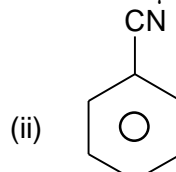
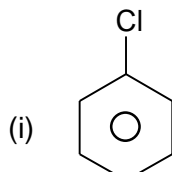
2. The pair of species having identical shape of both species
 (A) BF_3 , PCl_3 (B) PF_5 , IF_5
 (C) CF_4 , SF_4 (D) XeF_2 , CO_2

2. D

3. Which of the following pairs of species have the same bond order?
 (A) CN^- and NO^+ (B) CN^- and CN^+
 (C) O_2^+ and CN^- (D) NO^+ and CN^+

3. A

4. For which of the following molecule has dipole moment $\mu \neq 0$.



- (A) iv only
 (C) ii only

- (B) iii and iv
 (D) ii and iv

4. B

5. Which of the following carbonates is thermally unstable?
 (A) Na_2CO_3 (B) K_2CO_3
 (C) Li_2CO_3 (D) Rb_2CO_3

5. C

6. One mole of magnesium nitride on reaction with excess of water gives
 (A) 2 mole of HNO_3 (B) 2 mole of NH_3
 (C) 1 mole of NH_3 (D) 1 mole of HNO_3

6. B

(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.

7. In which of the following case(s), hybridization of the underlined atom is affected
 (A) $\underline{P}Cl_5(s)$ dissociates into PCl_4^+ and PCl_6^-
 (B) LiH reacts with $\underline{Al}H_3$ forming $LiAlH_4$
 (C) $\underline{N}H_3$ is protonated
 (D) $H_3\underline{P}O_2$ is heated forming PH_3 and H_3PO_3
7. ABD
8. Which among the following is/are isostructural pairs?
 $NF_3, NO_3^-, BF_3, H_3O^+, \overset{\cdot\cdot}{N}H_3, XeF_4$
 (A) NF_3, H_3O^+ (B) NH_3, NF_3
 (C) NF_3, NO_3^- (D) NO_3^-, BF_3
8. ABD
9. In which of the following cases, bond order decreases and also magnetic behaviour changes.
 (A) $N_2 \longrightarrow N_2^+$ (B) $O_2 \longrightarrow O_2^+$
 (C) $C_2 \longrightarrow C_2^-$ (D) $H_2 \longrightarrow H_2^+$
9. AD
10. Which of the following is/are in the correct order of the property as mentioned.
 (A) $CH_3Cl > CH_2Cl_2 > CHCl_3 > CCl_4$ (Dipole moment)
 (B) $BF_3 > BCl_3 > BBr_3$ (Lewis acid character)
 (C) $NaCl < MgCl_2 < AlCl_3$ (increasing covalent character)
 (D) $F_2 > Cl_2 > Br_2 > I_2$ (Decreasing bond enthalpy)
10. AC
11. Select the correct statement(s) of the following
 (A) H_2O_2 acts as oxidizing as well as reducing agent
 (B) H_2O_2 is more acidic than water
 (C) H_2O_2 can be stored in glass bottles
 (D) H_2O_2 has open book structure
11. ABD
12. Which of the following is the correct order of the property as mentioned?
 (A) $BeSO_4 > MgSO_4 > CaSO_4 > BaSO_4$ (Solubility)
 (B) $BeO < MgO < CaO < SrO$ (basic character)
 (C) $NaF < NaCl < NaBr < NaI$ (covalent character)
 (D) $Li_2CO_3 < Na_2CO_3 < K_2CO_3$ (thermal stability)
12. ABCD

PART – B
(Numerical based)

13. The percentage strength of 1 N H_2O_2 will be
13. 1.7
14. The bond order of CO_3^{2-} ion is
14. 1.33
15. Among the tri atomic molecule/ions BeCl_2 , N_3^- , N_2O , NO_2^+ , O_3 , SCl_2 , ICl_2^- , I_3^- and XeF_2 , the total number of linear molecule(s)/ion(s) where the hybridization of the central atom does not have contribution from the d-orbital(s) is
15. 4
16. % s-character in hybrid orbital used by central atom in PCl_5 is
16. 20.0
17. The total number of lone pairs of electrons in N_2O_3 is x, then $\frac{x}{3}$ is
17. 2.66
18. The total number of electron deficient hydrides of the following is y, then $y/2$ is BeH_2 , NH_3 , BH_3 , AlH_3 , CH_4 , SiH_4 , H_2O , HF
18. 1.5

SECTION-3 : MATHEMATICS

PART – A

(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**.

1. The lines $3x + 2y = 5$ and $4x + 3y = 7$ are diameters of a circle of area 154 sq. units, then the equation of the circle is
 (A) $x^2 + y^2 + 2x - 2y = 62$ (B) $x^2 + y^2 + 2x - 2y = 47$
 (C) $x^2 + y^2 - 2x - 2y = 47$ (D) $x^2 + y^2 - 2x + 2y = 62$
1. C
2. The line $4y - 3x + \lambda = 0$ touches the circle $x^2 + y^2 - 4x - 8y - 5 = 0$, then the value of λ will be
 (A) 29 (B) 10
 (C) -35 (D) -15
2. C
3. The tangents to the circle $x^2 + y^2 = 169$ at the points (5, 12) and (-5, -12) are
 (A) parallel (B) at right angle
 (C) inclined at an angle of 45° (D) none of these
3. A
4. The area of the triangle formed by the tangents from the point (4, 3) to the circle $x^2 + y^2 = 9$ and the line joining their point of contact is:
 (A) $\frac{192}{25}$ (B) 192
 (C) 25 (D) 250
4. A
5. The equation of director circle of the circle $x^2 + y^2 = 1$ is
 (A) $x^2 + y^2 = 2$ (B) $x^2 + y^2 = \sqrt{2}$
 (C) $x^2 + y^2 = 4$ (D) $x^2 + y^2 = 1$
5. A
6. Radii of two circles are 4 units and 8 units. Their centers are (-1, -2) and (2, 2) respectively. The length of their common tangent is
 (A) no common tangent exists (B) 3 units
 (C) 6 units (D) 5 units
6. B

(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.

7. Two circles $x^2 + y^2 + px + py - 7 = 0$ and $x^2 + y^2 - 10x + 2py + 1 = 0$ will cut orthogonally if the value of p is
 (A) -2 (B) -3
 (C) 2 (D) 3
7. CD
8. An equation of a circle which touches the y -axis at $(0, 2)$ and cuts off an intercept 3 from the x -axis is
 (A) $x^2 + y^2 + 4x - 5y + 4 = 0$ (B) $x^2 + y^2 + 5x - 4y + 4 = 0$
 (C) $x^2 + y^2 - 5x - 4y + 4 = 0$ (D) $x^2 + y^2 - 5x + 4y + 4 = 0$
8. BC
9. Coordinates of the centre of a circle, whose radius $\sqrt{2}$ units and which touches the line pair $x^2 - y^2 - 2x + 1 = 0$ are:
 (A) $(3, 0)$ (B) $(1, 2)$
 (C) $(-1, 0)$ (D) $(1, -2)$
9. ABCD
10. The circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 2x$
 (A) intersect in two distinct points
 (B) intersect on the line $x = \frac{1}{2}$
 (C) intersect in the points $\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$
 (D) have a common chord of length $\sqrt{3}$
10. ABCD
11. An equation of the tangent to the circle $x^2 + y^2 + 4x - 4y + 4 = 0$ which makes equal intercepts on the co-ordinate axes, is given by:
 (A) $x + y = 2\sqrt{2}$ (B) $x - y = 2\sqrt{2}$
 (C) $x + y + 2\sqrt{2} = 0$ (D) $x - y + 2\sqrt{2} = 0$
11. AC
12. Which of the following lines cut off intercepts of equal length on the circle $x^2 + y^2 - 2x + 4y = 0$?
 (A) $3x - y = 0$ (B) $x + 3y = 0$
 (C) $x + 3y + 10 = 0$ (D) $3x - y - 10 = 0$
12. ABCD

PART – B
(Numerical based)

1. The greatest distance of the point P (10, 7) from the circle $x^2 + y^2 - 4x - 2y - 20 = 0$ is K then $K/3$ is
1. 5
2. The line $4y - 3x + \lambda = 0$ touches the circle $x^2 + y^2 - 4x - 8y - 5 = 0$. Then the integral value of $\frac{|\lambda|}{7}$ is
2. 5
3. Tangents drawn from the point P (1, 8) to the circle $x^2 + y^2 - 6x - 4y - 11 = 0$ touches the circle at the points A & B. The equation of the circum-circle of the triangle PAB comes out to be $x^2 + y^2 - 4x - 10y + \lambda = 0$, then λ will be
3. 19
4. Find the shortest distance from the point M (-7, 2) to the circle $x^2 + y^2 - 10x - 14y - 151 = 0$.
4. 2
5. The intercept cut off by the circle $x^2 + y^2 + 4x - 7y + 12 = 0$ on y - axis will be of length
5. 1
6. If the line joining origin to the intersection of the line $y = mx + 2$ and curve $x^2 + y^2 = 1$ are at right angle. Then the value of m^2 will be
6. 7

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B