

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 – 2123 batches (C & D – lot)

SECTION-1 : PHYSICS

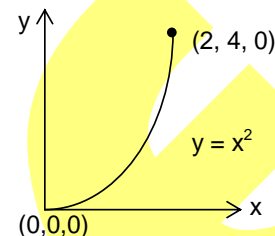
PART – A

(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. By applying a force $\vec{F} = (3xy - 5z)\hat{j} + 4z\hat{k}$ a particle is moved along the path $y = x^2$ from point $(0, 0, 0)$ to $(2, 4, 0)$. The work done by the force F on the particle is

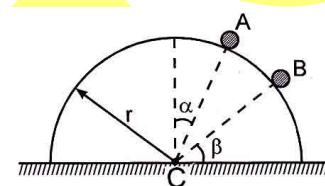
- (A) $\frac{280}{5}$ unit
(B) $\frac{140}{5}$ unit
(C) $\frac{232}{5}$ unit
(D) $\frac{192}{5}$ unit



1. **D**

2. A particle initially at rest starts moving from point A on the surface of a fixed smooth hemisphere of radius r as shown. The particle loses its contact with hemisphere at point B. C is centre of the hemisphere. The equation relating α and β is

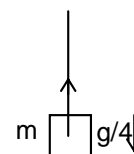
- (A) $3 \sin \alpha = 2 \cos \beta$
(B) $2 \sin \alpha = 3 \cos \beta$
(C) $3 \sin \beta = 2 \cos \alpha$
(D) $2 \sin \beta = 3 \cos \alpha$



2. **C**

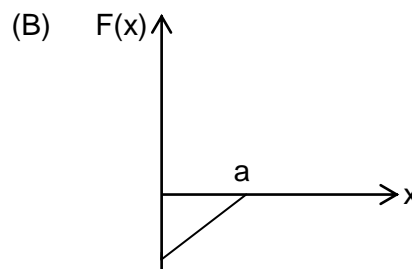
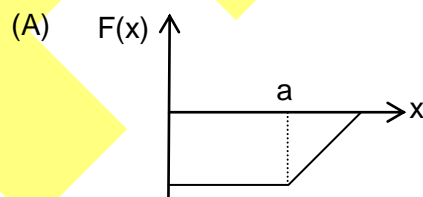
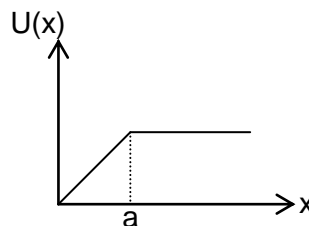
3. The work done by tension in lowering down a block of mass = m kg through a distance 'd' is

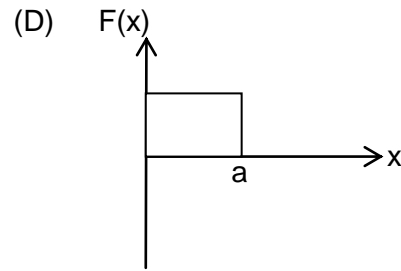
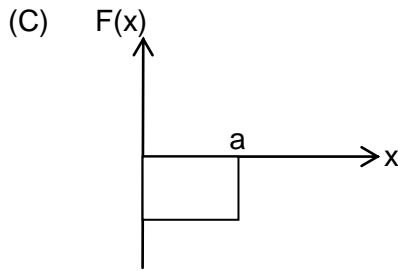
- (A) $mg \frac{d}{4}$
(B) $3mg \frac{d}{4}$
(C) $-3mg \frac{d}{4}$
(D) mgd



3. **C**

4. The potential energy of a system is represented in the first figure. The force acting on the system will be represented by





4. **C**

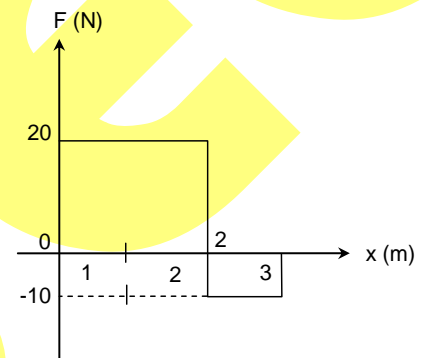
5. A force acts on a 3 gram particle such that its position $x = 3t - 4t^2 + t^3$, where x is in metre and t is in second. The work done during first 4s is

- (A) 825 mJ (B) 285 mJ
(C) 528 mJ (D) zero

5. **C**

6. A variable force F starts acting on a block of mass 5 kg resting on a smooth horizontal surface. F is varying with displacement x as shown in $F - x$ curve. The velocity of body when its displacement is 3m will be

- (A) 2 ms^{-1} (B) $2\sqrt{2} \text{ ms}^{-1}$
(C) $2\sqrt{3} \text{ ms}^{-1}$ (D) 6 ms^{-1}



6. **C**

(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.

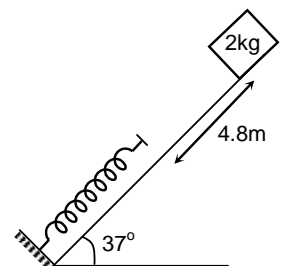
7. A particle of mass 5 kg moving in the X - Y plane has its potential energy given by $U = (-7x + 24y)$ Joule. The particle is initially at origin and has velocity $\vec{u} = (14.4\hat{i} + 4.2\hat{j})$ m/s

- (A) the particle has speed 25 m/s at $t = 4$ 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

7. **ABC**

8. Figure shows a massless spring fixed at the bottom end of an inclined of inclination 37° ($\tan 37^\circ = 3/4$). A small block of mass 2 kg start slipping down the incline from a point 4.8 m away from free end of spring. The block compresses the spring by 20 cm, stops momentarily and then rebounds through a distance 1 m up the inclined, then ($g = 10 \text{ m/s}^2$)

- (A) coefficient of friction between block and inclined is 0.5.
(B) coefficient of friction between block and inclined is 0.75.
(C) value of spring constant is 1000 N/m.
(D) value of spring constant is 2000 N/m.

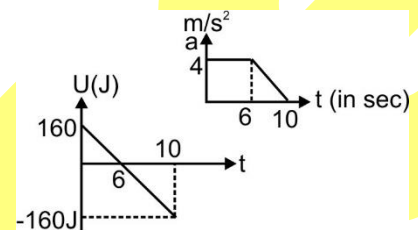


8. **AC**

9. 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} .

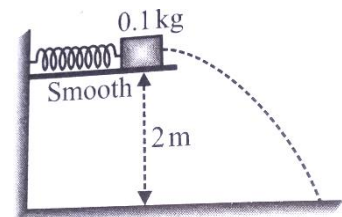
9. **BC**

10. A particle of mass 1 kg is moving along x-axis. Its velocity is 6 m/s at $t = 0$. Acceleration-time curve and potential energy-time curve of the particle are shown. In first 10 seconds:
- (A) the work done by all the forces is 704 J.
 (B) the work done by external forces is 350 J.
 (C) the work done by external forces is 384 J.
 (D) the work done by conservative forces is 300 J.

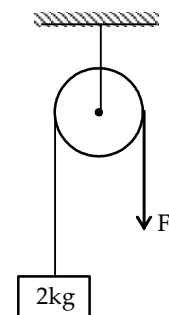
10. **AC**

11. A 0.1 kg block is pressed against a horizontal spring fixed at one end to compress the spring through 5 cm. The spring constant is 100 N/m. The ground is 2 m below the spring. Which of the following is/are correct?

- (A) When released, block shall have a kinetic energy of $\frac{1}{8}$ J.
 (B) The initial horizontal velocity of the block is $\sqrt{\frac{5}{2}}$ m/s.
 (C) The block shall reach the ground in $\sqrt{\frac{2}{5}}$ sec.
 (D) The block will hit the ground at a horizontal distance of 1 metre from the free end of the spring.

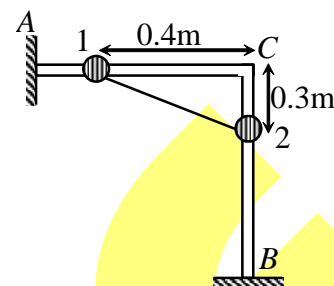
11. **ABCD**

12. A block of mass 2 kg is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force $F = 40$ N. The kinetic energy of the particle increases to 40 J in a given interval of time. Then ($g = 10$ m/s²)
- (A) tension in the string is 40 N.
 (B) displacement of the block in the given interval of time is 2 m.
 (C) work done by gravity is -20 J.
 (D) work done by tension is 80 J.

12. **ABD**

PART – B (Numerical based)

1. Two identical beads of $m = 100$ gram are connected by an inextensible massless string can slide along the two arms AC and BC of a rigid smooth wire frame in a vertical plane. If the system is released from rest, the kinetic energy of the first particle when they have moved by a distance of 0.1 m is K Joules, then find the value of $100K$. ($g = 10 \text{ m/s}^2$)

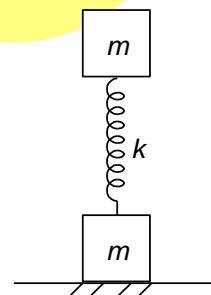


1. **6.40**

2. 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 $\frac{ma^2t^2}{10x}$, then find the value 'x'.

2. **0.80**

3. A system consists of two identical slabs each of mass m linked by compressed weightless spring of stiffness k as shown in Figure. The slabs are also connected by a thread, which is burnt at a certain moment. If the value of $\Delta\ell$ the initial compression of spring, the lower slab will bounce up after the thread is burned through is $\frac{2xmg}{k}$, then find the value of 'x'.



3. **1.50**

4. Power supplied to a particle of mass 2kg varies with time as $P = \frac{3t^2}{2}$ watt, where t is in seconds. If velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at $t = 2\text{sec}$ will be (in m/s).

4. **2**

5. A block of mass 1 kg is moved with a speed of 10 m/s at the highest point in a closed circular fixed tube of radius 1m kept in a vertical plane. The cross section of the tube is such that the block just fits in it. The block makes several oscillations inside the tube and finally stops at the lowest point. The work done by the tube on the block during the process is $-50x \text{ J}$. Find the value of x . ($g = 10 \text{ m/s}^2$)

5. **1.40**

6. 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 $xmgl$, then find the value of 'x'.

6. **0.44**

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. In the following electron-dot structure, - calculate the formal charge from left to right nitrogen atom, $\overset{\cdot\cdot}{\text{N}} = \text{N} = \overset{\cdot\cdot}{\text{N}}$
- (A) -1, -1, +1
(B) -1, +1, -1
(C) +1, -1, -1
(D) +1, -1, +1

1. B

2. In which of the following pairs of molecules/ion both the species are not likely to exist?
- (A) H_2^+ , He_2^{2-}
(B) H_2^- , He_2^{2-}
(C) H_2^+ , He_2
(D) H_2^- , He_2^{2+}

2. C

3. The shape of XeO_2F_2 molecule is
- (A) trigonal bipyramidal
(B) square planar
(C) tetrahedral
(D) see-saw

3. D

4. Match the following columns

	Column – I (molecule/ion)		Column – II (Type of hybridization)
(a)	NH_4^+	(1)	sp^3d^3
(b)	PCl_5	(2)	sp^3d
(c)	SF_6	(3)	sp^3
(d)	IF_7	(4)	sp^3d^2

Codes

	a	b	c	d
(A)	3	2	4	1
(B)	1	2	3	4
(C)	2	3	1	4
(D)	4	1	2	3

4. A

5. Match the compounds in the column-I with that in column-II

	Column – I		Column – II
(a)	XeO_3	(1)	Planar triangular
(b)	XeOF_4	(2)	T-shape
(c)	BO_3^{3-}	(3)	Trigonal pyramid
(d)	ClF_3	(4)	Square pyramid
(e)	I_3^-	(5)	Linear
		(6)	Bent

Codes

	a	b	c	d	e
(A)	1	4	3	2	5

Codes

	a	b	c	d	e
(B)	2	4	1	3	4

Codes

	a	b	c	d	e
(C)	3	4	1	2	5

Codes

	a	b	c	d	e
(D)	4	4	1	2	5

5. C
6. Which of the following compounds would have the highest boiling point?
 (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ (B) CH_3NH_2
 (C) CH_3OH (D) CH_2F_2

6. C

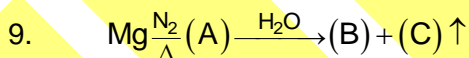
(Multi Correct Choice Type)

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. Which of the following compound(s) is/are more covalent than MgCl_2 according to Fajan's rule?
 (A) NaCl (B) CaCl_2
 (C) AlCl_3 (D) SiCl_4

7. **CD**

8. When zeolite, which is hydrated sodium aluminium silicate, is treated with hard water the sodium ions are exchanged with
 (A) H^+ ion (B) Ca^{++} ions
 (C) SO_4^+ ions (D) Mg^{++} ions

8. **BD**

Choose the correct unknown compounds of above reaction.

- (A) (A) is Mg_3N_2 (B) (B) is MgO
 (C) (C) is NH_3 (D) (C) is NO_2

9. **AC**

10. Choose correct statement(s) regarding the compound O_2BF_4
 (A) It is paramagnetic in nature
 (B) Boron undergoes sp^2 -hybridization
 (C) It's aqueous solution conducts electricity
 (D) It behaves as a Lewis acid.

10. **AC**

11. Hydrogen can be obtained from water, by the action of water on
 (A) calcium carbide (B) calcium hydride
 (C) Calcium oxide (D) calcium

11. BD
12. Which of the following element(s) is/are more reactive than sodium towards water?
 (A) Li (B) K
 (C) Rb (D) Mg
12. BC

PART – B
(Numerical based)

13. The bond length of HCl molecule is 1.275 \AA and its dipole moment is 1.03 D. The ionic character of the molecule (in percent) (charge of the electron = 4.8×10^{-10} esu) is
13. 16.83
14. Which is the value of 'n' in the given species?
 $(\text{PO}_3)_6^{n-}$
14. 6
15. How many of the following can be oxidized using H_2O_2 ?
 FeCl_2 , SnCl_2 , MnCl_2 , KMnO_4 , HOCl , F_2 , H_2S , KI , $\text{K}_2\text{Cr}_2\text{O}_7$, O_3
15. 5
16. In the given reaction

$$\text{Mg}^{2+}(\text{g}) + \text{C}(\text{s}) \xrightarrow{\text{Heat}} [\text{X}] \xrightarrow{\text{H}_2\text{O}} \underset{\text{Gas}}{[\text{Y}]} + \underset{\text{ppt}}{[\text{Z}]}$$
 Number of σ (sigma) bonds in 'Y' are
16. 6
17. Paramagnetic species (do not consider s-p mixing)
 N_2 , O_2 , O_2^{2-} , O_2^- , C_2 , H_2 , Li_2 , Li_2^- , B_2
17. 4
18. Among the given species, how many have at least two π -bonds
 C_2H_2 , C_2H_4 , C_3H_4 , N_2 , O_2 , C_2 , HCN , $\text{CH}_3 - \text{CHO}$, NH_2CN , CO
18. 7

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 co-ordinates of a point on the line $x + y = -13$, nearest to the circle $x^2 + y^2 + 4x + 6y - 5 = 0$ is
 (A) $(-6, -7)$ (B) $(-15, 2)$
 (C) $(-5, -6)$ (D) $(-7, -6)$
1. **A**
2. The angle between the two tangents from the origin to the circle $(x-7)^2 + (y+1)^2 = 25$ equals to
 (A) $\frac{\pi}{4}$ (B) $\frac{\pi}{3}$
 (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{12}$
2. **C**
3. The locus of the mid-point of a chord of the circle $x^2 + y^2 = 4$ which subtends a right angle at the origin is
 (A) $x + y = 2$ (B) $x^2 + y^2 = 1$
 (C) $x^2 + y^2 = 2$ (D) $x + y = 1$
3. **C**
4. The equation of normal to the circle $x^2 + y^2 - 4x + 4y - 17 = 0$ which passes through the point $(1, 1)$ will be
 (A) $3x + y - 4 = 0$ (B) $x - y = 0$
 (C) $x + y = 0$ (D) $3x + y = 0$
4. **A**
5. The centre of circle inscribed in a square formed by the lines $x^2 - 8x + 12 = 0$ and $y^2 - 14y + 45 = 0$ will be
 (A) $(9, 4)$ (B) $(7, 4)$
 (C) $(4, 9)$ (D) $(4, 7)$
5. **D**
6. The equation of common tangent to the circle $x^2 + y^2 - 4x - 6y - 12 = 0$ and $x^2 + y^2 + 6x + 18y + 26 = 0$ at their point of contact will be
 (A) $12x + 5y + 19 = 0$ (B) $5x + 12y + 19 = 0$
 (C) $5x - 12y + 19 = 0$ (D) $12x - 5y + 19 = 0$
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. The tangent lines to the circle $x^2 + y^2 - 6x + 4y - 12 = 0$ which are parallel to the line $4x + 3y + 5 = 0$ are

- (A) $4x + 3y - 31 = 0$ (B) $4x + 3y + 19 = 0$
 (C) $4x + 3y - 19 = 0$ (D) $4x + 3y + 31 = 0$

7. **AB**

8. Let the equation of a circle be $x^2 + y^2 - 5x - 13y - 14 = 0$, then which of the following are true?

- (A) Length of intercept on x-axis is 9 units.
 (B) Length of intercept on y-axis is 15 units.
 (C) Centre of the circle passes through the line $4x - 2y + 3 = 0$.
 (D) Two distinct tangents can be drawn to this circle from the point $(-2, -1)$.

8. **ABCD**

9. The centre of a circle passing through the points $(0,0)$ and $(1,0)$ & touching the circle $x^2 + y^2 = 9$ is/are

- (A) $\left(\frac{3}{2}, \frac{1}{2}\right)$ (B) $\left(\frac{1}{2}, \sqrt{2}\right)$
 (C) $\left(\frac{1}{2}, \frac{1}{2}\right)$ (D) $\left(\frac{1}{2}, -\sqrt{2}\right)$

9. **BD**

10. For the circles $S_1 \equiv x^2 + y^2 - 4x - 6y - 12 = 0$ and $S_2 \equiv x^2 + y^2 + 6x + 4y - 12 = 0$ & the line $L \equiv x + y = 0$, then which of the following is/are true?

- (A) L is common tangent of S_1 and S_2
 (B) L is common chord of S_1 and S_2
 (C) L is radical axis of S_1 and S_2
 (D) L is perpendicular to the line joining centre of S_1 and S_2

10. **BCD**

11. For the equation $x^2 + y^2 + 2\lambda x + 4 = 0$ which of the following can be true

- (A) It represents a real circle for all $\lambda \in \mathbb{R}$.
 (B) It represents a real circle for $|\lambda| > 2$.
 (C) The radical axis of any two circles of the family is the y-axis.
 (D) The radical axis of any two circles of the family is the x-axis.

11. **BC**

12. Equation $\frac{x - x_1}{\cos \theta} = \frac{y - y_1}{\sin \theta} = r$, may represents

- (A) Equation of straight line, if θ is constant and r is variable.
 (B) Equation of straight line, if r is constant and θ is variable.
 (C) A straight line passing through a fixed point & having a known slope.
 (D) A circle with a known centre & given radius.

12. **ABCD**

PART – B
(Numerical based)

1. Let x and y be the real numbers satisfying the equation $x^2 - 4x + y^2 + 3 = 0$. If the maximum and minimum values of $(x^2 + y^2)$ are M and m respectively, then the numerical value of $(M - m)$ will be
1. 8
2. The number of common tangents of the circles $(x + 2)^2 + (y - 2)^2 = 49$ and $(x - 2)^2 + (y + 1)^2 = 4$ will be
2. 1
3. The radius of the circle with centre $(3, -1)$ and cutting a chord of length 6 units on the line $2x - 5y + 18 = 0$ will be
3. 6.16
4. The length of tangent drawn from the point $(4, -1)$ to the circle $2x^2 + 2y^2 = 1$ comes out to be $\sqrt{\frac{\lambda}{2}}$, then the value of $(\lambda - 30)$ will be
4. 3
5. If the two circles $(x - 1)^2 + (y - 3)^2 = r^2$ and $x^2 + y^2 - 8x + 2y + 8 = 0$ intersect in two distinct points, then number of integral values r can take will be
5. 5
6. If the chord $y = mx + 1$ of the circle $x^2 + y^2 = 1$ subtends an angle of measure 45° at the major segment of the circle, then the value of $|m|$ will be
6. 1

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B