

**PHYSICS, CHEMISTRY & MATHEMATICS****QP CODE: 100816****Paper – 2****Time Allotted: 3 Hours****Maximum Marks: 180**

- 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. All the section can be filled in **PART-A & B** of 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 **Blue/Black Ball Point Pen** 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 (01-04)** – Contains Four (04) 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 (05-07)** contains (3) Multiple Choice Questions which have **One or More Than One 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.
- (iii) **Part-B (01-06)** This section contains **SIX (06)** questions. The answer to each question is a **NON-NEGATIVE INTEGER**. For each question, enter the correct integer corresponding to the answer. Each question carries **+4 marks** for correct answer. **There is no negative marking.**
- (iv) **Part-B (07-10)** This section contains Two paragraphs. Each paragraph having TWO questions Numerical answer type with answer XXXX.XX. For each question, enter the correct numerical value. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places. Each question carries **+3 marks** for the correct answer. **There is no negative marking.**

Name of the Candidate: \_\_\_\_\_

Batch: \_\_\_\_\_ Date of Examination: \_\_\_\_\_

Enrolment Number: \_\_\_\_\_

**BATCHES – PANINI426-G1 & PANINI426-A1-A2\_PT-2**

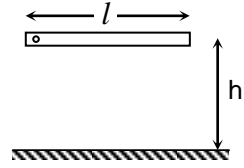
## **SECTION – I: PHYSICS**

### **(PART – A)**

**(Single Correct Answer Type)**

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. A thin rod of mass  $m$  and length  $l$  is hinged at a point which is at a distance  $h$  ( $h < l$ ) above the horizontal surface. The rod is released from rest from the horizontal position. If  $e$  is the coefficient of restitution, the angular velocity of rod just after collision will be ( $h = 1\text{m}$ ,  $l = 2\text{m}$ ,  $e = 1$ )

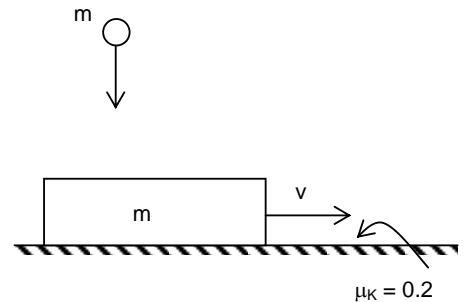


- (A)  $\frac{3\sqrt{3g}}{8}$                       (B)  $\frac{6\sqrt{3g}}{8}$                       (C)  $\frac{5\sqrt{3g}}{8}$                       (D) none of these

2. A man of mass  $M$  stands at one end of a plank of length  $L$  and mass  $3M$ , which lies at rest on a frictionless surface. If the man is walking with respect to the plank with speed  $v$  then the workdone by the man be

- (A)  $\frac{3}{4}MV^2$                       (B)  $\frac{3}{8}MV^2$                       (C)  $\frac{4}{3}MV^2$                       (D)  $\frac{2}{3}MV^2$

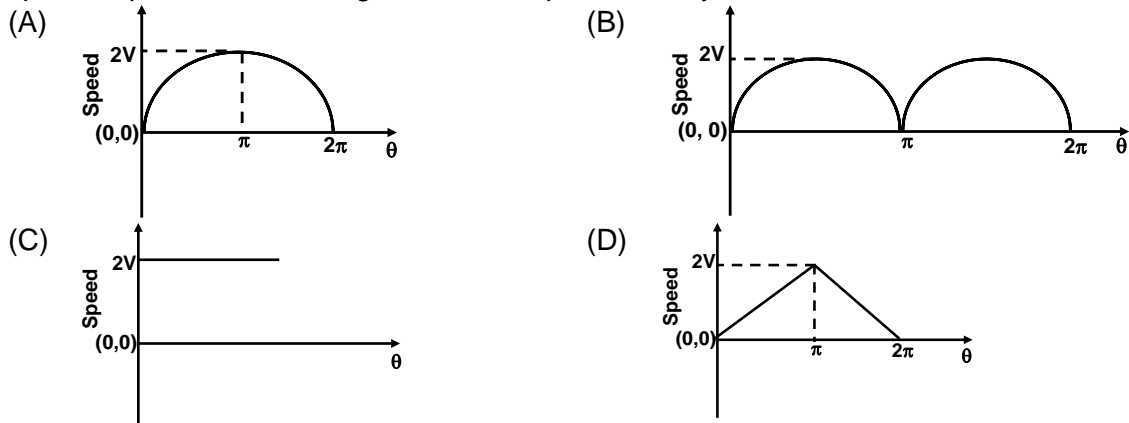
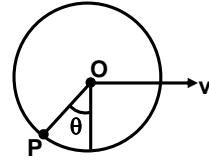
3. A ball of mass  $m$  falls vertically from a height  $h$  and collides with a block of equal mass  $m$  moving horizontally with a velocity  $v$  on a surface. The coefficient of kinetic friction between the block and the surface is  $\mu_k = 0.2$ , while the coefficient of restitution ( $e$ ) between the ball and the block is 0.5. There is no friction acting between the ball and the block. The velocity of the block just after the collision decreases by



- (A)  $0.5\sqrt{2gh}$                       (B) 0  
(C)  $0.1\sqrt{2gh}$                       (D)  $0.3\sqrt{2gh}$

*Space For Rough Work*

4. A ring is rolling without slipping on a horizontal surface. The velocity of centre of mass is  $V$ . A point  $P$  on the circumference of the ring makes an angle  $\theta$  with the downward vertical as represented in the figure. The speed of point  $P$  versus angle  $\theta$  is best represented by



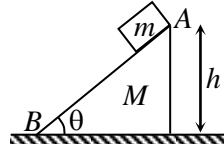
**(One or More Than One Options Correct Type)**

This section contains **3 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE or MORE THAN ONE is correct**.

5. A horizontal disc rotates freely about a vertical axis through its centre. A ring, having the same mass and radius as the disc, is now gently placed on the disc. After some time, they rotate with a common angular speed.
- (A) some friction exists between the disc and the ring.  
 (B) the angular momentum of the disc plus ring is conserved.  
 (C) the final common angular speed is  $\frac{2}{3}$ rd of the initial angular velocity of the disc.  
 (D)  $\frac{2}{3}$ rd of the initial kinetic energy changes to heat.
6. A cannon shell is fired to hit a target at a horizontal distance  $R$ , however it breaks into two equal parts at its highest point, one part returns to the cannon. The other part
- (A) will fall at a distance  $R$  beyond target  
 (B) will fall at a distance  $3R$  beyond target  
 (C) will hit the target  
 (D) have nine times kinetic energy of first

*Space For Rough Work*

7. A block of mass  $m$  is resting at point A on a wedge of mass  $M$  which is kept on a smooth surface as shown in figure. Now the block is set free to move. After some time the block reaches point B with respect to wedge. Then

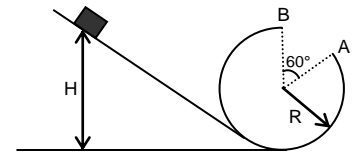


- (A) momentum of block-wedge system remains conserved in horizontal direction.  
 (B) momentum of black-wedge system remains conserved in vertical direction.  
 (C) displacement of wedge till this moment will be  $\frac{mh \cot \theta}{M + m}$ .  
 (D) displacement of wedge till this moment will be  $\frac{mh \tan \theta}{M + m}$ .

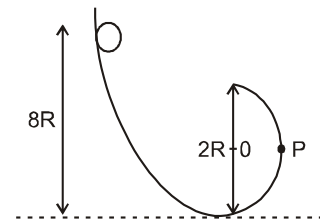
**(PART – B)**  
**(Non – Negative Integer)**

1. An inclined plane makes an angle of  $30^\circ$  with the horizontal. A solid sphere rolling down this inclined plane from rest without slipping has a linear acceleration is  $\frac{n}{2}$  then value of 'n' is \_\_\_\_\_ ( $g = 9.8 \text{ m/s}^2$ ).

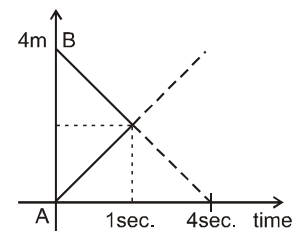
2. A small particle slides from height  $H = 45 \text{ cm}$  as shown and then loops inside the vertical loop of radius  $R$  from where a section of angle  $\theta = 60^\circ$  has been removed. If  $R = (1/N)$  meter, such that after losing contact at A and flying through the air, the particle will reach at the point B. Find N. Neglect friction everywhere.



3. A small solid ball rolls without slipping along the track shown in fig. radius of the circular part of the track is  $R$ . If the ball starts from rest at height  $8R$  above the bottom what is the horizontal force acting on it at point P, mass of the solid ball  $m = 0.05 \text{ kg}$ .

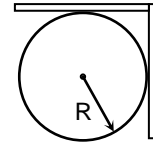


4. Position time graph of two bodies A and B same mass ' $m$ ' is given coefficient of restitution for collision is 0.5. Find the velocity of B after collision. (Dotted line after collision is indicative).



Space For Rough Work

5. A ring of mass 3 kg is rolling without slipping with linear velocity 1 m/sec on a smooth horizontal surface. A rod of same mass is fitted along its one diameter. Find total kinetic energy of the system (in J).
6. A plate bent at right angles along its centre line, is placed onto a horizontal fixed cylinder of radius  $R$  as shown. The minimum coefficient of friction between the cylinder and the plate so that plate does not slip off the cylinder will be  $\mu = \frac{\sqrt{n}}{2} - 1$ , then the value of 'n' is \_\_\_\_\_. (Assume mass of plate and cylinder to be same)



**(PART – B)**

This section contains Two paragraphs. Each paragraph having TWO questions Numerical answer type with answer XXXX.XX. For each question, enter the correct numerical value. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

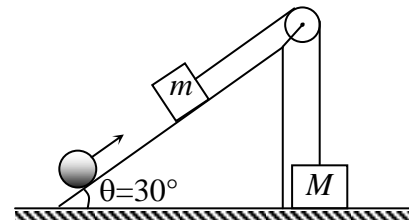
**Paragraph for Question no. 7 to 8**

A disc of radius  $R = 10 \text{ cm}$  is mounted on a light axle with the axle held horizontal, the disc is made to spin with angular speed  $\omega_0 = 2 \text{ rad/sec}$  It is then lowered gently on to a level table and released as soon as its rim makes contact with the table top. The disc begins to move along the table, skidding and picking up speed as it goes. (Take  $g = 10 \text{ S.I. Units}$ )

7. While the disc skids, its translational and angular acceleration are related as  $a = k R \alpha$ , then  $k$  is \_\_\_\_\_.
8. If  $\mu_k = 0.5$  is the coefficient of kinetic friction between the rim of the disc and table top, disc will continue to skid for a time (in milli seconds) =

**Paragraph for Question no. 9 to 10**

A light inextensible thread passes over a small frictionless pulley. Two blocks of masses  $m = 1 \text{ kg}$  and  $M = 3 \text{ kg}$  respectively are attached with the thread as shown in the figure. The heavier block rests on a horizontal surface. A shell of mass 1 kg moving upwards, parallel to the incline, with a velocity of 10 m/s collides with  $m$  at  $t = 0$  and sticks to it. The combined mass travels up the incline to a distance  $s$ , stops for a moment and then moves down the incline. When the moving mass reaches its initial position, the string regains its tension and the mass  $M$  starts to climb up with an initial speed  $v_0$ . The mass  $M$  moves up to a height  $h$  before stopping at  $t = t_0$ . The inclined plane is smooth and long. ( $g = 10 \text{ m/s}^2$ ).



9. The value of  $s$  (in m) is \_\_\_\_\_.
10. The value of  $h$  (in m) is \_\_\_\_\_.

*Space For Rough Work*

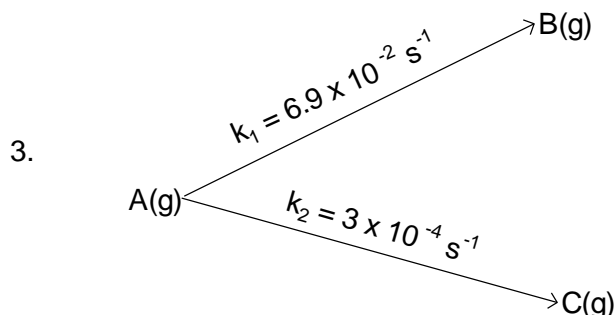
## SECTION – II: CHEMISTRY

### (PART – A)

#### (Single Correct Answer Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

- In the molecule  $\text{SOF}_4$ 
  - sulphur uses only 3s and 3p-orbitals in hybridization
  - it is a planar molecule all the six atoms are present in a plane
  - it's dipole moment is zero
  - it contains sigma as well as pi-bonds
- Which does not happen when molecules of ideal gases collide with each other (intermolecular collision)?
  - Pressure is produced
  - Direction of motion of the molecules changes
  - The energy of the molecules does not change
  - None of these



The reaction starts with taking 10 M concentration of A(g). What will be the concentration of A(g) in  $\text{mol L}^{-1}$  after 20 sec from the start of the reaction?

- |          |         |
|----------|---------|
| (A) 1.25 | (B) 2.5 |
| (C) 5    | (D) 3.5 |
- The molarity of a solution is a/an
 

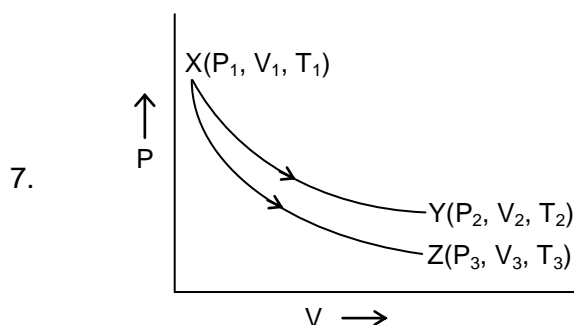
(A) extensive property	(B) intensive property
(C) state function	(D) path function

*Space For Rough Work*

**(One or More Than One Options Correct Type)**

This section contains **3 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE or MORE THAN ONE is correct**.

5. Which of the following molecule(s) do(es) not follow octet rule?  
 (A)  $\text{BF}_3$  (B)  $\text{NF}_3$   
 (C)  $\text{PF}_5$  (D)  $\text{SF}_4$
6. Which of the following characteristic(s) of ideal gases depends on temperature?  
 (A) Velocities (B) Kinetic energy  
 (C) Vapour density (D) Liquification



In above P vs V graph two thermodynamic processes are given. Choose correct statement(s).

- (A) Both are expansion processes  
 (B) Work done along path  $X \rightarrow Y$  is greater than that done along path  $X \rightarrow Z$   
 (C)  $T_2 > T_3$   
 (D)  $P_1 > P_2 > P_3$

**(PART – B)****(Non – Negative Integer)**

1. The molar heat capacity of a substance at constant pressure ( $C_{P,m}$ ) is  $9 \text{ J K}^{-1} \text{ mol}^{-1}$ .  $C_{P,m}$  of the substance is directly proportional to  $T^3$ , i.e.  $C_{P,m} \propto T^3$ . What is the molar entropy of the substance at 8 K if its molar entropy at zero Kelvin is zero.
2. What is the kinetic energy in joule unit of a certain quantity of an ideal gas for which the value of  $\frac{PV}{R}$  is 400 mol K and the temperature of the gas is 200 K?  
 [Assume  $R = 8 \text{ J K}^{-1} \text{ mol}^{-1}$ ]
3. A closed container contains 10 moles of an ideal gas at 600 K. The gas was heated by supplying 2 KJ of heat. What will be the final temperature of the gas in Kelvin unit?  
 [Molar heat capacity at constant pressure of the gas is  $\frac{7R}{2}$ , i.e.  $C_{P,m} = \frac{7R}{2}$  and  $R = 8 \text{ JK}^{-1} \text{ mol}^{-1}$ ]

*Space For Rough Work*

4. The internal energy of an ideal gas increases by 20 kJ when the gas was heated by supplying 12 kJ of heat. If the work done in this process is  $x \text{ kJ mol}^{-1}$ . What is the value of  $x$ ?
5. How many molecular orbitals of  $\text{N}_2$  is/are completely filled with electrons?
6. If  $x$  is the root mean square velocity ( $C_{\text{rms}}$ ) of NO at 200 K in  $\text{ms}^{-1}$  unit and  $y$  is the mean square velocity of NO at 200 K in the same unit then the value of  $\frac{y}{x}$  is  
[Assume  $R = 8 \text{ JK}^{-1} \text{ mol}^{-1}$ ]

**(PART – B)**

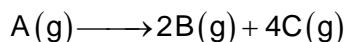
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**Paragraph for Question no. 7 to 8**

The values of van der Waal's constant  $a$  and  $b$  for four gases are given below

$a(\text{atm L}^2 \text{ mol}^{-2})$	$b(\text{L mol}^{-1})$
1.4	0.8
1.5	0.3
3.2	1.6
1.2	0.6

7. The value of  $\left(\frac{a+b}{2}\right)$  of the most easily liquefiable gas is
8. What is the Boyle temperature of the gas which is most difficult to liquefy?  
[ $R = 0.08 \text{ L atm K}^{-1} \text{ mol}^{-1}$ ]

**Paragraph for Question no. 9 to 10**

In above first order decomposition reaction, A(g) was taken initially at 10 atm. After 25 sec, the total pressure of the container become 47.5 atm, after a long time the maximum observed pressure in the container becomes 60 atm.

Answer the following questions.

9. The half-life period of A(g) is
10. If the maximum partial pressure of 'B' in the container is X atm, what is the value of  $\left(\frac{X}{16}\right)$ ?

*Space For Rough Work*



## **SECTION – III: MATHEMATICS**

### **(PART – A)**

#### **(Single Correct Answer Type)**

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. If the equation  $4y^3 - 8a^2yx^2 - 3ay^2x + 8x^3 = 0$  represent three straight lines, two of them are perpendicular then sum of all possible values of 'a' is equal to:  
 (A)  $\frac{3}{8}$  (B)  $-\frac{3}{4}$   
 (C)  $\frac{1}{4}$  (D)  $-2$
2. If  $f(x) = ax^2 + bx + c$  ( $a \neq 0$ , &  $a, b, c \in \mathbb{Q}$ ) be a quadratic function with  $f\left(\tan\left(\frac{\pi}{12}\right)\right) = 0$  and passing through  $(1, 2)$ . Then  $f(x) = ?$ . (where 'Q' represents the set of rational numbers)  
 (A)  $x^2 - 4x + 1$  (B)  $-x^2 + 4x - 1$   
 (C)  $x^2 - 2x + 3$  (D) None of these
3. A student score the following marks in five tests : 45, 54, 41, 57, 43. His score is not known for the sixth test. If the mean score is 48 in the six tests, then the standard deviation of the marks in six tests is:  
 (A)  $\frac{10}{3}$  (B)  $\frac{100}{3}$   
 (C)  $\frac{100}{\sqrt{3}}$  (D)  $\frac{10}{\sqrt{3}}$
4. If both the mean and the standard deviation of 50 observations  $x_1, x_2, \dots, x_{50}$  are equal to 16, then the mean of  $(x_1 - 4)^2, (x_2 - 4)^2, \dots, (x_{50} - 4)^2$  is  
 (A) 480 (B) 400  
 (C) 380 (D) 525

*Space For Rough Work*

**(One or More Than One Options Correct Type)**

This section contains **3 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE or MORE THAN ONE is correct**.

5. From a point 'A' on x – axis, two tangents are drawn to the circle  $x^2 + y^2 = 16$  meeting y – axis at 'P' and 'Q' then:  
 (A)  $\min.(AP^2 + AQ^2) = 128$   
 (B)  $\min.\text{area } \Delta APQ = 32$   
 (C)  $\min.(OA^2 + OP^2) = 64$   
 (D) For min. area of  $\Delta APQ$ , A is  $(4\sqrt{2}, 0)$  or  $(-4\sqrt{2}, 0)$
6. Consider  $f(x) = x^2 - (b+1)x + 2(a-5)$  where  $a, b \in \mathbb{N}$ . Identify which of the following statement(s) is (are) correct?  
 (A) If  $f(x) = 0$  has two distinct real roots for all values of 'b', then sum of values of 'a' is 15.  
 (B) If  $f(x) = 0$  has two distinct real roots for all values of 'b', then sum of values of 'a' is 10.  
 (C) If  $f(-1) > 0$  for all values of 'a' then least value of 'b' is 7.  
 (D) If  $f(-1) > 0$  for all values of 'a' then least value of 'b' is 6.
7. A line 'L' passing through the point (2, 1) intersects the curve  $4x^2 + y^2 - x + 4y - 2 = 0$  at the points 'A' and 'B'. If the lines 'OA' and 'OB' are such that the co – ordinate axes are the angle bisectors between them, then possible equations of line 'L' are:-  
 (A)  $4y = x + 2$  (B)  $y = x - 1$   
 (C)  $4y - 3x + 2 = 0$  (D)  $x + 2y = 4$

**(PART – B)****(Non – Negative Integer)**

1. A circle passes through the vertex C of a rectangle ABCD and touches its sides AB and AD at M and N, respectively. If the distance from C of the line segment MN is equal to 5 units and the area of the rectangle ABCD is 'x' sq. units, then the value of  $\sqrt{x}$  is \_\_\_\_\_
2. Let 'A' be the centre of the circle  $x^2 + y^2 - 2x - 4y - 20 = 0$ . Suppose that the tangents at the points B (1, 7) and D (4, -2) on the circle meet at the point 'C'. Then the area of quadrilateral ABCD is \_\_\_\_\_

*Space For Rough Work*

3. If  $bc \neq ad$  and the lines  
 $(\sin 3\theta)x + ay + b = 0$   
 $(\cos 2\theta)x + cy + d = 0$   
 $2x + (a + 2c)y + (b + 2d) = 0$  are concurrent then ; the sum of all possible values of ' $\sin \theta$ ' is  $\frac{1}{k}$  (where  $k$  is a natural number). Find  $k$ .
4. If  $\alpha, \beta$  are the roots of  $x^2 - 2x + 5 = 0$  and  $S = \alpha^3 + \beta^3 + \alpha^2 + 4\beta^2 - \alpha - 7\beta + 57$ ; then the value of 'S' is \_\_\_\_\_.
5. If exactly one root of  $x^2 + mx + m^2 + 6m$  lies in the interval  $(-2, 0)$  then number of possible integral values of 'm' are \_\_\_\_\_.
6. If the sum of the deviations of 50 observations from 30 is 50, then the mean of these observations is \_\_\_\_\_.

**(PART – B)**

This section contains Two paragraphs. Each paragraph having TWO questions Numerical answer type with answer XXXX.XX. For each question, enter the correct numerical value. If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.

**Paragraph for Question no. 7 to 8**

If the locus of the circumcentre of a variable triangle having sides  $y$  – axis,  $y = 2$  and  $\ell x + my = 1$ , where  $(\ell, m)$  lies on the parabola  $y^2 = 4x$  is curve C, then:

7. The length of smallest focal chord of this curve C is:
8. If the curve C is symmetric about the line  $y = k$ ; then value of  $k$  is:

**Paragraph for Question no. 9 to 10**

Consider a rational function  $f(x) = \frac{x^2 - 3x - 4}{x^2 - 3x + 4}$  and a quadratic function  $g(x) = x^2 - (b + 1)x + b - 1$ , where 'b' is a parameter.

9. Number of integers in the range of  $f(x)$  are \_\_\_\_\_
10. The largest natural number 'b' satisfying  $g(x) > -2 \quad \forall x \in \mathbb{R}$ , is:

*Space For Rough Work*

# FIITJEE INTERNAL TEST

BATCHES: PANINI426-G1 & PANINI426-A1-A2\_PT-2

Paper – 2

Code: 100816

JEE ADVANCED LEVEL

ANSWER KEY

ANSWER KEYS

**Physics**

PART – A

- |        |       |       |      |
|--------|-------|-------|------|
| 1. A   | 2. B  | 3. D  | 4. A |
| 5. ABD | 6. AD | 7. AC |      |

PART – B

- |                                  |      |         |          |
|----------------------------------|------|---------|----------|
| 1. 7                             | 2. 5 | 3. 5    | 4. 2     |
| 5. 5                             | 6. 8 | 7. 0.5  |          |
| 8. 13.33 (range: 13.32 to 13.34) |      | 9. 2.50 | 10. 0.50 |

**Chemistry**

PART – A

- |        |        |         |      |
|--------|--------|---------|------|
| 1. D   | 2. A   | 3. B    | 4. B |
| 5. ACD | 6. ABD | 7. ABCD |      |

PART – B

- |                                |         |                               |      |
|--------------------------------|---------|-------------------------------|------|
| 1. 3                           | 2. 4800 | 3. 610                        | 4. 8 |
| 5. 7                           | 6. 400  | 7. 0.9                        |      |
| 8. 21.87(range 19.00 to 22.00) |         | 9. 12.5(range 12.00 to 13.00) |      |
| 10. 1.25                       |         |                               |      |

**Mathematics**

PART – A

- |         |       |       |      |
|---------|-------|-------|------|
| 1. B    | 2. B  | 3. D  | 4. B |
| 5. ABCD | 6. AC | 7. AD |      |

PART – B

- |         |       |                              |       |
|---------|-------|------------------------------|-------|
| 1. 5    | 2. 75 | 3. 2                         | 4. 12 |
| 5. 4    | 6. 31 | 7. 0.13 (Range 0.12 to 0.13) |       |
| 8. 1.50 | 9. 4  | 10. 2                        |       |