

FITJEE INTERNAL TEST

PHYSICS, CHEMISTRY & MATHEMATICS

QP CODE: 101041

RIT – 4

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 (05-08)** contains (4) 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 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.
- (iii) **Part-B** – This section contains Eight (08) questions numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places. Each question carries **+4 marks** for correct answer. **There is no negative marking.**

Name of the Candidate: _____

Batch: _____ Date of Examination: _____

Enrolment Number: _____

BATCHES – Class – XII (CTY426 Batches

SECTION – I: PHYSICS

(PART – A)

(Single Correct Answer Type)

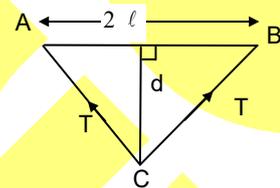
This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. Three point masses A, B, C each having mass m are kept on the x-axis at the points $(0, 0)$, $(a, 0)$ and $(2a, 0)$ respectively. Initially, they are all at rest. They start moving due to the gravitational force between themselves. Then the instantaneous acceleration of the centre of mass of the system consisting of (B + C) will be

(A) $\frac{Gm}{a^2} \times \frac{4}{9}$ (B) $\frac{Gm}{a^2} \times \frac{8}{9}$ (C) $\frac{Gm}{a^2} \times \frac{5}{8}$ (D) zero

2. A wire of radius r stretched without tension along a straight line is lightly fixed at A and B. What is the tension in the wire, when it is pulled into the shape A C B. Take $Y =$ young's modulus and $d \ll \ell$

(A) $\frac{Y^2 d^2}{2\pi r^2 \ell^2}$ (B) $\frac{Y\pi r^2 d^2}{2\ell^2}$ (C) $\frac{Y\pi r^2}{2\ell^2 d^2}$ (D) $\frac{Y\pi r^2 \ell^2}{2d^2}$



3. In figure A, a stationary spacecraft of mass M is passed by asteroid A of mass m , asteroid B of the same mass m , and asteroid C of mass $2m$. The asteroids move along the indicated straight paths at the same speed; the perpendicular distances between the spacecraft and the paths are given as multiples of R . Figure B gives the gravitational potential energy $U(t)$ of the spacecraft-asteroid system during the passage of each asteroid treating time $t = 0$ as the moment when separation is minimum. Which asteroid corresponds to which plot of $U(t)$?

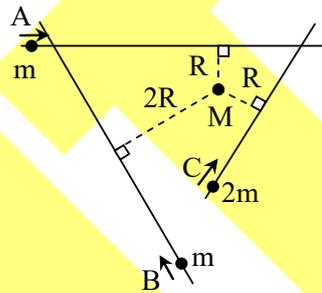


Figure A

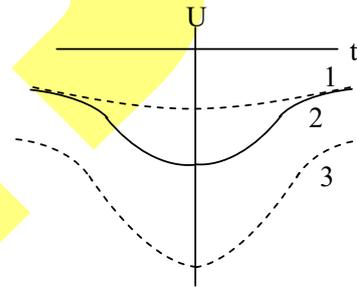
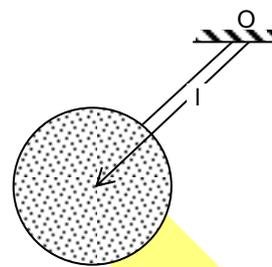


Figure B

- (A) A-1 B-2, C-3 (B) B-1 A-3, C-2 (C) B-1, A-2, C-3 (D) None

Space For Rough Work

4. Time period of a pendulum which is constructed as a thin walled sphere of radius R filled up with water and suspended from a point O is T_1 (Neglecting viscous forces). Centre of sphere from O is l apart. The time period of small oscillation change to T_2 when the water freezes, then $T_2/T_1 =$



- (A) 1
 (B) $1 + \frac{2}{5} \left(\frac{R}{l} \right)^2$
 (C) $\sqrt{1 + \frac{2}{5} \left(\frac{R}{l} \right)^2}$
 (D) $\sqrt{\frac{1}{1 + \frac{2}{5} \left(\frac{R}{l} \right)^2}}$

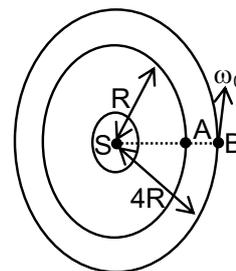
(One or More Than One Options Correct Type)

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

5. An object is weighed at the equator by a beam balance and a spring balance, giving readings W_b and W_s respectively. It is again weighed in the same manner at the north pole, giving readings of W'_b and W'_s respectively. Assume that the acceleration due to gravity is the same every where on the earth's surface and that the balances are quite sensitive
- (A) $W_b = W'_b$ (B) $W_b = W_s$ (C) $W'_b = W'_s$ (D) $W'_s > W_s$

6. A particle is executing SHM with amplitude A . At displacement $x = \frac{-A}{4}$, force acting on the particle is F , potential energy of the particle is U , velocity of particle is v and kinetic energy is K . Assuming potential energy to be zero at mean position. At displacement $x = \frac{A}{2}$
- (A) force acting on the particle will be $-2F$ (B) potential energy of particle will be $4U$
 (C) velocity of particle will be $\pm \sqrt{\frac{4}{5}}v$ (D) kinetic energy of particle will be $0.8K$

7. Two planets A and B, having orbital radius R and $4R$ are initially at the closest position, and rotating in the same direction. If angular velocity of planet B is ω_0 , then after how much time, will both the planets be again in the closest position?



- (A) $\frac{2\pi}{7\omega_0}$ (B) $\frac{2\pi}{9\omega_0}$
 (C) $\frac{2\pi}{\omega_0}$ (D) $\frac{10\pi}{\omega_0}$

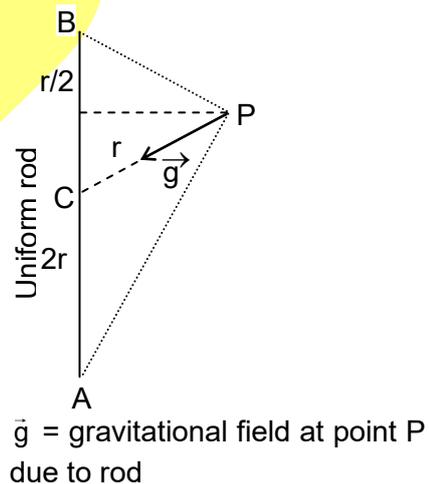
Space For Rough Work

8. A composite rod consists of a steel rod of length 25 cm and cross-sectional area $2A$ and copper rod of length 50 cm and cross-sectional area A . The composite rod is subjected to an axial load F . If the young's moduli of steel and copper are in the ratio $2 : 1$ then
- (A) the extension produced in copper rod will more.
 (B) the extension in copper and steel parts will be in the ratio $1 : 8$.
 (C) the stress in copper rod will be more.
 (D) no extension will be produced in the steel rod.

(PART – B)

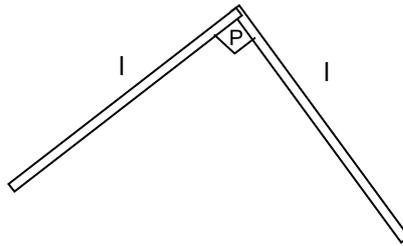
This section contains **Eight (08)** numerical based questions. The answer to each question is a **NUMERICAL VALUE**. If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

1. If a particle of small mass is dropped from a height $h = R$, above the earth's surface and its speed with which strikes the earth's surface is $\sqrt{\frac{xGM}{R}}$, then find the value of x .
 (Assume M – mass of earth, R – radius of earth & neglect air resistance)
2. Two small balls, each of mass m are connected by a light rigid rod of length L . The system is suspended from its centre by a thin wire of torsional constant k . The rod is rotated about the wire through an angle $\sqrt{\frac{\sqrt{3} mgL}{k}}$ and released. Find the ratio of tension in the rod when the system passes through the mean position and its weight. (acceleration due to gravity = g)
3. A light wooden rod fixed at one end is kept horizontal. A load of 0.4 kg tied to the free end of the rod causes that end to be depressed by 2.8 cm. If this load is set into up and down vibrations, with what frequency will it oscillate?
4. As situation shown in figure, the value of $\frac{\angle APB}{\angle CPB}$



Space For Rough Work

5. A system (L shaped) of two identical rods of mass m and length l are resting on a peg P shown in the figure. If the system is displaced in its plane by a small angle θ , then period of oscillation is given by $2\pi\sqrt{\frac{kl}{3g}}$. Find the value of $k^2/8 =$



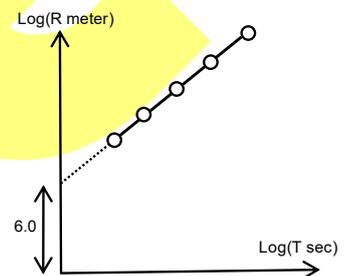
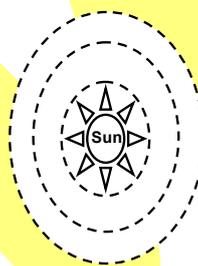
6. If the time period of a simple pendulum of infinite length is on earth's surface is $2\pi\sqrt{\frac{aR_e}{2g}}$, then $a =$

7. Many particles are revolving around a fixed sun, in circular orbits of different radius (R) and different time period (T). To estimate the mass of the sun, the orbital radius (R) and time period (T) of planets were noted. Then $\log_{10}T$ v/s $\log_{10}R$ curve was plotted.

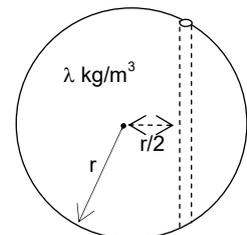
The curve was found to be approximately straight line (as shown in figure) having y intercept = 6.0 (neglect the gravitational interaction among the planets)

[Take $G = \frac{20}{3} \times 10^{-11}$ in MKS, $\pi^2 = 10$]

Find the value of 3 times of slope of the line



8. Consider a planet of radius r having density λ . A tunnel is dug inside it at a distance $r/2$ from its centre as shown in figure. An object of mass m is left in the tunnel at the surface at $t = 0$, if the magnitude of velocity of object at the centre of the tunnel is $\sqrt{n\pi G\lambda r^2}$, then find the value of 'n'.



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**.

1. When heat is supplied to a thermodynamic system containing an ideal gas, the increase in energy is called increase in internal energy of the system if the process is carried out at constant.

(A) Volume	(B) Pressure
(C) Temperature	(D) Number of moles of gases

2. BF_3 does not undergo easy hydrolysis unlike the other halides of boron (BCl_3 , BBr_3 and BI_3). This is due to

(A) least Lewis acidity of BF_3
(B) strong B – F bonds
(C) sp^2 hybridized boron atom with only 33% s-orbital character
(D) absence of vacant d-orbitals in boron

3. When an aqueous solution of a mixture of salts of K_2SO_4 and $\text{Al}_2(\text{SO}_4)_3$ are crystallized, a hydrated solid $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ is obtained. The solid crystal contains more than one type of ions, one of such ions is

(A) $[\text{K}(\text{H}_2\text{O})_6]^+$	(B) $[\text{Al}(\text{OH})_4]^-$	(C) H^+	(D) HSO_4^-
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4.

p_i, V_i, T_i	→ Adiabatic process →	p_f, V_f, T_f
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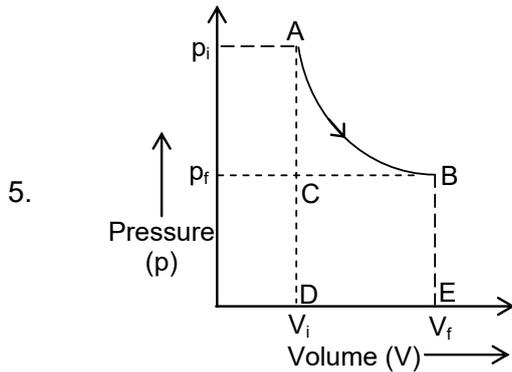
A thermodynamic system containing an ideal gas at p_i, V_i and T_i undergoes an adiabatic process to transform into the final state (p_f, V_f and T_f). Choose the correct statement.

(A) if $p_i > p_f$ then $V_i > V_f$	(B) if $V_i < V_f$ then $T_f < T_i$
(C) if $p_i > p_f$ then $T_i < T_f$	(D) $p_i V_i = p_f V_f$

Space For Rough Work

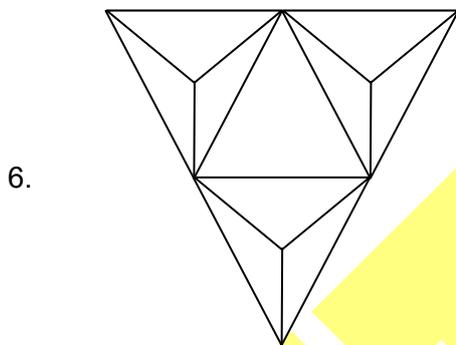
(One or More Than One Options Correct Type)

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



The work done in a thermodynamic system containing an ideal gas, through isothermal process is given above in the PV diagram. Choose the correct statement(s).

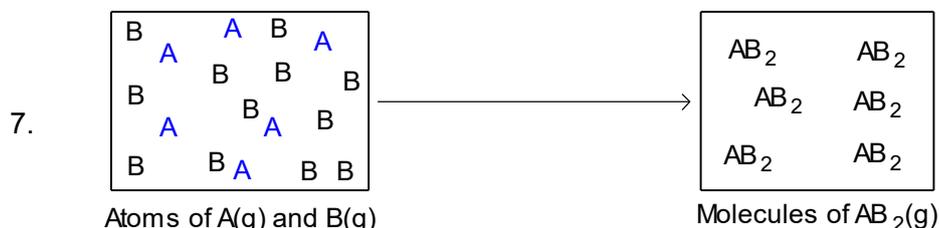
- (A) It is a reversible process
- (B) The area represented by BCDE gives irreversible work
- (C) The area represented by ABDE gives the reversible work
- (D) Work is done by the system on the surrounding



The characteristic of the silicate ion, represented in above figure is/are

- (A) it is a cyclic silicate
- (B) two oxygen atoms are shared by each tetrahedra
- (C) the formula of the silicate is $\text{Si}_3\text{O}_8^{4-}$
- (D) the oxidation number of each oxygen atom is -2

Space For Rough Work



The reaction taking place is



If the gaseous atoms in the left side container are changed into molecules in the right side container at constant temperature and following ideal gas behaviour, the correct statement(s) are: [The containers behave as closed systems]

- (A) the pressure will decrease in the transformation, if the volumes of the containers are same.
 (B) the entropy of the system decreases and that of the surrounding increases.
 (C) the A to B attractive interaction is stronger than that of A to A and B to B interactions.
 (D) the reaction becomes spontaneous at all temperature.
8. Which of the following substance(s) produce(s) only H₃BO₃ as a single product when they react with water?
 [Ignore intermediate products]
 (A) H₂B₄O₇ (B) HBO₂ (C) BCl₃ (D) B₂H₆

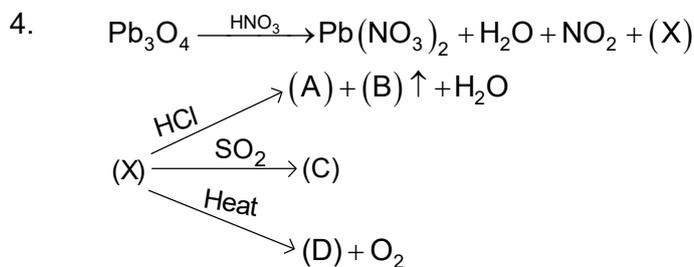
(PART – B)

This section contains **Eight (08)** numerical based questions. The answer to each question is a NUMERICAL VALUE. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.

- The reaction between BF₃ and CH₃MgBr produces more than one products. How many boron containing products are formed in the reaction?
- The enthalpy change of a system containing one mole of a monoatomic gas is 18.007 kJ mol⁻¹ at 298 K. What will be its enthalpy change at 302 K in kJ mol⁻¹ unit?
 [Given the heat capacity of the gas as: C_P = (0.8 + 0.001T) JK⁻¹mol⁻¹]
- $$\frac{3}{2} B_2H_6 + 3 CO \xrightarrow[\text{THF}]{\text{NaBH}_4} B_3O_3C_3H_9 (P)$$

The product(P) is a cyclic compound containing six B – O bonds and the carbon and hydrogen atoms are attached to the six-membered ring as CH₃ groups.
 If (P) contains x number of sp³-hybrid atoms and y number of sp²-hybrid atoms, the value of $\left(\frac{x+y}{2}\right)$ is

Space For Rough Work

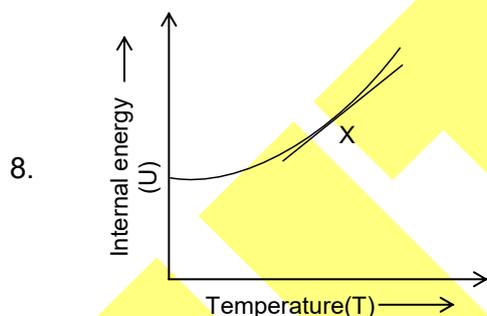


If the oxidation numbers of lead(Pb) in (X), (A), (C) and (D) are respectively +a, +b, +c and +d, what is the value of $x \left(\frac{3a + 2b + 4c + d}{10} \right)$?

5. 56 g of iron(molar mass = 56 g mol⁻¹) reacts with HCl to produce aqueous FeCl₂ and H₂ gas in an open container at 227°C. If the work done in the reaction is expressed as -x kJ mol⁻¹, the value of x is
[Assume R = 8.4 JK⁻¹ mol⁻¹]

6. $\text{B}(\text{OH})_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_3\text{O}^+ + \text{HSO}_4^- + (\text{X})$
(X) is a complex anion which contains boron, hydrogen, sulphur and oxygen. How many total number of atoms of different elements are present in (X)?

7. A thermodynamical system contains $\frac{1}{2.303}$ moles of an ideal gas. If the volume of the container is increased to 10 times of its original volume by a reversible isothermal process, the entropy change of the system is found to be x JK⁻¹mol⁻¹. What is the value of x?
[Assume R = 8.4 JK⁻¹mol⁻¹]



In the internal energy vs temperature graph, the slope of the curve at point 'X' at a certain temperature is 0.2 Cal K⁻¹mol⁻¹. What is the value of C_p(heat capacity at constant pressure of the system) in cal K⁻¹ mol⁻¹ unit?

[Assume that the thermodynamic system contains one mole of an ideal gas]

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. The median from the table

Value	7	8	10	9	11	12	13
Frequency	2	1	4	5	6	1	3

Is

- (A) 100 (B) 10 (C) 110 (D) 1110

2. The sum of the infinite series

$$\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) + \sin^{-1}\left(\frac{\sqrt{2}-1}{\sqrt{6}}\right) + \sin^{-1}\left(\frac{\sqrt{3}-\sqrt{2}}{12}\right) + \dots + \dots + \sin^{-1}\left(\frac{\sqrt{n}-\sqrt{(n-1)}}{\sqrt{\{n(n+1)\}}}\right) + \dots \text{ is}$$

- (A) $\frac{\pi}{8}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (D) π

3. The mirror image of the parabola $y^2 = 4x$ in the tangent to the parabola at the point (1, 2) is

- (A) $(x-1)^2 = 4(y+1)$ (B) $(x+1)^2 = 4(y+1)$
 (C) $(x+1)^2 = 4(y-1)$ (D) $(x-1)^2 = 4(y-1)$

4. Let n be a positive integer such that $\sin\left(\frac{\pi}{2n}\right) + \cos\left(\frac{\pi}{2n}\right) = \frac{\sqrt{n}}{2}$, then

- (A) $n=6$ (B) $n=2$ (C) $n=1$ (D) $n=3,4,5$

(One or More Than One Options Correct Type)

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

5. The value of x satisfying $\sin^{-1}x + \sin^{-1}(1-x) = \cos^{-1}x$ are

- (A) 0 (B) $\frac{1}{2}$ (C) 1 (D) 2

6. Let PQ be a chord of the parabola $y^2 = 4x$. A circle drawn with PQ as a diameter passes through the vertex of the parabola. If area of $\Delta PVQ = 2$ sq. unit, then coordinates of P are

- (A) $(-16, -8)$ (B) $(-16, 8)$ (C) $(16, -8)$ (D) $(16, 8)$

Space For Rough Work

7. $\sin x + \cos x = 1 + \sin x \cos x$, if
- (A) $\sin\left(x + \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$ (B) $\sin\left(x - \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$
- (C) $\cos\left(x + \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$ (D) $\cos\left(x - \frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$
8. The equation of the tangent to the parabola $y^2 = 9$ which goes through the point (4, 10) is
- (A) $x + 4y + 1 = 0$ (B) $9x + 4y + 4 = 0$ (C) $x - 4y + 36 = 0$ (D) $9x - 4y + 4 = 0$

(PART – B)

This section contains **Eight (08)** numerical based questions. The answer to each question is a NUMERICAL VALUE. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.

1. From the top of cliff 50 m high, the angle of depression of the top and bottom of a tower are observed to be 30° and 45° . If the height of tower is $25a\left(1 - \frac{1}{\sqrt{b}}\right)$, where a and b are prime numbers then the value of (a + b) is
2. A house subtends a right angle at the window of an opposite house and the angle of elevation of the window from the bottom of the first house is 60° . If the distance between the two houses be 6 m, then the height of the first house is $2^m \cdot 3^n$ then the value of $\frac{m}{n}$ is _____
3. The value of $\frac{1}{\pi} \left\{ 216 \sin^{-1}\left(\sin \frac{7\pi}{6}\right) + 27 \cos^{-1}\left(\cos \frac{2\pi}{3}\right) + 28 \tan^{-1}\left(\tan \frac{5\pi}{4}\right) + 200 \cot^{-1}\left(\cot\left(\frac{-\pi}{4}\right)\right) \right\}$ must be
4. If $\lambda = \tan\left(2 \tan^{-1}\left(\frac{1}{5} - \frac{\pi}{4}\right)\right)$, then the value of $2890\lambda^2$ must be
5. The normal to the parabola $y^2 = 8x$ at the point (2, 4) meets it again at (18, -12). If length of normal chord is λ , then the value of λ^2 must be
6. A variable chord PQ of the parabola $y = 4x^2$ subtends a right angle at the vertex. If the locus of the point of intersection of the normals at P and Q is $y = \lambda x^2 + \mu$, then the value of $\lambda^3 + 64\mu^2$ must be
7. The number of values of x between 0 and 2π that satisfies the equation $\sin x + \sin 2x + \sin 3x = \cos x + \cos 2x + \cos 3x$ must be
8. The sum of the roots of equation $\cos 4x + 6 = 7 \cos 2x$ over the interval $[0, 314]$ is $\lambda\pi$, then the numerical quantity λ must be

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES – Class – XII (CTY426 Batches)

RIT – 4

Code: 101041

JEE ADVANCED

ANSWER KEY

ANSWER KEYS

Physics

PART – A

- | | | | |
|--------|---------|--------|-------|
| 1. C | 2. B | 3. C | 4. C |
| 5. ACD | 6. ABCD | 7. ACD | 8. AC |

PART – B

- | | | | |
|------|------|---------|------|
| 1. 1 | 2. 2 | 3. 2.98 | 4. 2 |
| 5. 4 | 6. 2 | 7. 2 | 8. 1 |

Chemistry

PART – A

- | | | | |
|---------|--------|--------|-------|
| 1. A | 2. B | 3. A | 4. B |
| 5. ABCD | 6. ABD | 7. ABC | 8. AB |

PART – B

- | | | |
|----------------------------|--------------------------|--------|
| 1. 3 | 2. 18.01(range 17 to 19) | 3. 4.5 |
| 4. 2.6 | 5. 4.2 | 6. 25 |
| 7. 8.4 | | |
| 8. 2.2(range 2.00 to 3.00) | | |

Mathematics

PART – A

- | | | | |
|-------|-------|--------|-------|
| 1. B | 2. C | 3. C | 4. A |
| 5. AB | 6. CD | 7. ACD | 8. CD |

PART – B

- | | | | |
|--------|-------|--------|---------|
| 1. 5 | 2. 6 | 3. 139 | 4. 490 |
| 5. 512 | 6. 80 | 7. 4 | 8. 4950 |