FIITJEE INTERNAL TEST

PHYSICS, CHEMISTRY & MATHEMATICS

QP CODE: 101071 | **Common Test-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 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 –** 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 – Two Year CRP(2426) Batches

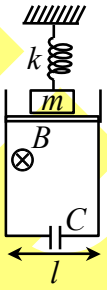
SECTION – I: PHYSICS

(PART – A)

(Single Correct Answer Type)

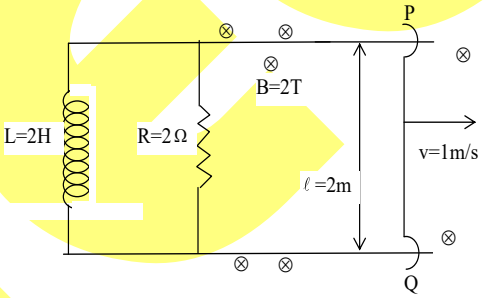
This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A block is attached to the ceiling by a spring that has a force constant k = 200 N/m. A conducting rod is rigidly attached to the block. The combined mass of the block and the rod is m = 0.3 kg. The rod can slide without friction along two vertical parallel rails, which are a distance l = 1 m apart. A capacitor of known capacitance C = 500 μF is attached to the rails by the wires. The entire system is placed in a uniform magnetic field B = 20 T directed as shown. The angular frequency (in rad/sec) of the vertical oscillations of the block is 4y. Neglect the self-inductance and electrical resistance of the rod and all wires. The value of 'y' will be



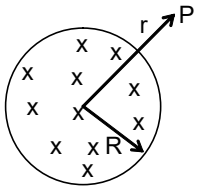
(A) 5.9 (B) 9.67 (C) 3.93 (D) 5.0

2. The given figure shows an inductor and resistance fixed on a conducting wire. A movable wire PQ starts moving on the fixed rails from t = 0 with constant velocity 1 m/s. A constant magnetic field (B = 2T) exist perpendicular to the plane of paper. The work done by the external force on the wire PQ in 2 second is



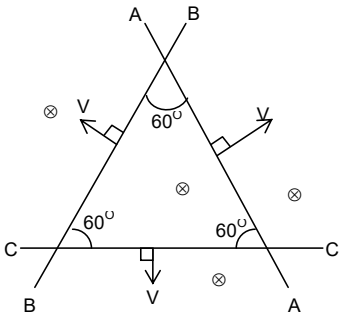
(A) 16 J (B) 32 J
(C) 48 J (D) 64 J

3. The uniform but time varying magnetic field B(t) exists in a circular region of radius a and is directed into one of the paper as shown in the figure. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region.



(A) is zero (B) decreases as 1/r
(C) increases as r (D) decreases as $1/r^2$

4. Three long rods AA, BB, CC are moving with a speed v in a uniform magnetic field B_o perpendicular to the plane of paper as shown in the figure. The triangle formed between the three wires is always an equilateral triangle. The induced the three wires is always an equilateral triangle. The induced current in the triangle is (resistance per unit length of wire is λ)



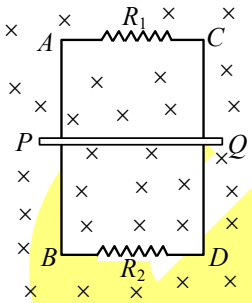
(A) $B_o v/3\lambda$ (B) $2B_o v/3\lambda$
(C) $B_o v/\sqrt{3\lambda}$ (D) vB_o/λ

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.**

5. Two parallel vertical metallic rails AB and CD are separated by 1 m. They are connected at the two ends by resistances R_1 and R_2 as shown. A horizontal metallic bar PQ of mass 0.2 kg slides without friction, vertically down the rails under the action of gravity. There is uniform horizontal magnetic field of 0.6 T perpendicular to plane of the rails. It is observed that when the terminal velocity attained, the power dissipated in R_1 and R_2 are 0.76 W and 1.2 W respectively.
($g = 9.8\ m/s^2$).



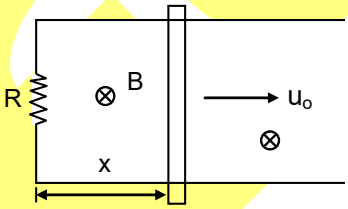
(A) Find the terminal velocity of bar in nearly 1 m/s.

(B) Find the terminal velocity of bar in nearly 2.2 m/s.

(C) at the terminal velocity of bar, it experiences zero gravity force.

(D) at the terminal velocity of bar, it experiences zero magnetic force.

6. A conducting rod of length ℓ is moved at constant velocity 'v_0' on two parallel conducting, smooth, fixed rails, that are placed in a uniform constant magnetic field B perpendicular to the plane of the rails as shown in figure. A resistance R is connected between the two ends of the rail. Then, which of the following is/are correct?



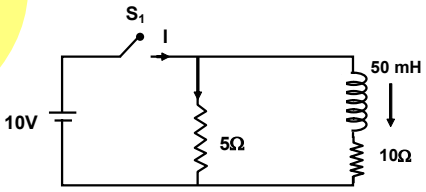
(A) The thermal power dissipated in the resistor is equal to rate of work done by external person pulling the rod.

(B) If applied external force is doubled then a part of external power increase the velocity of rod.

(C) Lenz's law is not satisfied for direction of current in loop.

(D) If resistance R is doubled then power required to maintain the constant velocity v_0 becomes double.

7. In the given circuit, key S_1 is closed at t = 0, then the current I is



(A) at t = 0, I = 3A

(B) at t = 0, I = 2A

(C) at t = ∞, I = 3A

(D) at t = ∞, I = 2A

8. A circular coil of n turns and radius r is placed in a uniform magnetic field B. Initially the plane of the coil is perpendicular to the field. The coil is rotated through 180° in time T about one of its diameter such that its plane is still perpendicular to the field. If the resistance of the coil is R. Then

(A) the average emf induced in the coil = $\frac{2n\pi r^2B}{T}$

(B) the average current induced in the coil = $\frac{2n\pi r^2B}{RT}$

(C) the charge passing through the coil = $\frac{2n\pi r^2B}{R}$

(D) none of these

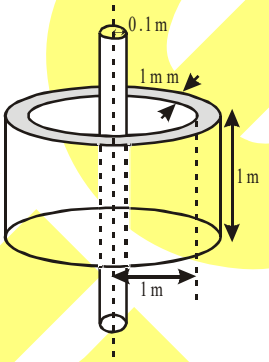
Space For Rough Work

(PART – B)

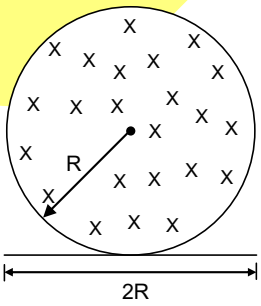
This section contains **Eight (08)** numerical based questions. The answer to each question is a NUMERICAL VALUE. If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.

1. An inductor of inductance 2 mH is connected across a charged capacitor of capacitance 5 μF and the resulting LC circuit is set oscillating at its natural frequency. Let Q denote the instantaneous charge on the capacitor and I the current in the circuit. It is found that the maximum value of charge is 200 μC. When charge = 100 μC the value of $\left|\frac{dI}{dt}\right|$ is 10^n As^{-1}. Find the value of 'n'.

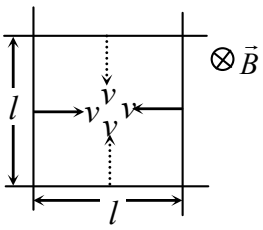
2. A long solenoid of radius 0.1 m and number of turns 1000 per unit length is enclosed by cylindrical shell of radius 1 metre thickness 1 mm and length 1 m. A variable current $I = 10^2 \sin 10^3 t$ amp flows through the solenoid coil. If the resistivity of the material of cylindrical shell is $0.5 \times 10^{-3}\ \Omega \times m$, find the maximum induced current in the shell.
(Take $\pi^2 \cong 10$)



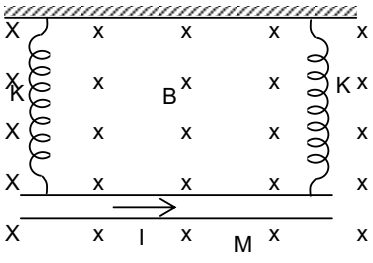
3. A uniform but time varying magnetic field is present in a circular region of radius R = 4 m. The magnetic field is perpendicular and into the plane of the paper and the magnitude of the field is increasing at a constant rate $\alpha = \frac{1}{\pi}$ T sec^{-1}. There is a straight conducing rod of length 2R placed as shown in the figure. Find the magnitude of induced emf (in volt) across the rod.



4. In the figure shown the four rods have $\lambda = 0.5\ \Omega$/m resistance per unit length. The arrangement is kept in a magnetic field of constant magnitude B = 0. 2T and directed perpendicular to the plane of the figure and directed inwards. Initially the rods form a square of side length l = 15m as shown. Now each wire starts moving with constant velocity v = 5 m/s towards opposite wire. Find the magnetic force (in newton) at t = 1 sec.

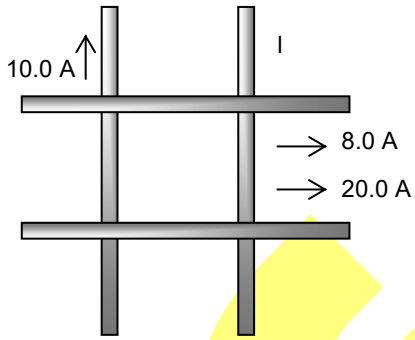


5. A metal rod of mass 10gm and length 25 cm is suspended on two springs as shown in figure. The springs are extended by 4 cm. When a 20 ampere current passes through the rod it rises by 1 cm. The magnetic field is $x \times 10^{-2}$ T ($g = 10\ m/s^2$). Find the value of 'x'.

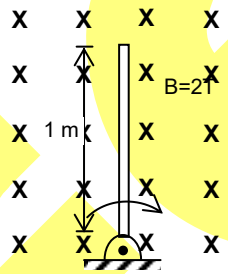


Space For Rough Work

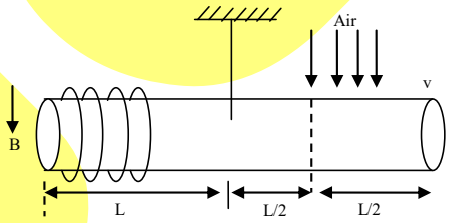
6. Four very long, current carrying wires in the same plane intersect to form a square 40.0 cm on each side as shown in Figure. Find the magnitude and direction of the current I so that the magnetic field at the centre of the square is zero



7. A rod of length 1 m rotates about one of its end point with an angular velocity 2 rad/ sec in a plane perpendicular to the magnetic field B = 2T as shown in the figure. Then find magnitude of electric field(In SI unit) at the mid point of the rod



8. A non-conducting non-magnetic rod having circular cross section of radius R is suspended from a rigid support as shown in figure. A light and small coil of 300 turns is wrapped tightly at the left end of the rod where uniform magnetic field B exists in vertically downward direction. Air of density ρ hits the half of the right part of the rod with velocity V as shown in the figure. What should be current in the clockwise direction (as seen from O) in the coil so that rod remains horizontal? Give answer in mA. Given $\frac{2}{L\nu}\sqrt{\frac{\pi RB}{\rho}} = \frac{1}{\sqrt{5}}A^{-1/2}$.



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. $BaCl_2 \xrightarrow[-NaCl]{Na_2SO_3} \underset{(Precipitate)}{(P)\downarrow} \xrightarrow{Cl_2/H_2O} \underset{(Precipitate)}{(Q)\downarrow}$

Which reagent(s) can distinguish between (P) and (Q)?
(A) NaOH (B) HCl (C) KCN (D) KSCN

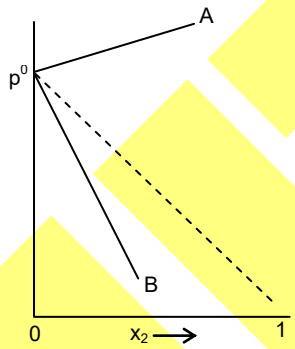
2. When a salt of copper is heated with a borax bead in an oxidizing flame, a blue - green bead (X) is formed. In a reducing flame, the bead (X) turns reddish – brown due to formation of (Y). The oxidation number of copper in the beads (X) and (Y) are respectively
(A) +2 and +1 (B) +1 and zero (C) +2 and zero (D) +1 and –1

3. A white powder turns yellow (B) on heating and evolves a gas which turns lime water milky. (B) reacts with dilute H_2SO_4 to give a colourless solution (C). Reaction of (C) with dil. NaOH, forms a white precipitate (D) initially, which dissolves on adding excess NaOH. With dilute NH_3 solution, (C) gives a white precipitate which dissolves in excess NH_3 giving a colourless solution (E). Which metal is present in the white powder and what is the number of NH_3 molecules present in one molecule of (E)?
(A) Sn, 4 (B) Zn, 4 (C) Zn, 6 (D) Al, 6

4. When 0.004 M K_2SO_4 is isotonic with 0.01 M fructose, the degree of dissociation of Na_2SO_4 is
(A) 0.75 (B) 0.5 (C) 0.25 (D) 0.85

(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. 

p^0 is the vapour pressure of the solvent
x_2 is the mole fraction of non-volatile solute
p is the vapour pressure of the solution in equilibrium state
In the graph the dashed line is given for ideal solution
Choose correct statement(s)
(A) $p = p^0$ when x_2 is zero
(B) curve-B is followed by a solution of NaCl in water
(C) curve-A is followed by a solution of CH_3COOH in benzene
(D) $p = x_2p^0$

Space For Rough Work

6. Which of the following can liberate brown fumes with conc.H_2SO_4?
(A) $NaNO_2$ (B) $NaNH_2$ (C) KBr (D) KNO_3

7. What happens when the following gas(es) react(s) with $FeCl_3$ solution?
(A) NH_3 gas forms a brown precipitate of $Fe(OH)_3$
(B) H_2S gas forms a colloidal solution of sulphur
(C) HCl gas forms a complex ion of $FeCl_4^-$
(D) H_2 gas forms a blue solution of $FeCl_2$

8. Assuming ideal behaviour, when a solution of 1 mol of liquid A in 9 mol of liquid B is mixed at 300 K then for the solution which of the following is/are correct.
(A) $\Delta G_{mix} = -8000.06\,J$ (B) $\Delta S_{mix} = 27.04\,JK^{-1}$
(C) $\Delta H_{mix} = 0$ (D) $\Delta G_{mix} = -8112\,J$

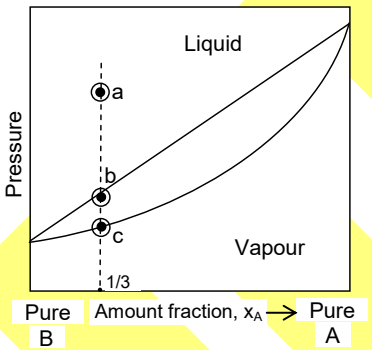
(PART – B)

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. How many of the following cations can form soluble complex when treated with conc.NaOH(excess)
Cu^{2+}, Pb^{2+}, Zn^{2+}, Ni^{2+}, Al^{3+}, Fe^{3+}, Sn^{2+}, Cd^{2+}, Co^{2+}

2. A solution containing 0.011 kg of barium nitrate in 0.1 kg of water boils at 100.46°C. Calculate the degree of ionization of salt
(K_b water = 0.52 k kg mol^{-1}, Boiling point of water at 1 atm is 100°C; $M_{Ba(NO_3)_2} = 261.3$)

3. The total vapour pressure of a 4 mol % solution of NH_3 in water at 293K is 50.0 Torr, the vapour pressure of pure water is 17.0 Torr at this temperature. The total vapour pressure for a 5 mol % solution in Torr unit is
(Assuming that Henry's law is applicable for solute and Raoult's law for solvent)

4. 

Total pressure of the system at point 'c' in Torr unit is
(p_A^0 = 200 Torr and p_B^0 = 100 Torr & X_A is the mole fraction of A in solution)

Space For Rough Work

5. Reaction of $FeCl_3$ with $K_4[Fe(CN)_6]$ produces a blue colour precipitate $Fe_x[Fe(CN)_y]_z$. What is the value of (x + y + z)?

6. The Van't Hoff factor for $K_4[Fe(CN)_6]$ if degree of dissociation is 50% is

7. The osmotic pressure of a solution containing 40 g of solute(molecular mass 246) per litre at 27°C is x atm (R = 0.0822 atm L mol^{-1} K^{-1}). The x is

8. Out of the following salts
$ZnCO_3$, $Fe_2(SO_4)_3$, $AgNO_3$, K_2CrO_4, $CaCl_2$, Na_3AsO_4, CaI_2, $Ba_3(PO_4)_2$, $NiBr_2$
The properties of salt(A) and salt(B) which are present in the above list, are given below.
(i) Both (A) and (B) are completely soluble in water
(ii) Treatment of the solution of (A) forms no precipitate with NH_4OH, but solution of (B) forms a precipitate with it. The precipitate of (B) is dissolved in excess NH_4OH.
(iii) Both (A) and (B) form precipitates with NaOH. Their precipitates are not soluble in excess NaOH.
If the total number of atoms present in (A) and (B) are x and y respectively, then the value of (x – y) is:

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 area enclosed by the curves y = cos x, y = 1 + sin 2x, x = 0 and x = $\frac{3\pi}{2}$ equals

(A) $\frac{3\pi}{2}-2$ (B) $\frac{3\pi}{2}$ (C) $2+\frac{3\pi}{2}$ (D) $1+\frac{3\pi}{2}$

2. A function y = f(x) satisfies the condition f'(x) sin x + f(x) cos x = 1, f(x) being bounded when $x \to 0$ if $I=\int_0^{\pi/2} f(x)dx$, then

(A) $\frac{\pi}{2}<I<\frac{\pi^2}{2}$ (B) $\frac{\pi}{2}<I<\frac{\pi^2}{4}$ (C) $1<I<\frac{\pi}{2}$ (D) 0 < I < 1

3. The area common to the region determined by $y \geq \sqrt{x}$ and $x^2 + y^2 \leq 2$ has the value

(A) π - 2 (B) 2π - 1 (C) $3\pi-\frac{\sqrt{2}}{3}$ (D) None of these

4. If A_m represent the area bounded by the curve $y = \ln x^m$, the x-axis and the lines x = 1 and x = e, then $A_m + mA_{m-1}$ is

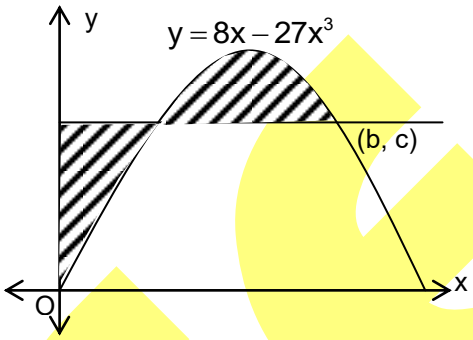
(A) m (B) m^2 (C) $\frac{m^2}{2}$ (D) $m^2 - 1$

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.**

5. The figure shows a horizontal line $y = c$ passing through (b, c) intersecting the curve $y = 8x - 27x^3$. If the shaded areas are equal, then



(A) $b = \frac{1}{9}$

(B) $b = \frac{4}{9}$

(C) $c = \frac{32}{27}$

(D) $c = \frac{23}{27}$

6. The area bounded by the region $x^2 + y^2 \le a^2$ and $|x| + |y| \ge a$ is $8(\pi - 2)$ sq. units. Then a is (are) equal to

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

7. If $c_1 \equiv y = \frac{1}{1+x^2}$ and $c_2 \equiv y = \frac{x^2}{2}$ be two curve lying in xy plane. Then

(A) area bounded by curve $y = \frac{1}{1+x^2}$ and y = 0 is π

(B) area bounded by C_1 and C_2 is $\frac{\pi}{2} - \frac{1}{3}$

(C) area bounded by C_1 and C_2 is $1 - \frac{\pi}{2}$

(D) area bounded by curve $y = \frac{1}{1+x^2}$ and x – axis is $\frac{\pi}{2}$

8. For which of the following values of m, the area of the region bounded by the curves $y = x - x^2$ and the line y = mx equals $\frac{9}{2}$?

(A) –4 (B) –2 (C) 2 (D) 4

Space For Rough Work

(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. Let $f : g : R \to R$ are functions such that $f(x) = 3x - \sin\left(\frac{\pi x}{2}\right)$ $g(x) = x^3 + 2x - \sin\left(\frac{\pi x}{2}\right)$, and if area bounded by $y = f^{-1}(x)$, $y = g^{-1}(x)$ equals A, then 2A equals _____

2. Area bounded by min (|x|, |y|) = 1 and max (|x|, |y|) = 3 is

3. Let 'a' be a positive constant number. Consider two curves $C_1 : y = e^x, C_2 : y = e^{a-x}$. Let S be the area of the part surrounded by C_1, C_2 and the y-axis, then $\lim_{a\to 0} \frac{4S}{a^2}$ equals:

4. The area (in sq. units) of the region A = {(x, y): $x^2 \le y \le x + 2$} is k square units then 2k is

5. If the area (in sq. units) bounded by the parabola $y^2 = 4\lambda x$ and the line $y = \lambda x$, $\lambda > 0$, is $\frac{1}{9}$, then λ is equal to :

6. The area bounded by the curves $y = \left|[x-2]\right|$, the x – axis and the lines $x = -1$ and x = 2 is ([.] G.I.F.)

7. Area enclosed by the curve $|x-2| + |y+1| = 1$ is equal to

8. The area bounded by $y = xe^{|x|}$ and lines $|x| = 1$ and y = 0 is

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES – Two Year CRP(2426) Batches

Common Test – 4

Code: 101071

JEE ADVANCED

ANSWER KEY

ANSWER KEYS

Physics

PART – A

1.	D	2.	B	3.	B	4.	D
5.	A	6.	AB	7.	BC	8.	ABC

PART – B

1.	4	2.	8	3.	4	4.	2
5.	0.5	6.	2	7.	2	8.	2

Chemistry

PART – A

1.	B	2.	C	3.	B	4.	A
5.	AB	6.	ACD	7.	ABCD	8.	BCD

PART – B

1.	4	2.	0.55 (range 0.4 to 0.6)				
3.	58.2 (range 58.00 to 59.00)			4.	120	5.	13
6.	3	7.	4	8.	2		

Mathematics

PART – A

1.	C	2.	B	3.	D	4.	B
5.	BC	6.	AD	7.	AB	8.	BD

PART – B

1.	1	2.	16	3.	1	4.	9
5.	24	6.	6	7.	2	8.	2