FIITJEE COMMON TEST

PHYSICS, CHEMISTRY & MATHEMATICS

CODE:

Time Allotted: 3 Hours **Maximum Marks: 192**

- 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 Section.
3. **Section-I** is Physics, Section-**II** is Chemistry and Section-**III** is Mathematics.
4. Each section is further divided into three parts: Part-**A , Part-B & Part-C**
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 Three Parts.

(i) **Part-A (01 – 8)** contains 8 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

PART – A (**09 – 12)** contains **4** Multiple Choice Questions which have **One or More Correct** answer.
For each question in the group **Q. 9 – 12** of **PART – A** you will be awarded
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.

(ii) **Part -B (01 – 06)** contains 6 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 – 1921

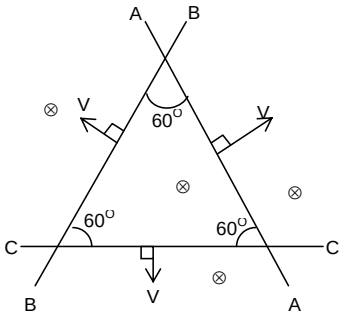
Section – I (Physics)

PART – A

(Single Correct Choice Type)

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

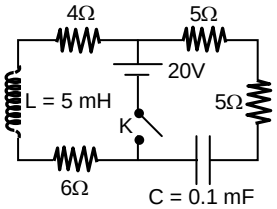
1. Three long rods AA, BB, CC are moving with a speed v in a uniform magnetic field B_o perpendicular to the plane of paper as shown in the figure. The triangle formed between the three wires is always an equilateral triangle. The induced current in the triangle is (resistance per unit length of wire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

2. In the circuit shown, the key (K) is closed at t = 0, the current through the key at the instant $t = 10^{-3}$ ln2 sec, is



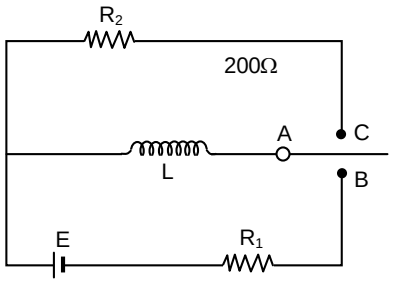
(A) 2 A (B) 3.5 A

(C) 2.5 A (D) zero

3. Magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by

(A) $Q = \frac{1}{R}\frac{\Delta\phi}{\Delta t}$ (B) $Q = \frac{\Delta\phi}{R}$ (C) $Q = \frac{\Delta\phi}{\Delta t}$ (D) $Q = R\frac{\Delta\phi}{\Delta t}$

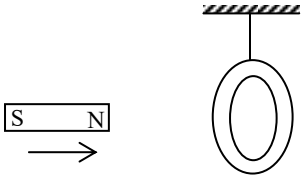
4. The circuit shown in the figure consists of a battery of emf E, resistances R_1 and R_2, inductance L and a two way switch ABC. First A is connected to B for a long time and then A is connected to C. The total heat produced in R_2 is



(A) $L\frac{E^2}{R_1^2}$ (B) $\frac{LE^2}{2R_2^2}$

(C) $\frac{LE^2}{2R_1^2}$ (D) $\frac{LE^2}{2R_1R_2}$

5. A copper ring is suspended by a thread in a vertical plane. The north pole of a magnet is brought near the ring in horizontal direction as shown in figure. What will be effect on the ring?



(A) ring will be attracted towards the magnet (B) ring will be repelled away

(C) ring will make simple away (D) no change in the position of ring

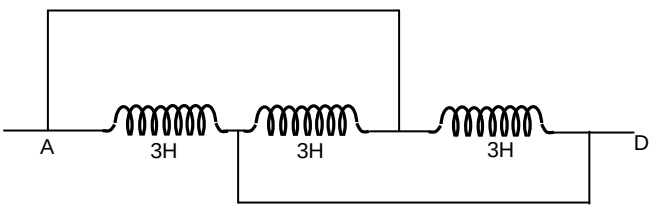
6. The inductance between A and D is

(A) 3.66 H

(B) 9 H

(C) 0.66 H

(D) 1 H



7. In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

(A) Q / 2 (B) $Q/\sqrt{3}$

(C) $Q/\sqrt{2}$ (D) Q

8. In an a.c. circuit the applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$. The power consumption in the circuit is given by

(A) $P = \sqrt{2} E_0 I_0$ (B) $P = \frac{E_0 I_0}{\sqrt{2}}$ (C) $P = \text{zero}$ (D) $P = \frac{E_0 I_0}{2}$

(Multi Correct Choice Type)

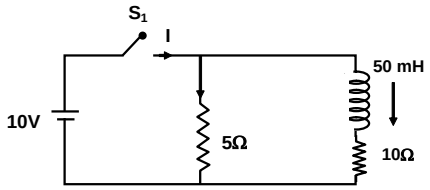
This section contains 4 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

9. In an oscillating LC circuit, the maximum charge present on capacitor is Q_0, ω is angular frequency of oscillation. The time at which energy stored in the capacitor is equal to 3 times of energy stored in inductor is (At t = 0, I = 0 in the circuit)

(A) $\frac{\pi}{6\omega}$ (B) $\frac{5\pi}{6\omega}$ (C) $\frac{\pi}{2\omega}$ (D) $\frac{\pi}{3\omega}$

10. 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



11. A conducting circular loop of radius 5.0 cm is placed perpendicular to a magnetic field of 0.50 T. It is removed from the field in 0.5 sec.
(A) The change of magnetic flux = 3.927 m weber.
(B) The change of magnetic flux = 7.854 m weber.
(C) The average emf induced in the loop during this time = 3.927 mV.
(D) The average emf induced in the loop during this time = 7.854 mV.

12. An L-C-R series circuit with 100 Ω resistance is connected to an *ac* source. When only the capacitance is removed, the current lags behind voltage by $\frac{\pi}{4}$. When only the inductance is removed, the current leads voltage by $\frac{\pi}{4}$. Then

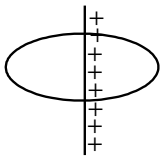
(A) Inductive reactance is 100 Ω
(B) Capacitive reactance is 100 Ω
(C) Impedance of L-C-R circuit is 100 Ω
(D) maximum potential difference across inductor is equal to maximum potential difference across capacitor when all are connected in series in circuit.

PART – B
(Numerical Based)

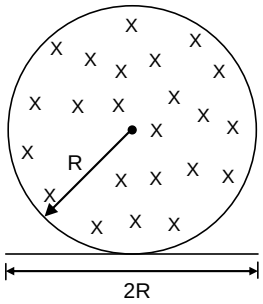
This section contains 06 Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30)

1. A uniform disc of radius R having charge Q distributed uniformly all over its surface is placed on a smooth horizontal surface. A magnetic field, $B = kxt^2$, where k is a constant, x is the distance (in metre) from the centre of the disc and t is the time (in second), is switched on perpendicular to the plane of the disc. Find the torque (in N-m) acting on the disc after 15 sec. (Take 4kQ = 1 S.I. unit and R = 1m)

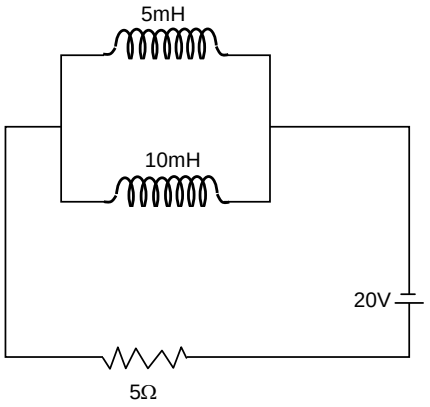
2. A very long uniformly charged rod falls with a constant velocity V = 5 m sec^{-1} through the center of a circular loop of radius R = 2 m. Find the magnitude of induced emf (in volt) in the loop. (charge per unit length of rod = 2 C m^{-1})



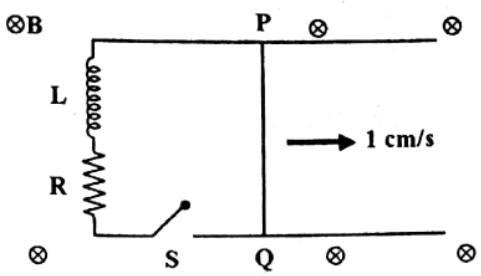
3. A uniform but time varying magnetic field is present in a circular region of radius R = 4 m. The magnetic field is perpendicular and into the plane of the paper and the magnitude of the field is increasing at a constant rate $\alpha = \frac{1}{\pi}$ T sec^{-1}. There is a straight conducing rod of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



4. In the given circuit, find the current through the 5mH inductor in steady state



5. A 10 cm long perfectly conducting wire PQ is moving with a velocity 1 cm/s on a pair of horizontal rails of zero resistance. One side of the rails is connected to an inductor L = 1 mH and a resistance R = 1 Ω as shown in the figure. The horizontal rails, L and R lie in the same plane with a uniform magnetic field B = 1 T perpendicular to the plane. If the key S is closed at certain instant, the current in the circuit after 1 millisecond is x × 10^{-3} A, where the value of x is _____. [Assume the velocity of wire PQ remains constant (1 cm/s) after key S is closed. Given: e^{-1} = 0.37, where e is base of the natural logarithm]



6. A series R-C combination is connected to an AC voltage of angular frequency ω = 500 radian/s. If the impedance of the R-C circuit is $R\sqrt{1.25}$, the time constant (in millisecond) of the circuit is

space for rough work

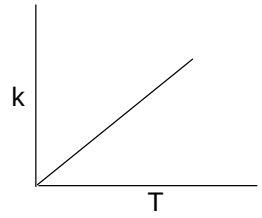
Section – II (Chemistry)

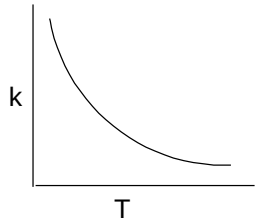
PART – A

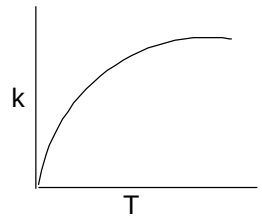
(Single Correct Choice Type)

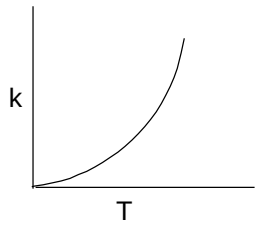
This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A white crystalline solid(A) on boiling with caustic soda solution gave a gas(B), which when passed through an alkaline solution of potassium mercuric iodide gave brown ppt. the substance(A) on heating gave a gas(X), which rekindled a glowing splinter but did not give brown fumes with nitric oxide. The gas(B) is
   (A) H_2S (B) NH_3
   (C) HCl (D) CO_2

2. The rate constant of most of the reactions increases with increase in temperature. According to Arrhenius equation $k = Ae^{-Ea/RT}$. The curve of rate constant k against temperature T will be
   (A) 

   (B) 

   (C) 

   (D) 

3. For the formation of B from A, heat liberated is 20 kJ/mol and required activation energy of 100 kJ/mol. Then activation energy (in kJ/mol) for the reaction $A \rightarrow B$ is
   (A) 120 (B) 100
   (C) 80 (D) 60

4. Na^+ is having octet while Ag^+ is having pseudo inert gas configuration. Then which of the following property is not correct for these ions or their compounds.
   (A) Na_2CO_3 is thermally stable while Ag_2CO_3 decomposes into Ag, CO_2 and O_2
   (B) Ag^+ forms complexes, Na^+ does not
   (C) NaCl is water soluble, AgCl is insoluble
   (D) NaCl and AgCl both give colour in flame when ignited

5. The acid hydrolysis of ester is
   (i) Pseudo first order reaction (ii) Multistep reaction
   (iii) Unimolecular reaction (iv) Single step reaction
   Which of the following statement is correct?
   (A) i, ii (B) All are correct
   (C) ii, iv (D) ii, iii, iv

6. The rate of a reaction doubles when its temperature changes from 300 K to 310 K. Activation energy of such a reaction will be ($R = 8.3JK^{-1}mol^{-1}$ and log 2 = 0.3)
   (A) 48.6 kJ mol^{-1} (B) 58.5 kJ mol^{-1}
   (C) 60.5 kJ mol^{-1} (D) 53.3 kJ mol^{-1}

7. In a first order reaction A $\rightarrow$ B the concentration of product 'x' at time 't' is given by the expression (a = initial concentration, k = rate constant, n = order)

(A) $x = a\left(1 - e^{-kt}\right)$ (B) $x = \dfrac{1}{(a-x)}$

(C) $x = \dfrac{1}{2^{n-1}}$ (D) $x = \dfrac{a}{(a-x)}$

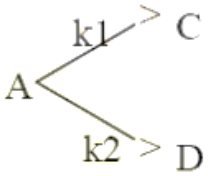
8. Borax is used in bead test for identification of metal cations, based on the color produced due to formation of metal metaborate. Consider the following statements about structure of crystalline borax.
(i) It has tetranuclear $[B_4O_5(OH)_4]^{2-}$ unit
(ii) It has all boron atoms in the same plane
(iii) It has equal number of sp^2 & sp^3 hybridised boron atoms
(iv) One terminal hydroxide per boron atom
The correct statements are
(A) i, ii, iv (B) i, iii, iv
(C) iii, iv (D) i, ii, iii & iv

(Multi Correct Choice Type)

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

9. Select incorrect statement/s
(A) $K_3[Fe(CN)_6]$ gives white colour of $KFe[Fe(CN)_6]$ with Fe^{2+} ion
(B) $K_3[Fe(CN)_6]$ gives brown colouration of $Fe[Fe(CN)_6]$ with Fe^{3+} ion
(C) $K_4[Fe(CN)_6]$ gives blue ppt of $K_2Fe[Fe(CN)_6]$ with Fe^{2+} ion
(D) $K_4[Fe(CN)_6]$ gives Prussian blue colour of $Fe_4[Fe(CN)_6]_3$ with Fe^{3+} ion

10. Consider the following case of competing 1st order reactions



After the start of the reaction at t = 0 with only A, the [C] is equal to [D] at all times. The time in which all three concentrations will be equal is given by:

(A) $t = \dfrac{1}{2k_1}\ln 3$ (B) $t = \dfrac{1}{2k_2}\ln 3$

(C) $t = \dfrac{1}{3k_1}\ln 2$ (D) $t = \dfrac{1}{3k_2}\ln 2$

11. Which of the following ions can be separated by using H_2S in the presence of dilute HCl?
(A) Cu^{2+} and Co^{2+} (B) Pb^{2+} and Ni^{2+}
(C) Hg^{2+} and Cu^{2+} (D) Cu^{2+} and Bi^{3+}

12. Which of the following statements are true regarding the first order reaction

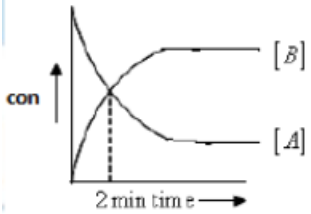
$$2A(aq) \longrightarrow B(aq) + C(aq)$$

(A) The rate of reaction decreases as more and more of B and C form
(B) The time required for one-half of substance A to react is directly proportional to the quantity of A present initially
(C) A graph of [A] versus time is a straight line
(D) The rate of reaction is one-half the rate of disappearance of A

PART – B
(Numerical Based)

This section contains 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)

1. For a first order reaction $A(g) \longrightarrow 3B(g)$ the concentration verses time graph is given below



What is the half life in minutes?
(log 2 = 0.3, log3 = 0.48)

2. Total number of black precipitate which dissolve in yellow ammonium sulphide (YAS) as well as hot and dil. HNO_3
PbS, CuS, HgS, CdS, As_2S_3, As_2S_3, Sb_2S_3, Sb_2S_5, SnS_2, Bi_2S_3

3. An organic compound undergoes first order decomposition. The time taken for its decomposition to $\frac{1}{8}$ and $\frac{1}{10}$ of its initial concentration are $t_{1/8}$ and $t_{1/10}$ respectively.
What is the value of $\frac{t_{1/8}}{t_{1/10}}(\log 2 = 0.3)$

4. Among the following the number of cations that form precipitate with NaOH which is not soluble in NH_3
Pb^{2+}, Mg^{2+}, Ba^{2+}, Al^{3+}, Fe^{3+}, Ag^{+}, Zn^{2+}, K^{+}, Mn^{2+}

5. The rate constant of a reaction at 27°C is 3×10^{-3} min^{-1}. The fraction of molecules crossing the energy barrier of the reaction at that temperature is 10^{-3}%. If the temperature is increased, the maximum values of rate constant K can be attained is _____min^{-1}

6. How many of the following give precipitate with potassium ferrocyanide
Zn^{2+}, Fe^{2+}, Fe^{3+}, Cu^{2+}, Ag^{+}, Co^{2+}

space for rough work

Section – III (Mathematics)

PART – A

(Single Correct Choice Type)

This section contains 8 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

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1. The area (in sq. units) bounded by $y = x^2 + 3$ and $y = 2x + 3$ is

   (A) $\frac{12}{7}$ (B) $\frac{4}{3}$

   (C) $\frac{3}{4}$ (D) $\frac{8}{3}$

2. Which of the following is CORRECT?

   (A) $\int_{-1}^{1} \frac{dx}{x^2} = \left(-\frac{1}{x}\right)_{-1}^{1} = -2$

   (B) If $\int_a^b f(x)dx = 0$, then the equation $f(x) = 0$ must have at least one root in (a,b)

   (C) The equation $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx$ is valid only if c lies between a and b

   (D) $\left|\int_a^b f(x)dx\right| \le \int_a^b |f(x)|dx$,where $f(x)$ is continuous in (a,b)

3. The area of the region bounded by $y = x^2$ and $y = \sqrt{|x|}$ is (in sq. units)

   (A) $\frac{1}{3}$ (B) $\frac{2}{3}$

   (C) $\frac{1}{6}$ (D) None of these

4. The value of $\int_{1/2}^{2} \frac{1}{x}\sin\left(x - \frac{1}{x}\right)dx$ is

   (A) 0 (B) $\frac{3}{4}$

   (C) $\frac{1}{6}$ (D) None of these

5. For $f(x) = 1 + x + \int_1^x \left(\ln^2 t + 2\ln t\right)dt$, the value of x at the point where $f'(x) = 0$ is

   (A) $\frac{1}{e}$ (B) 0

   (C) $\frac{2}{e}$ (D) $1 + \frac{2}{e}$

6. The area bounded by the curves $|x|+|y|\geq 1$ and $x^2+y^2\leq 1$ is

(A) 2 sq. units
(B) π sq. units
(C) $\pi-2$ sq. units
(D) $\pi+2$ sq. units

7. The area of the region bounded by the function $f(x)=x^3$, the x-axis and the lines $|x|=1$ is

(A) $\frac{1}{4}$
(B) $\frac{1}{3}$
(C) $\frac{1}{8}$
(D) $\frac{1}{2}$

8. $\int_0^1 x(1-x)^n\,dx=$

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

(Multi Correct Choice Type)

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

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9. The value of integral $\int_0^{\frac{\pi}{2}}\ln\sin x\,dx$ is equal to

(A) $\int_0^{\frac{\pi}{2}}\ln\cos x\,dx$
(B) $\int_0^{\frac{\pi}{2}}\ln\sin 2x\,dx$
(C) $-\frac{\pi}{2}\ln 2$
(D) $\frac{\pi}{2}\ln\frac{1}{2}$

10. Which of the following is/are correct?

(A) $\int_0^{\frac{\pi}{2}}\frac{\cos x}{\cos x+\sin x}dx=\frac{\pi}{4}$
(B) $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}\frac{dx}{1+\sqrt{\tan x}}=\frac{\pi}{6}$
(C) $\int_0^{\frac{\pi}{2}}\cos\left(\pi\sin^2 x\right)dx=0$
(D) $\int_0^a\frac{f(x)}{f(x)+f(a-x)}dx=\frac{a}{2}$

11. The value of $\int_0^{2\pi} x \ln\left(\frac{3+\cos x}{3-\cos x}\right) dx$ is equal to

(A) $\pi\int_0^{2\pi} \ln\left(\frac{3+\cos x}{3-\cos x}\right) dx$

(B) $2\pi\int_0^{\pi} \ln\left(\frac{3+\cos x}{3-\cos x}\right) dx$

(C) $2\pi\int_0^{\pi} \ln\left(\frac{3-\cos x}{3+\cos x}\right) dx$

(D) zero

12. The area enclosed by $y = \sin x$ and x-axis between $x = 2n\pi$ and $y = 2(n+1)\pi$ is equal to (n is an integer)

(A) $\int_0^{2\pi} \sin x \, dx$

(B) $2\int_0^{\pi} \sin x \, dx$

(C) $\int_0^{\pi} \sin x \, dx$

(D) 4

PART – B
(Numerical Based)

This section contains 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)

1. If $2f(x) + f(-x) = \frac{1}{x}\sin\left(x - \frac{1}{x}\right)$ then $\int_{1/e}^{e} f(x) dx =$

2. The value of $\lim_{n\to\infty} \frac{1}{\sqrt{n}}\left(1 + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} + \frac{1}{\sqrt{4}} + ... + \frac{1}{\sqrt{4n}}\right)$ is equal to

3. The area bounded by the parabola $y^2 = 12x$ and its latus rectum is (in sq. units)

4. The area enclosed by the curve $y = \ln(x + e)$ and coordinate axes is

5. The value of $\int_{\pi}^{10\pi} |\sin x| \, dx$ is equal to

6. The number of points of local extrema of the function $f(x) = \int_0^{x^2} \frac{t^2 - 5t + 4}{1 + e^t} dt$ is

space for rough work

FIITJEE INTERNAL TEST

BATCHES – 1921

COMMON TEST – IV

ANSWER KEY

QP Code:

Section – I (Physics)

1. **D**
2. **C**
3. **B**
4. **C**
5. **B**
6. **D**
7 **C**
8. **C**
9. **AB**
10. **BC**
11. **AD**
12. **ABCD**

1. **1.50**
   Range: 1.47 to 1.53
2. **0**
3. **4**
4. **2.67**
   Range: 2.65 to 2.69
5. **0.63**
   Range: 0.60 to 0.65
6. **4**

Section – II (Chemistry)

1. B
2. D
3. B
4. D
5. A
6. D
7. A
8. B
9. ACD
10. AB
11. AB
12. AD

1. 5 (range 5.00 to 5.02)
2. 0
3. 0.90
4. 5
6. 6

Section – III (Mathematics)

1. B
2. D
3. B
4. A
5. A
6. C
7. D
8. **C**
9. ABCD
10. ACD
11. ABCD
12. BD

1. 0
2. 4
3. 24
4. 1
5. 18
6. 5