PHYSICS, CHEMISTRY & MATHEMATICS

QP CODE: 101104 | **RIT – 6**

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.

BATCHES – Class – XII (CTY426 Batches

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: _____

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 certain sample of monoatomic ideal gas is subject to a thermodynamic process in which V and T are related as $V^2 = kT$ (k is constant). The molar specific heat of the gas in this process is

    (A) $\dfrac{3R}{2}$ (B) 2R   (C) $\dfrac{5R}{2}$ (D) $\dfrac{7R}{2}$

2. Three metallic blocks A, B and C have masses m, m and 2m respectively. Specific heat of A, B and C are C, 2C and C respectively. Initial temperature of A, B and C are 10°C, 5°C and 5°C respectively. Now the blocks are connected by 3-identical rods as shown. Find the final temperature of block A on Celsius scale (Neglect any heat loss due to radiation).

    (A) 2   (B) 4   (C) 6   (D) 8
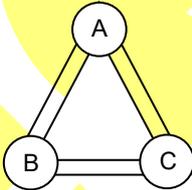
3. An enclosed gas is taken through a cycle as shown in the figure:
    (A) along AB, the temperature increases, while along BC the temperature decreases.
    (B) along AB, the temperature decreases, while along BC, temperature increases.
    (C) along CA, work is done on the gas, and the internal energy of the gas decreases.
    (D) along CA, work is done by the gas and the internal energy remains constant.
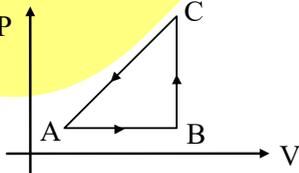
4. A Carnot's engine working between 27°C and 127°C has a work output of 200 J per cycle. The energy supplied to the engine from the source in each cycle is
    (A) 400 J   (B) 800 J   (C) 600 J   (D) 500 J

(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. A mixture of two diatomic gases X and Y is enclosed in a container at constant temperature. The molecular weight of X is 16 times that of Y and mass of the gas X is 2 times that of Y. Then
    (A) The average molecular kinetic energy of X equals that of Y
    (B) The r.m.s. molecular speed of translation of X is 1/4th that of Y.
    (C) The pressure exerted by X is 1/8th that by Y.
    (D) The pressure exerted by X is 8 times that by Y.

Space For Rough Work

6. n moles of an ideal gas undergo an isothermal process at temperature T. P-V graph of the process is as shown in the figure. A point A (V_1, P_1) is located on the P-V curve. Tangent at point A, cuts the V-axis at point D. AO is the line joining the point A to the origin O of PV diagram. Then,
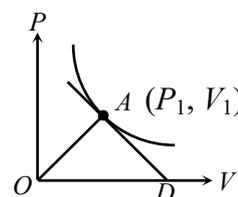

    (A) coordinates of points D is $\left(\dfrac{3V_1}{2}, 0\right)$

    (B) coordinates of points D is $(2V_1, 0)$

    (C) area of the triangle AOD is nRT

    (D) area of the triangle AOD is $\dfrac{3}{4}$nRT

7. A bimetallic strip is formed by two identical strips, one of copper and the other of brass. The coefficients of linear expansion of the two metals are α_C and α_B. On heating, the temperature of the strip goes up by ΔT and the strip bends to from an arc of radius of curvature R. Then R is
    (A) proportional to ΔT (B) inversely proportional to ΔT
    (C) proportional to $|\alpha_B - \alpha_C|$ (D) inversely proportional to $|\alpha_B - \alpha_C|$

8. A black body emits radiation at the rate P when its temperature is T. At this temperature the wavelength at which the radiation has maximum intensity is λ_0. If at another temperature T′ the power radiated is P′ and wavelength at maximum intensity is $\dfrac{\lambda_0}{2}$ then

    (A) T′ = 2T   (B) $T' = \dfrac{T}{2}$ (C) P′ = 16P   (D) $P' = \dfrac{P}{16}$

(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. A cylindrical rod of length l = 674 cm and cross sectional radius r = (2/π) cm is placed at a distance 50 r from a infrared point source S of power 1.25 kW as shown in the figure.
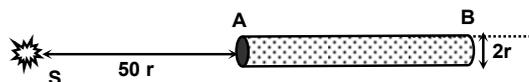
    The lateral surface of the rod is perfectly insulated from the surroundings.
   The cross section A absorbs 80% of incident energy, has temperature T_A in steady state. The surface B is radiating energy into space and the wavelength emitted by it with maximum energy density is 100,000A°. Determine the values of k if temperature of end B is 250k

2. A steel rod with a cross-sectional area of 150 mm2 is stretched between two fixed points. The tensile load at 20°C is 500 N. If stress at –20° is $k \times 10^6 N/m^2$ find the value of k. (assume α = 1.17 μm/m°C and Y = 200 GN/m^2)

Space For Rough Work

3. A hollow sphere of inner radius R_0 and outer radius $2r_0$ is made of a uniform material of constant thermal conductivity K. The temperature with in the ball is maintained at $2T_0$ and outside the ball is T_0. If temperature at distance $\dfrac{3r_0}{2}$ from centre is $\dfrac{pT_0}{3}$, then find the value of p.

4. The specific heat capacity of mono-atomic ideal gas for thermodynamic process $P = \alpha v^2$, is equal to "KR". Where α and K are positive constant and R is gas constant. Find the value of K.

5. A solid copper sphere of diameter 10 mm is cooled to a temperature of 150 K and is then placed in an enclosure at 290 K. Assuming that all interchange of heat is by radiation, calculate the value of x if initial rate of rise of temperature of the sphere is 0.022x.. The sphere may be treated as a black body.

6. An adiabatic cylinder has 8 gm of helium. A light smooth adiabatic piston is connected to a light spring of force constant 30 N/m. The other end of the spring is connected with a block of mass 1 kg kept on a rough horizontal surface of coefficient of friction $\mu = 0.3$. Area of cross section of cylinder is a = 25 cm^2.

    Initially the spring is in a relax position and the temperature of the gas is 400 K. The gas is heated slowly from some time by means of an electric heater so as the block M just starts moving. If work done by the gas is W (in J), then the value of 10W is

7. The volume of glass vessel is 1000 cc at 20°C. What volume of mercury should be poured into it at this temperature so that the volume of the remaining space does not change with temperature is 10n cc. Coefficient of cubical expansion of mercury and glass are 1.8×10^{-4}/°C and 9.0×10^{-6}/°C respectively. Find the value of 'n'?

8. Two identical cylindrical containers A and B are interconnected by a tube of negligible dimensions. Containers A is filled with an ice block up to height H = 1.8 m and container B is filled up to same height with water. Ice is at 0°C and water is at 40°C. Due to heat exchange between water and ice, the ice block begins to melt. Assume that the ice block melt in horizontal layers starting from the bottom. The thickness of ice block reduces uniformly over the entire cross section of the container. The ice block moves without friction inside the container and no water enters between the vertical wall of the container and the ice block. Heat is exchanged only between the ice block and the water and there is no heat exchange with containers or atmosphere. Calculate the height (in meter) of water in container B when thermal equilibrium is attained. Relative density and specific latent heat of fusion of ice are 0.9 and 80 cal g^{-1} respectively. Specific heat capacity of water is 1 cal g^{-1} °C^{-1}.
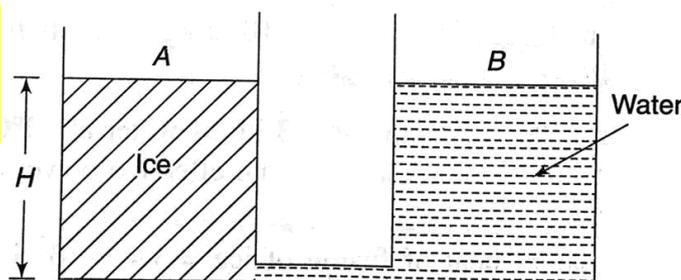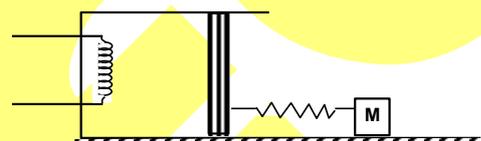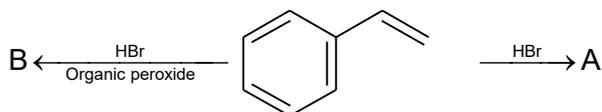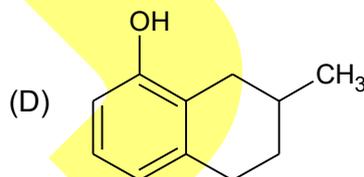

Space For Rough Work
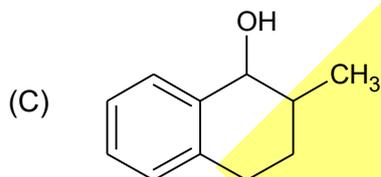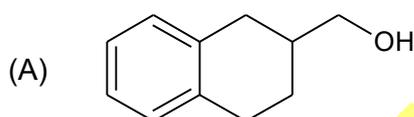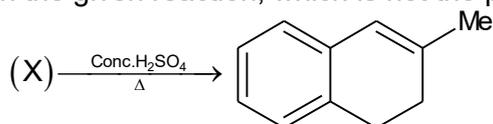
SECTION – II: CHEMISTRY

(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.**
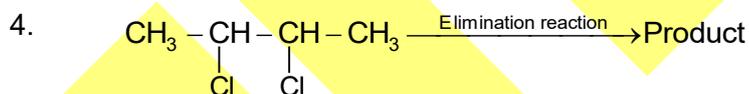
1.   Observe the following reactions and predict the nature of A and B.

$$B \xleftarrow[\text{Organic peroxide}]{\text{HBr}} \text{(styrene)} \xrightarrow{\text{HBr}} A$$

(A) B is optically active and A is optically inactive
(B) A and B are a pair of diastereomers
(C) A is a racemic mixture and B is a terminal halide
(D) Both A and B contain aromatic and non-aromatic rings

2.   In the given reaction, which is not the possible structure of compound(X)?

$$(X) \xrightarrow[\Delta]{\text{Conc.H}_2\text{SO}_4} \text{(2-methyl-3,4-dihydronaphthalene)}$$

(A) (tetralin-2-yl)methanol structure with CH₂OH

(B) 2-methyl-2-hydroxy tetralin (2-methyl with OH)

(C) 2-methyl-1-hydroxy tetralin (OH and CH₃)

(D) 1-hydroxy-6-methyl tetralin (OH and CH₃)

3.   Which is not a harmful gas in troposphere?
(A) SO_2 (B) NO_2 (C) O_3 (D) CO

4. $CH_3 - \underset{\underset{Cl}{|}}{CH} - \underset{\underset{Cl}{|}}{CH} - CH_3 \xrightarrow{\text{Elimination reaction}} \text{Product}$

Which substance is not formed in the above reaction?
(A) $CH_3 - CH = CH - CH_3$ (B) $CH_3 - CH_2 - C \equiv CH$
(C) $CH_3 - C \equiv C - CH_3$ (D) $CH_3 - CH - CH = CH_2$

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 simplest alkene[X] on reductive ozonolysis yields sole product hexandial. Which of the following statement(s) is/are correct for [X]
(A) The molecular weight of alkene is 82 g mol^{-1}
(B) The alkene contains at least 12 carbons
(C) The alkene is cyclic
(D) The alkene is acyclic

6.   Consider the following reaction:
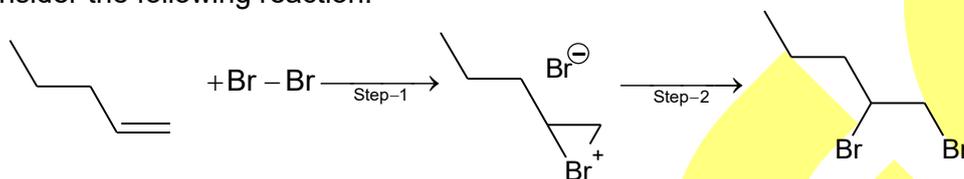
Which of the following statements is/are correct?
(A) The Br_2 addition occurs with anti-stereospecificity
(B) The final product will be a mixture of enantiomers
(C) In step-2, the Br^- anion acts as a Lewis base
(D) In step-1, the Br_2 molecule acts as a Lewis base

7. $CH_3 - C \equiv C - CH_3 \xrightarrow[\text{Quinoline}]{H_2, Pd-BaSO_4} (A) \xrightarrow[\text{NaHSO}_3/H_2O]{OsO_4} (B)$

The final product/s of above reaction can be
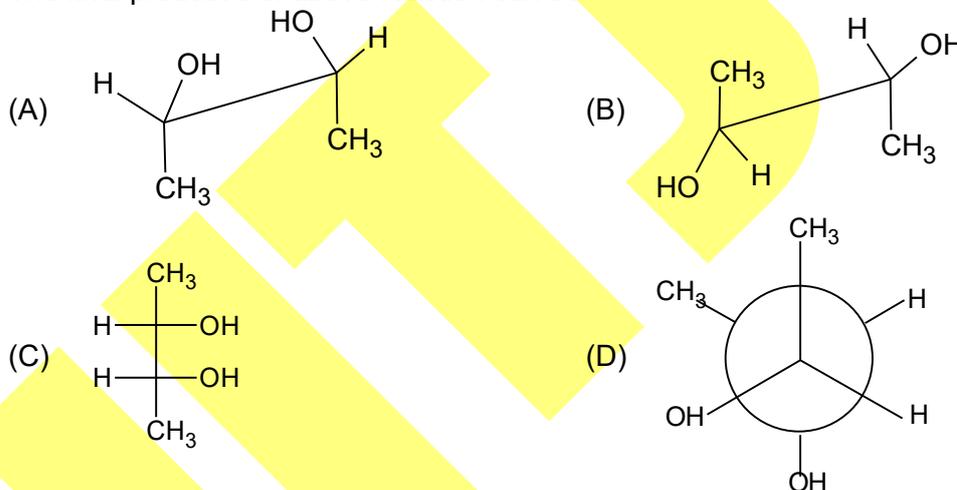

Space For Rough Work

8.   Which of the following product(s) is/are formed in the reaction shown below
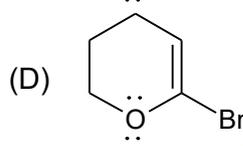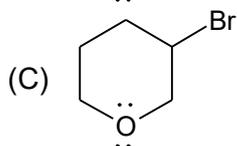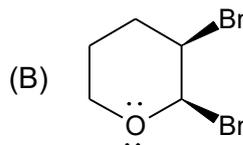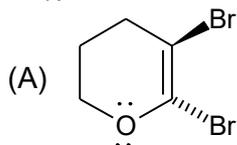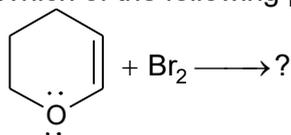
(A)

(B)

(C)

(D)

(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.   A compound on acidified permanganate oxidation forms two moles of same carboxylic acid which on decarboxylation forms the simplest saturated hydrocarbon. Therefore the molar mass of the compound is

2.   When relative reactivity of primary, secondary and tertiary hydrogen for bromination is 1:80 : 1600, then find the percentage of tertiary bromide in the given reaction.
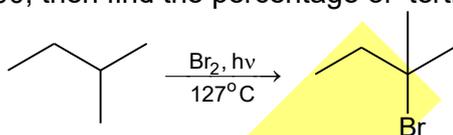
3.   If X is the number of moles of H_2 is used for the complete hydrogenation of the given compound in the presence of a metal catalyst. Then $\dfrac{X}{2}$ is

4.   Alkene $- Z\left(C_7H_{14}\right) \xrightarrow[\Delta]{H_2,Ni}$ Optical active alkane

Alkane $- Y\left(C_7H_{16}\right) \xrightarrow{\frac{Cl_2}{h\nu}}$ 6 Monochloro structural isomers

How many isomers of alkene-Z(including stereo) give the alkane-Y on catalytic hydrogenation

Space For Rough Work

5.   Consider the following reactions:
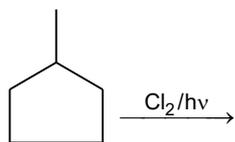
   $\xrightarrow{Cl_2/h\nu}$ Total number of monochlorinated product = X(Excluding stereoisomers)
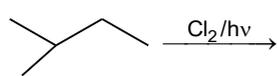
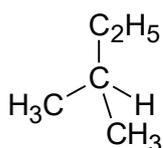 $\xrightarrow{Cl_2/h\nu}$ Total number of monochlorinated product = Y(Excluding stereoisomers)

Identify the value of $\dfrac{X+Y}{5}$?

6. $CH_3CH_2CH=C=CH_2 \xrightarrow[Zn/H_2O]{O_3} A+B+C$

The molar masses of products (A) and (B) are 58 and 44 g mol^{-1}. If the molar mass of (C) is (X) g mol^{-1}, what is the value of $\left(\dfrac{X}{20}\right)$?

7. $\xrightarrow[Cl_2/h\nu]{Monochlorination}$ Products

If the number of monochloro products formed in above reaction, including stereoisomers is (X), what is the value of $\left(\dfrac{5X}{25}\right)$?

8.   A hydrocarbon(X) upon ozonolysis reaction gives four moles of glyoxal. If the number of sp^2-hybridized carbon atoms in(X) is a and the number of sp^3 hybridized carbon atom is b, what is the value of $\dfrac{a+2b}{4}$?

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 $C_0, C_1, C_2, ..., C_{20}$ are the binomial coefficients in the expansion of $(1+x)^{20}$, then the

    value of $\dfrac{C_1}{C_0} + 2\dfrac{C_2}{C_1} + 3\dfrac{C_3}{C_2} + ... + 19\dfrac{C_{19}}{C_{16}} + 20\dfrac{C_{20}}{C_{19}}$ is equal to (where C_r represents ^nC_r)

    (A) 120   (B) 210   (C) 180   (D) 240

2. If $n \ge 2$ is a positive integer, then the sum of the series
    $^{n+1}C_2 + 2\left(^2C_2 + {}^3C_2 + {}^4C_2 + ... + {}^nC_2\right)$ is:

    (A) $\dfrac{n(n-1)(2n+1)}{6}$ (B) $\dfrac{n(n+1)(2n+1)}{6}$

    (C) $\dfrac{n(2n+1)(3n+1)}{6}$ (D) $\dfrac{n(n+1)^2(n+2)}{12}$

3. Let the complex number be $w = 1 - \sqrt{3}\,i$. Let another complex number z be such that $|zw| = 1$

    and $\arg(z) - \arg(w) = \dfrac{\pi}{2}$. Then the area of the triangle with vertices origin, z and w is equal

    to

    (A) 4   (B) $\dfrac{1}{2}$ (C) $\dfrac{1}{4}$ (D) 2

4. If for $x \in \left(0, \dfrac{\pi}{2}\right), \log_{10} \sin x + \log_{10} \cos x = -1$ and $\log_{10}(\sin x + \cos x) = \dfrac{1}{2}(\log_{10} n - 1), n > 0$, then

    the value of n is equal to
    (A) 20   (B) 12   (C) 9   (D) 16

(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. If $\dfrac{z+1}{z+i}$ is a purely imaginary number (where $i = \sqrt{-1}$), then z lies on a

    (A) straight line   (B) circle

    (C) circle with radius $= \dfrac{1}{\sqrt{2}}$ (D) circle passing through the origin

Space For Rough Work

6.   In a triangle, the lengths of the two larger sides are 10 and 9. If the angles are in A.P., the length of the third side can be

(A) $5 - \sqrt{6}$ (B) $3\sqrt{3}$ (C) 5   (D) $5 + \sqrt{6}$

7.   If α is a complex constant, such that $\alpha z^2 + z + \overline{\alpha} = 0$ has a real roots, then

(A) $\alpha + \overline{\alpha} = 1$ (B) $\alpha + \overline{\alpha} = 0$

(C) $\alpha + \overline{\alpha} = -1$ (D) the absolute value of real root is 1

8.   If $(1 + 2x + 3x^2)^{10} = a_0 + a_1x + a_2x^2 + ... + a_{20}x^{20}$, then

(A) $a_1 = 20$ (B) $a_2 = 210$ (C) $a_1 = 10$ (D) $a_2 = 105$

(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 $(1 + x)^n = C_0 + C_1x + C_2x^2 + ...C_nx^n$, $\sum_{r=0}^{n}(r+1)\,^2C_r = 2^{n-2}f(n)$ and if the roots of the equation $f(x) = 0$ are α and β, then the value of $\alpha^2 + \beta^2$ is equal to (where C_r denotes ^nC_r)

2.   If A is the remainder when 2^{2021} is divided by 17, then the value of λ must be equal to

3.   The number of integral terms in the expansion of $\left(5^{\frac{1}{6}} + 7^{\frac{1}{9}}\right)^{1824}$ is abc then $a + b + c$ is

4.   If a and b are positive integers such that $N = (a + ib)^3 - 107i$ (where N is a natural number), then the value of a is equal to (where $i^2 = -1$)

5.   For a complex number Z, if $Z = \frac{\pi}{4}(1+i)^4\left(\frac{1 - \sqrt{\pi}i}{\sqrt{\pi} + i} + \frac{\sqrt{\pi} - i}{1 + \sqrt{\pi}i}\right)$, then the value of $\left(\frac{|Z|}{amp(Z)}\right)$ is equal to (where $amp(Z) \in (-\pi,\, \pi]$)

6.   The least value of $|z|$ where z is complex number which satisfies the inequality exp $\left(\frac{(|z| + 3)(|z| - 1)}{||z| + 1|}\log_e 2\right) \ge \log_{\sqrt{2}}|5\sqrt{7} + 9i|$, $i = \sqrt{-1}$, is equal to

7.   Suppose that the side lengths of a triangle are three consecutive integers and one of the angles is twice another. The number of such triangles is/are

8.   The number of solutions of the equation $x + 2\tan x = \frac{\pi}{2}$ in the interval $[0,\, 2\pi]$ is:

Space For Rough Work

FIITJEE INTERNAL TEST

BATCHES – Class – XII (CTY426 Batches)

RIT – 6
Code: 101104
JEE ADVANCED
ANSWER KEY

ANSWER KEYS
Physics

PART – A

1.	B	2.	C	3.	C	4.	B
5.	ABC	6.	BC	7.	BD	8.	AC

PART – B

1.	2	2.	12.69	3.	4	4.	1.83
5.	3	6.	11.3	7.	5	8.	1.71

Chemistry

PART – A

1.	C	2.	D	3.	C	4.	D
5.	AC	6.	ABC	7.	BCD	8.	AB

PART – B

1.	56	2.	90.44 (range 90.3 to 90.5)	3.	3.5
4.	8	5.	1.6	6.	1.5	7.	1.2
8.	2				

Mathematics

PART – A

1.	B	2.	B	3.	B	4.	B
5.	BCD	6.	AD	7.	ACD	8.	AB

PART – B

1.	17	2.	15	3.	3	4.	6
5.	4	6.	3	7.	1	8.	3