FIITJEE

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-2 | **QP CODE:** | **PAPER - 2**

Time Allotted: 3 Hours **Maximum Marks: 186**

- 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.

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. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the 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 Part.

(i) **PART–A** (**01–08)** contains **(**8) Multiple Choice Questions which have **One or More 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.

(ii) **Part-A (09-12) –** This section contains Two (02) List-Match Sets, each List-Match set has Two (02) Multiple Choice Questions. Each List-Match set has two lists: List-I and List-II. FOUR options are given in each Multiple Choice Question based On List-I and List-II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question. Each question carries **+3 Marks** for correct combination chosen and **-1 marks** for wrong options chosen.

(iii) **Part-B (01-06)** contains six (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) and each question carries **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

BATCH –

SECTION-1 : PHYSICS

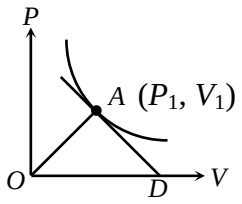
PART – A

(Multi Correct Choice Type)

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

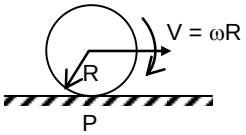
1. Two moles of a monatomic ideal gas undergoes a thermodynamic process $\frac{V^3}{T^2} =$ constant, if the temperature is raised by 300K then
(A) work done by the gas is 400 R
(B) change in internal energy is 900 R
(C) molar heat capacity of the gas for the process is 13/6 R
(D) molar heat capacity of the gas for the process is 3/2 R

2. 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 $\left(\frac{3V_1}{2}, 0\right)$
(B) coordinates of points D is $(2V_1, 0)$
(C) area of the triangle AOD is nRT
(D) area of the triangle AOD is $\frac{3}{4}$nRT

3. A spherical body of radius R rolls on a horizontal surface with linear velocity v. Let L_1 and L_2 be the magnitudes of angular momenta of the body about centre of mass and point of contact P. Then



(A) $L_2 = 2L_1$ if radius of gyration K = R
(B) $L_2 = 2L_1$ for al cases
(C) $L_2 > 2L_1$ if radius of gyration K < R.
(D) $L_2 > 2L_1$ if radius of gyration K > R.

4. The pitch of a screw gauge is 1 mm and there are 100 divisions on circular scale. When there is nothing between the two ends (studs) of screw gauge 95th divisions of circular scale is coinciding with screw gauge and in this situation zero of main scale is not visible. When a wire is placed between the studs the linear scale reads 2 division and 20th divisions of circular scale coincides with reference line. For this situation mark the correct statement(s). Each division on the main scale to 1 mm.
(A) LC of the instrument is 0.01 mm.
(B) Zero correction for the instrument is +0.05 mm.
(C) Thickness of wire is 1.20 mm
(D) Thickness of the wire is 2.25 mm.

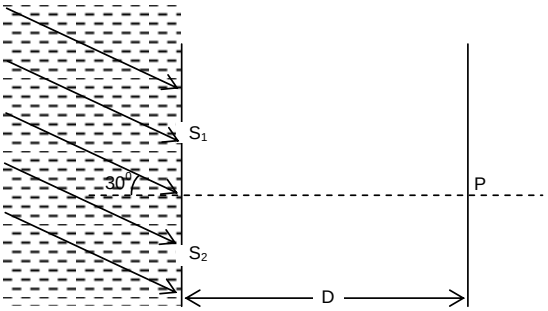
5. A nucleus splits into two nuclear parts which have their velocities in the ratio of 2 : 1. Then :
(A) Momentum of both parts are equal and opposite
(B) The ratio of their nuclear radii $2^{1/3}$: 1
(C) The ratio of their nuclear radii 1 : $2^{1/3}$
(D) None of these

6. The distance between an object and the screen is 100 cm. A lens produces an image on the screen when placed at either of the positions 40 cm apart. Choose from following the correct option(s).

(A) Power of lens is $\frac{21}{100}$ dioptres (B) Power of lens is $\frac{100}{21}$ dioptres

(C) Magnification by the lens $= -\frac{3}{7}$ (D) Magnification by the lens $= -\frac{7}{3}$

7. The given figure shows a YDSE apparatus. Parallel monochromatic coherent light rays are incident on slits S_1 and S_2 $\left(S_1S_2 = \frac{2}{3}\text{mm}\right)$ at an angle 30^o with the horizontal. The medium on left side of the slits is water $\left(\mu_w = 4/3\right)$. To obtain the central maxima at point P, a glass slab $\left(\mu_g = 3/2\right)$ inside water is introduced in front of slit S_1. The thickness of the glass slab required for this purpose is



(A) 2 mm (B) 4/3 mm (C) 4 mm (D) 8/3 mm

8. Two waves travelling in opposite directions produce a standing wave. The individual wave functions are given by $y_1 = 4\sin(3x - 2t)$ and $y_2 = 4\sin(3x + 2t)$ cm, where x and y are in cm

(A) The maximum displacement of the motion at $x = \frac{3\pi}{4}$ cm is 4 cm.

(B) The maximum displacement of the motion at $t = \frac{\pi}{6}$ sec is $4\sqrt{2}$ cm.

(C) Nodes are formed at x values given by 0, $\pi/3$, $2\pi/3$, π, $4\pi/3$, ……..

(D) Antinodes are formed at x values given by $\pi/6$, $\pi/2$, $5\pi/6$, $7\pi/6$, …….

(Single Correct Choice 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.**

Answer Q. 9 and Q. 10 by appropriately matching the lists based on the information given in the paragraph.

An optical instrument is made using four different mirror or lens but radius of curvature of reach is R and refractive index of material of lens (μ) is 1.5. List-I gives the four different optical instruement (mirror / lens) and list-II of some quantity.

List-I		List-II	
(I)	Convex mirror	(P)	1
(II)	Concave mirror	(Q)	–1
(III)	Convex lens	(R)	2
(IV)	Concave lens	(S)	–2
		(T)	–2/3
		(U)	$-\infty$

9. If the focal length of convex mirror is R/2 then the correct match for their focal length in terms of R/2.

(A) I – P, II – Q, III – R, IV –S (B) I – S, II – R, III – Q, IV – P

(C) I – T, II – Q, III – R, IV – S (D) I – U, II – R, III – Q, IV – P

10. If a point object is placed at 'R' distance from concave lens then its image distance is v. The correct match for the image distance in all four case in the unit of v will be
(A) I – T, II – R, III – U, IV –P (B) I – P, II – Q, III – R, IV – S
(C) I – Q, II – R, III – S, IV – T (D) I – R, II – S, III – T, IV – U

Answer Q. 11 and Q. 12 by appropriately matching the lists based on the information given in the paragraph.

A musical instrument is made using four different metal strings, 1, 2, 3 and 4 with mass per unit length μ, 2μ, 3μ and 4μ respectively. The instrument is played by vibrating the strings by varying the free length in between the range L_0 and $2L_0$. It is found that in string-1.(μ) at free length L_0 and tension T_0 the fundamental mode frequency is f_0.List-I gives the above four strings while List-II lists the magnitude of some quantity.

List – I		List – II	
(I)	String-1 (μ)	(P)	1
(II)	String-2 (2μ)	(Q)	$1/2$
(III)	String-3 (3μ)	(R)	$1/\sqrt{2}$
(IV)	String-4 (4μ)	(S)	$1/\sqrt{3}$
		(T)	$3/16$
		(U)	$1/16$

11. If the tension in each string is T_0 the correct match for the highest fundamental frequency in f_0 units will be.
(A) I $\rightarrow$ P, II $\rightarrow$ R, III $\rightarrow$ S, IV $\rightarrow$ Q (B) I $\rightarrow$ Q, II $\rightarrow$ S, III $\rightarrow$ R, IV $\rightarrow$ P
(C) I $\rightarrow$ P, II $\rightarrow$ Q, III $\rightarrow$ T, IV $\rightarrow$ S (D) I $\rightarrow$ Q, II $\rightarrow$ P, III $\rightarrow$ R, IV $\rightarrow$ T

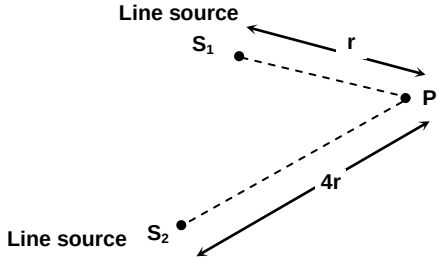
12. The length of the strings 1, 2, 3 and 4 are kept fixed at L_0, $\frac{3L_0}{2}, \frac{5L_0}{4}$ and $\frac{7L_0}{4}$, respectively. Strings 1, 2, 3 and 4 are vibrated at their 1st, 3rd, 5th and 14th harmonies, respectively such that all the strings have same frequency. The correct match for the tension in the four strings in the units of T_0 will be.
(A) I $\rightarrow$ P, II $\rightarrow$ Q, III $\rightarrow$ T, IV $\rightarrow$ U (B) I $\rightarrow$ P, II $\rightarrow$ Q, III $\rightarrow$ R, IV $\rightarrow$ T
(C) I $\rightarrow$ P, II $\rightarrow$ R, III $\rightarrow$ T, IV $\rightarrow$ U (D) I $\rightarrow$ T, II $\rightarrow$ Q, III $\rightarrow$ R, IV $\rightarrow$ U

PART – B
(Numerical based)

This section 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)

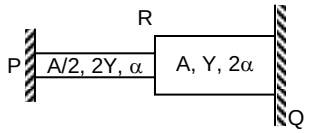
1. The power radiated by a black body is P, and it radiates maximum energy around the wavelength λ_0. If the temperature of black body is now changed so that it radiates maximum energy around a wavelength $\frac{3\lambda_0}{4}$, the new power radiated by it is $\frac{64P}{81}\times n$, then find the value of 'n'.

2. Intensity due to a line source S_1 at a distance of r is I_0 and intensity due to other line source S_2 at a distance of r is $4I_0$ and frequency of both source are equal. If interference occurs at a point P as shown in the figure and wavelength of both sources is r, find the resultant intensity (in watt/m^2) at P. (where I_0 = 3.2 watt/m^2)



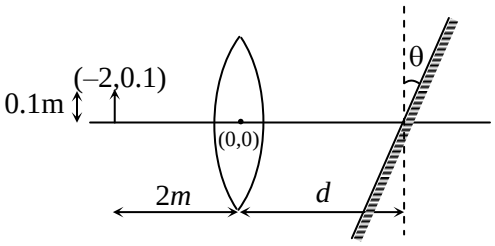
3. A rod of negligible heat capacity has a length of 50 cm, area of cross-section 5 cm^2 and thermal conductivity 500 W/m^{o}C. The temperature of one end is maintained at 0°C and that of the other end is slowly and linearly varied from 0°C to 60°C in 20 min. Assuming no heat loss through the lateral side, the total heat transmitted through the rod in 20 minutes is n kJ, then find the value of 'n'.

4. A composite rod (formed by joining two rods of equal length ℓ but different materials) is held between two fixed supports as shown. If temperature of the system is lowered by $\Delta\theta$, then the displacement of the contact point R is $\frac{\alpha\ell\Delta\theta}{n}$, then find the value of 'n'. [Symbols are having their usual meanings]



5. One mole of a gas expands with temperature according to the relation $V = KT^{2/3}$. The work done when the temperature changes by 30^0C is 5R × n, then find the value of 'n'

6. A convex lens of focal length 1.5m is placed in a system of coordinate axis such that its optical centre is at origin and principal axis coinciding with the *x*-axis. An object and a plane mirror are arranged on the principal axis as shown in figure. Find the value of *d* (in deci-meter) so that *y*-coordinate of final image (after refraction and reflection) is 0.3m. (Take tan θ = 0.3)



SECTION-2 : CHEMISTRY

PART – A

(Multi Correct Choice Type)

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

1. Which of the following carbides gives alkynes with water?
   (A) SrC_2 (B) Al_4C_3
   (C) Mg_2C_3 (D) Bi_2C

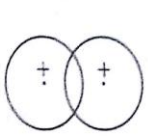
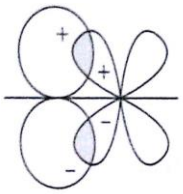
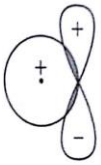
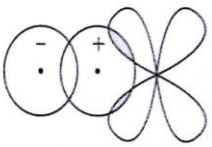
2. Which of the following statements is/are correct about the ionic product of water?
   (A) K (Equilibrium constant) < Kw (ionic product of water)
   (B) pKa > pKw for water
   (C) At 300 K, Kw of water becomes 10^{-12}
   (D) Ionic product of water at 25ºC is 10^{-14}

3. An oleum which is labelled as 109 % H_2SO_4, suggests
   (A) 100 g oleum consists of 109 g H_2SO_4 (B) 100 g oleum is diluted by 9 g H_2O
   (C) 100 mL oleum consists of 109 g H_2SO_4 (D) oleum consists of 40% free SO_3

4. Which statements correctly represent the behaviour of an ideal gas?
   (A) $pV_m \propto CT$ (B) $pM_m \propto dT$
   (C) $p \propto CT$ (D) $pV_m \propto T$

5. In a given process on an ideal gas, dW= 0 and dq =-ve then for the gas
   (A) the pressure will remain constant (B) the internal energy will decrease
   (C) then temperature will decrease (D) the volume will increases

6. Which of the following combination(s) of atomic orbitals suggest non-bonding combinations of atomic orbitals?

   (A)  (B)  (C)  (D) 

7. '20 volume ' H_2O_2 is equal to
   (A) 6.06 % H_2O_2 by mass (B) 3.57 N solution H_2O_2
   (C) 20 mL H_2O_2 (D) 3.57 M solution of H_2O_2

8. One mole of an ideal diatomic gas (C_v= 5 cal) was transformed from initial $25°C$ and 1L to the state when temperature is $100°C$ and volume 10 L. Then for this process (R= 2cal/mol/K) (take calories as unit of energy and Kelvin for temperature)
   (A) $\Delta H = 525$
   (B) $\Delta S = 5\ln\frac{373}{298} + 2\ln 10$
   (C) $\Delta E = 525$
   (D) ΔG of the process can not be calculated using given information

(Single Correct Choice 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.**

9. Match the following:

List – I		List– II	
(I)	$CH_3CH = CH_2$	(P)	Forms $CH_3\underset{\underset{Br}{|}}{C}HCH_3$ as the major product when reacts with HBr
(II)	$CH_3C \equiv CH$	(Q)	Forms $CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}} - CH_3$ as the major product when reacts with HBr
(III)	$CH_2 = C = CH_2$	(R)	Forms $CH_3\underset{\underset{Br}{|}}{C}HCH_3$ as the major product when reacts with $Br_2/h\nu$
(IV)	$CH_3CH_2CH_3$	(S)	Forms $CH_3CH_2CH_2Br$ as the major product when reacts with HBr/R_2O_2
		(T)	Forms $CH_2 = \overset{\overset{Br}{|}}{C} - CH_3$ when reacts with Br_2
		(U)	Forms $CH \equiv C - CH_2Br$ when reacts with Br_2/CCl_4

Correct matching according to above list is

(A) II $\rightarrow$ Q (B) I $\rightarrow$ R

(C) III $\rightarrow$ P (D) IV $\rightarrow$ T

10. Match the following:

List – I		List– II	
(I)	$CH_3CH = CH_2$	(P)	Forms $CH_3\underset{\underset{Br}{|}}{C}HCH_3$ as the major product when reacts with HBr
(II)	$CH_3C \equiv CH$	(Q)	Forms $CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}} - CH_3$ as the major product when reacts with HBr
(III)	$CH_2 = C = CH_2$	(R)	Forms $CH_3\underset{\underset{Br}{|}}{C}HCH_3$ as the major product when reacts with $Br_2/h\nu$
(IV)	$CH_3CH_2CH_3$	(S)	Forms $CH_3CH_2CH_2Br$ as the major product when reacts with HBr/R_2O_2
		(T)	Forms $CH_2 = \overset{\overset{Br}{|}}{C} - CH_3$ when reacts with Br_2
		(U)	Forms $CH \equiv C - CH_2Br$ when reacts with Br_2/CCl_4

Correct matching according to above list is

(A) IV $\rightarrow$ Q (B) I $\rightarrow$ S

(C) III $\rightarrow$ P (D) II $\rightarrow$ U

11. Answer the following by appropriately matching the lists

List – I		List– II	
(I)	CH_4	(P)	Undergoes substitution reaction
(II)	C_2H_6	(Q)	Undergoes addition reaction
(III)	C_2H_4	(R)	Contains pi-bonds
(IV)	C_2H_2	(S)	Contains sp^3-hybridised carbon atoms

Which of the following options has the correct combination considering List-I and List-II?

(A) III $\rightarrow$ QR (B) IV $\rightarrow$ PS

(C) III $\rightarrow$ PS (D) IV $\rightarrow$ P

12. Answer the following by appropriately matching the lists

List – I		List– II	
(I)	CH_4	(P)	Undergoes substitution reaction
(II)	C_2H_6	(Q)	Undergoes addition reaction
(III)	C_2H_4	(R)	Contains pi-bonds
(IV)	C_2H_2	(S)	Contains sp^3-hybridised carbon atoms

Which of the following options has the correct combination considering List-I and List-II?

(A) I $\rightarrow$ QR (B) II $\rightarrow$ QR

(C) I $\rightarrow$ PS (D) II $\rightarrow$ R

PART – B

(Numerical based)

This section 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)

1. If Al^{3+} replaces Na^+ at the edge centre of NaCl lattice, how many vacancies will be created in an unit cell?

2. A solution containing 253.02 g of water and 0.6721 mole of glycol($HOCH_2CH_2OH$) freezes at -5°C. How many gram of ice is formed at the freezing point?
[K_f for water = 1.86 K m^{-1}]

3. The half-life of a second order reaction is 1 minute. How much minute is needed for 75% completion of the reaction?

4. In a cube 'A' atoms forms fcc arrangements, 'B' atoms occupy alternate tetrahedral voids 'C' atoms occupy 1/4th of octahedral voids then find the number of atoms per unit cell

5. In the reaction $P_4 + NaOH \longrightarrow PH_3 + NaH_2PO_2$, mole ratio of NaH_2PO_2 and PH_3 is :

6. Assuming that all the four valency of carbon atom in propane pointing towards the corners of a regular tetrahedron, calculate the distance between the terminal carbon atoms in propane.

Given , C – C single bond length is $1.54\,\mathring{A}$ (Ans Should be $\approx \overset{o}{A}$)

SECTION-3 : MATHEMATICS

PART – A

(Multi Correct Choice Type)

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

1. If tangents at two points (1,2) and (3,6) on a parabola intersect at point (-1,1) then the slope of directrix of parabola can not be

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

(C) -1 (D) 1

2. Which of the following is incorrect for a non – singular matrix A of order 'n'?

(A) $\text{Adj}(\text{Adj}\,A) = |A|^{n-1} A$ (B) $|kA^{-1}| = k\dfrac{1}{|A|}$, where 'k' is a scalar quantity

(C) $\text{Adj}(2A) = 2^{n-1}\text{Adj}(A)$ (D) none of these

3. A man wants to distribute 101 coins of a rupee each, among his 3 sons with the condition that no one receives more money than the combined total of other two. The number of ways of doing this is

(A) ${}^{103}C_2 - 3.\,{}^{52}C_2$ (B) $\dfrac{{}^{103}C_2}{3}$

(C) 1275 (D) $\dfrac{{}^{103}C_2}{6}$

4. If $g(x) = \lim\limits_{m\to\infty} \dfrac{x^m f(x) + h(x) + 3}{2x^m + 4x + 1}$ when $x \neq 1$ and $g(1) = e^3$ such that $f(x), g(x)$ and $h(x)$ are continuous functions at $x = 1$, then

(A) $f(1) = 2e^3$ (B) $h(1) = 5e^3 - 3$

(C) $f(1) + h(1) = 7e^3 + 3$ (D) $f(1) - h(1) = 7e^3 + 3$

5. A line L passing through the point P (1, 4, 3) is perpendicular to both the lines $\dfrac{x-1}{2} = \dfrac{y+3}{1} = \dfrac{z-2}{4}$ and $\dfrac{x+2}{3} = \dfrac{y-4}{2} = \dfrac{z+1}{-2}$. If the position vector of point Q on L is (a_1, a_2, a_3) such that $(PQ)^2 = 357$, then $(a_1 + a_2 + a_3)$ can be

(A) 16 (B) 15

(C) 2 (D) 1

6. Values of x for which the sixth term of the expansion of $E = \left(3^{\log_3 \sqrt{9^{|x-2|}}} + 7^{(1/5)\log_7\left[(4).3^{|x-2|}-9\right]}\right)^7$ is 567, are

(A) 1 (B) 2

(C) 3 (D) none of these

7. If the tangent drawn at point $(t^2, 2t)$ to the parabola $y^2 = 4x$ is the same as the normal at the point $\left(\sqrt{5}\cos\theta, 2\sin\theta\right)$ on the ellipse $4x^2 + 5y^2 = 20$ than.

(A) $\theta = \cos^{-1}\left(\frac{-1}{\sqrt{5}}\right)$ (B) $\cos^{-1}\left(\frac{+1}{\sqrt{5}}\right)$

(C) $t = \frac{-2}{\sqrt{5}}$ (D) $t = \frac{-1}{\sqrt{5}}$

8. If $\left(x^{2006} + x^{2008} + 2\right)^{2010} = a_0 + a_1x + a_2x^2 + ... + a_nx^n$ (2)

then value of $a_0 - \frac{1}{2}a_1 - \frac{1}{2}a_2 + a_3 - \frac{1}{2}a_4 - \frac{1}{2}a_5 + a_6 + ...$ is

(A) less than 2 (B) greater than 0

(C) equals 2 (D) none of these

(Single Correct Choice 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.**

List Match Sets (Each List – Match Set has Two (02) Multiple Choice Question (9 – 12) (12)

9. Answer the following by appropriately matching the lists

List – I		List – II	
(I)	$f(x) = \sin^{-1}\left(\frac{2x}{1+x^2}\right)$	(P)	be continuous $\forall R$
(II)	$f(x) = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$	(Q)	be differentiable $\forall R - \{-1, 1\}$
(III)	$f(x) = \sin^{-1}\left(3x - 4x^3\right)$	(R)	be differentiable $\forall R - \{0\}$
(IV)	$f(x) = \tan^{-1}\left(\frac{2x}{1-x^2}\right)$	(S)	be continuous $\forall R$ and differentiable $\forall R$ except two points
		(T)	Continuous and differentiable $\forall R$ except two points

Which is the correct combination?

(A) I$\rightarrow$P, Q, T (B) II$\rightarrow$P, Q, R

(C) I$\rightarrow$ Q, R, T (D) II$\rightarrow$P, R

10. Answer the following by appropriately matching the lists

List – I		List – II	
(I)	$f(x)=\sin^{-1}\left(\frac{2x}{1+x^2}\right)$	(P)	be continuous $\forall R$
(II)	$f(x)=\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$	(Q)	be differentiable $\forall R-\{-1,1\}$
(III)	$f(x)=\sin^{-1}(3x-4x^3)$	(R)	be differentiable $\forall R-\{0\}$
(IV)	$f(x)=\tan^{-1}\left(\frac{2x}{1-x^2}\right)$	(S)	be continuous $\forall R$ and differentiable $\forall R$ except two points
		(T)	Continuous and differentiable $\forall R$ except two points

Which is only correct combination?

(A) III$\rightarrow$S, T
(B) I$\rightarrow$ P, Q, R
(C) III$\rightarrow$P, T
(D) IV$\rightarrow$R, S, T

(11 – 12)

Let $f(\theta)=\begin{vmatrix}1+\sin^2\theta & \cos^2\theta & 4\sin 4\theta\\ \sin^2\theta & 1+\cos^2\theta & 4\sin 4\theta\\ \sin^2\theta & \cos^2\theta & 1+4\sin 4\theta\end{vmatrix}$, $g(\theta)=\begin{vmatrix}1+\cos^2\theta & \sin^2\theta & 4\sin 4\theta\\ \cos^2\theta & 1+\sin^2\theta & 4\sin 4\theta\\ \cos^2\theta & \sin^2\theta & 1+4\sin 4\theta\end{vmatrix}$

$h(\theta)=\begin{vmatrix}\sin\theta & \cos\theta & \cos\theta\\ \cos\theta & \sin\theta & \cos\theta\\ \cos\theta & \cos\theta & \sin\theta\end{vmatrix}$, $u(\theta)=\begin{vmatrix}1+y & 1-y & 1-y\\ 1-y & 1+y & 1-y\\ 1-y & 1-y & 1+y\end{vmatrix}$, where $y=\sin\theta+\sqrt{3}\cos\theta$

11. Match the statements/expressions in Column I to statements/ expressions in Column II

List – I		List – II	
(I)	The value of θ lying between 0 and $\frac{\pi}{2}$ and satisfying the equation $f(\theta)=0$ is	(P)	$\frac{2\pi}{3}$
(II)	The value of θ between 0 and $\frac{\pi}{2}$ and satisfying the equation $g(\theta)=0$ is	(Q)	$\frac{5\pi}{3}$
(III)	The value of θ from $-\frac{\pi}{4}$ to $\frac{\pi}{4}$ satisfying the equation $h(\theta)=0$ is	(R)	$\frac{7\pi}{24}$
(IV)	The value of θ between 0 and 2π satisfying the equation $u(\theta)=0$	(S)	$\frac{11\pi}{24}$
		(T)	$\frac{\pi}{4}$

Which is correct combination?

(A) I$\rightarrow$R, S, T
(B) II$\rightarrow$R, S
(C) III$\rightarrow$ R, S, T
(D) IV$\rightarrow$P, Q, R, S

Let $f(\theta)=\begin{vmatrix}1+\sin^2\theta & \cos^2\theta & 4\sin 4\theta\\ \sin^2\theta & 1+\cos^2\theta & 4\sin 4\theta\\ \sin^2\theta & \cos^2\theta & 1+4\sin 4\theta\end{vmatrix}$, $g(\theta)=\begin{vmatrix}1+\cos^2\theta & \sin^2\theta & 4\sin 4\theta\\ \cos^2\theta & 1+\sin^2\theta & 4\sin 4\theta\\ \cos^2\theta & \sin^2\theta & 1+4\sin 4\theta\end{vmatrix}$

$h(\theta)=\begin{vmatrix}\sin\theta & \cos\theta & \cos\theta\\ \cos\theta & \sin\theta & \cos\theta\\ \cos\theta & \cos\theta & \sin\theta\end{vmatrix}$, $u(\theta)=\begin{vmatrix}1+y & 1-y & 1-y\\ 1-y & 1+y & 1-y\\ 1-y & 1-y & 1+y\end{vmatrix}$, where $y=\sin\theta+\sqrt{3}\cos\theta$

12. Match the statements/expressions in Column I to statements/ expressions in Column II

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(I)	The value of θ lying between 0 and $\frac{\pi}{2}$ and satisfying the equation $f(\theta)=0$ is	(P)	$\frac{2\pi}{3}$
(II)	The value of θ between 0 and $\frac{\pi}{2}$ and satisfying the equation $g(\theta)=0$ is	(Q)	$\frac{5\pi}{3}$
(III)	The value of θ from $-\frac{\pi}{4}$ to $\frac{\pi}{4}$ satisfying the equation $h(\theta)=0$ is	(R)	$\frac{7\pi}{24}$
(IV)	The value of θ between 0 and 2π satisfying the equation $u(\theta)=0$	(S)	$\frac{11\pi}{24}$
		(T)	$\frac{\pi}{4}$

Which is correct combination?

(A) I$\rightarrow$R, S (B) II$\rightarrow$P, Q, R, S

(C) III$\rightarrow$ P, T (D) III$\rightarrow$P, Q

PART – B

(Numerical based)

This section 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)

1. If $k\sin 27^\circ=\left(5+\sqrt{5}\right)^{\frac{1}{2}}-\left(3-\sqrt{5}\right)^{\frac{1}{2}}$ then k =

2. If $\frac{x}{a}=\cos\theta+\cos 2\theta, \frac{y}{b}=\sin\theta+\sin 2\theta,$ then elimination of θ may yield $\frac{2x}{a}=\left(\frac{x^2}{a^2}+\frac{y^2}{b^2}\right)\left(\frac{x^2}{a^2}+\frac{y^2}{b^2}-k\right)$, then the numerical quantity k =

3. Evaluate $\frac{4}{\pi}\int_0^{\frac{\pi}{2}}x(\sin x+\cos x)^{101}dx-100\int_0^{\frac{\pi}{2}}(\cos x-\sin x)^2(\sin x+\cos x)^{99}dx$

4. If $\vec{a},\vec{b},\vec{c}$ are three vectors mutually perpendicular to each other and $|\vec{a}|=1,|\vec{b}|=3$ and $|\vec{c}|=5$, then $\left[\vec{a}-2\vec{b}\ \vec{b}-3\vec{c}\ \vec{c}-4\vec{a}\right]$ is equal to 350-k then find the value of k

5. If $\lim\limits_{n\to\infty}\left(\prod\limits_{r=1}^{n}\sin\left(\frac{r\pi}{4n}\right)\cos\left(\frac{r\pi}{4n}\right)\right)^{1/n}=\frac{a}{b}, a,b\in N$ then find the least value of (a + b)

6. The number of integral values of α for which three distinct chords drawn from (α,0) to the ellipse $x^2+2y^2=1$ are bisected by the parabola $y^2=4x$ is _____

ANSWERS

PHYSICS

PART – A

1.	**ABC**	2.	**BC**	3.	**AC**	4.	**ABD**
5.	**AC**	6.	**BCD**	7.	**D**	8.	**CD**
9.	**A**	10.	**A**	11.	**A**	12.	**A**

PART – B

1.	**4**	2.	**12.80**	3.	**18**	4.	**2**
5.	**4**	6.	**50**				

CHEMISTRY

PART – A

1.	**AC**	2.	**ABD**	3.	**ABD**	4.	**BCD**
5.	**BC**	6.	**CD**	7.	**AB**	8.	**AB**
9.	**A**	10.	**B**	11.	**A**	12.	**C**

PART – B

1.	**2**	2.	**3**	3.	**3**	4.	**9**
5.	**3**	6.	**3**				

MATHEMATICS

PART – A

1.	**ABD**	2.	**AB**	3.	**AC**	4.	**AB**
5.	**BD**	6.	**AC**	7.	**AD**	8.	**AB**
9.	**D**	10.	**C**	11.	**A**	12.	**A**

PART – B

1.	**4**	2.	**3**	3.	**2**	4.	**5**
5.	**5**	6.	**1**				