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 – 1921_PT-5

SECTION – I : PHYSICS

(PART – A)

(One or More Than One Options Correct Type)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. A plane wave front after incidence on an optical device becomes spherical, it may have incident on

(A) convex mirror (B) concave mirror

(C) convex lens (D) concave lens

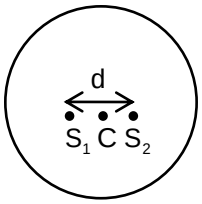
1. **ABCD,**

2. A points source is emitting light of wavelength λ. Phase difference between two wavefronts is $\pi/3$, then distance between them will be

(A) $\frac{\lambda}{3}$ (B) $\frac{\lambda}{6}$ (C) $\frac{\lambda}{4}$ (D) $\frac{\lambda}{2}$

2. **B**

3. Two coherent sources of wavelength4 λ are placed on a diameter, symmetrically around the centre of a circular screen as shown. It is found that a total of 54 maxima are obtained on the screen.
The possible separation between the sources d is/are:

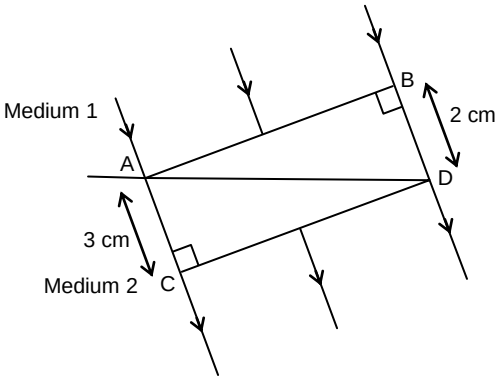


(A) 13.3 λ (B) 13.8 λ

(C) 13.7 λ (D) 13 λ

3. **ABC,**

4. Figure shows wavefront AB from medium 1 refracting as wavefront CD in medium 2. Refractive index of medium 2 w.r.t. medium 1 is



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

(C) $\frac{9}{4}$ (D) $\frac{4}{9}$

4. **B**

5. Which of the following is not correct?

(A) For point source intensity $I = \frac{constant}{r^2}$ (r is the distance from point source)

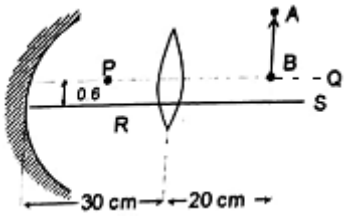
(B) For line source intensity $I = \frac{constant}{r}$

(C) For plane wave front intensity I = (constant) r

(D) For cylindrical wave front intensity $I = \frac{constant}{r}$

5. **C**

6. A convex lens of focal length 15 cm and a concave mirror of focal length 30 cm are kept with their optical axes PQ and RS parallel but separated in vertical direction by 0.6 cm as shown. The distance between the lens and mirror is 30 cm. An upright object AB of height 1.2 cm is placed on the optic axis PQ of the lens at a distance of 20 cm from the lens. If A' B' is the image after refraction from the lens and reflection from the mirror, then



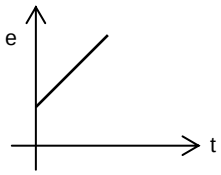
(A) the distance of A'B' from the pole of the mirror is 15cm
(B) Net magnification is -1.5
(C) distance of A' from the optic axis RS is 1.5 cm
(D) Distance of B' from the optic axis RS is 0.3 cm

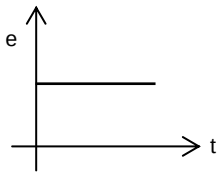
6. **ABCD,**

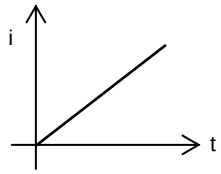
7. A wire is bent to form a square loop of side a. it carries a current I and is kept perpendicular to a uniform magnetic field. Such that magnetic moment is in the same direction as the field. Shape of the loop is changed from square to a circle without changing the length of the wire and current. Then:
(A) The decrease in magnetic moment of the square loop with respect to circular loop is $ia^2(1 - 4/\pi)$
(B) The decrease in magnetic moment of the square loop with respect to circular loop is $ia^2(1 - 2/\pi)$
(C) The amount of work done in doing so is $iBa^2(\pi - 4)/\pi$.
(D) The amount of work done in doing so is $iBa^2(\pi - 4)/4$.

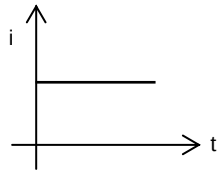
7. **AC,**

8. Two parallel long straight conductors lie on a smooth horizontal surface. Two other parallel conductors rest on them at right angles so as to form a square of side a initially. A uniform magnetic field B exists in vertical direction. Now all the four conductors start moving outwards with a constant velocity v. The magnitude of induced e.m.f. e and induced current i will vary with time t as (more than one option may be correct)

(A) 

(B) 

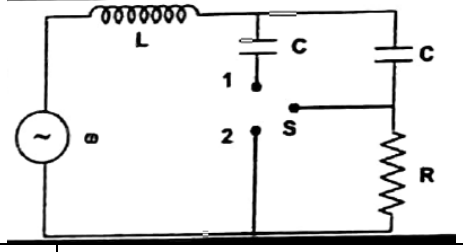
(C) 

(D) 

8. **AD,**

This section contains **2 List-Match Sets**, each List-Match set has **2 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.

P1. The AC generator, shown in the figure, supplies V volt at an angular frequencyω. The switch can be in two positions 1 or 2. L, C, R has their usual meaning, then answers the following questions.



list – 1		list – 2	
(I)	L=10 mH	(P)	C=5 mF, R=10 Ω
(II)	L=20 mH	(Q)	C=10 mF, R=1 Ω
(III)	L=30 μH	(R)	C=20 μF , R=0.1 Ω
(IV)	L=40 μH	(S)	C=40 μF , R=0.01 Ω

9. First this circuit is adjusted for resonance corresponding to angular frequency 100 rad/s. The switch is now suddenly switched to position 1. For which case will the voltage drop across the capacitor be 50% of that across the resistor?
(A) (I) (Q) (B) (III) (P) (C) (II) (R) (D) (IV) (S)

9. **A,**

10. The circuit is again adjusted (by changing values of L,C,R and ω)for resonance with the switch pushed to position 1. In which case the sharpness of the resonance will be maximum?
(A) (I) (Q) (B) (III) (R) (C) (IV) (P) (D) (II) (S)

10. **D,**

The overall efficiency of a transformer is 90%. The transformer is rated for an output of 9000 watt. The iron losses at full load are 700 watt. The primary coil has a resistance of 1 ohm.

List – 1		**List – 2** (Voltage in Secondary & Current in Primary)	
(I)	Primary voltage is 1000 V.	(P)	100 Volts, 9 amp
(II)	Primary voltage is 1500 V.	(Q)	200 Volts, 4.5 amp
(III)	Primary voltage is 2000 V.	(R)	250 Volts, 1 amp
(IV)	Primary voltage is 2500 V.	(S)	500 Volts, 5 amp

11. If ratio of turns in primary to secondary coil is 5 : 1, then
(A) (I) (Q) (B) (II) (Q) (C) (III) (R) (D) (IV) (Q)

11. **A**

12. If ratio of turns in primary to secondary coil is 4 : 1 then
(A) (III) (S) (B) (IV) (P) (C) (II) (Q) (D) (IV) (Q)

12. **A**

(PART – B)

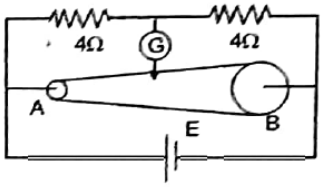
(Integer Type)

Part-C (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 **+4 marks** for correct answer and **there will be no negative marking.**

1. An AC circuit contains only inductor and capacitor joined to a source with emf given as $e = 4\sqrt{2}\sin\omega t$ Volt. Inductive reactance and capacitive reactance are different. Calculate emf (in volt) at the instant when instantaneous power delivered by source is maximum.

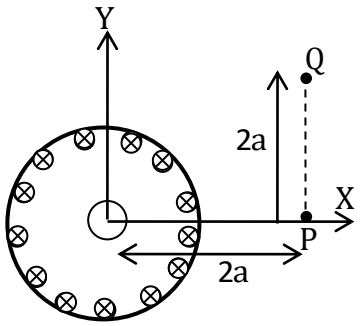
1. **4**

2. The radius of a wire AB of length 1 m changes linearly from r to 2r from left end to right end as shown in the diagram. At what distance (in cm) from end A should the jockey of the galvanometer be connected on wire AB so that the deflection in the galvanometer is zero?



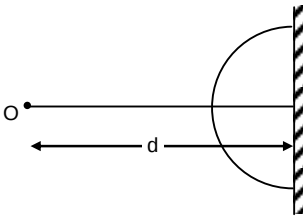
2. **33.33,**

3. There is a uniform but variable magnetic field along –z axis, in a cylindrical region of radius a=3m, boundary described by $x^2 + y^2 = a^2$, whose magnitude changes with time as B = 2t Tesla, then $\int_p^Q \vec{E}.\vec{dy}$ is equal to (in Volt)



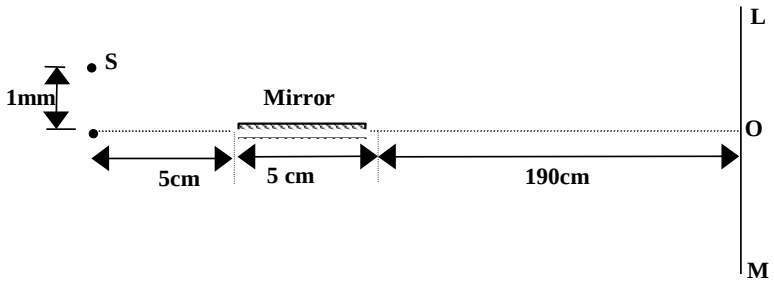
3. **7.07,**

4. A plano-convex then lens of focal length 10 cm is silvered at its plane surface. The distance d at which an object must be kept in order to get its image on itself in cm is



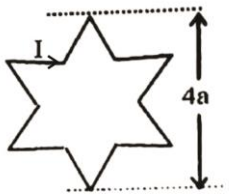
4. **10**

5. The arrangement of the Lloyd's mirror experiment is shown in the figure. 'S' is a point source of frequency 6×10^{14} Hz. The number of fringes formed on the screen LOM is



5. **40**

6. A symmetric star conducting wire loop is carrying a steady current I=2A in clockwise sense as shown in figure. The distance between the diametrically opposite vertices of the star is 4a(a=3m). The magnitude of the magnetic field (in μT) at the centre of the loop is



6. **0.29**

SECTION - II : CHEMISTRY

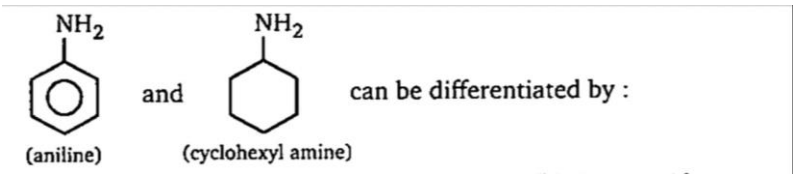
(PART – A)

(One or More Than One Options Correct Type)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. Which of the following reaction produces SO_2 gas?
   (A) Burning of sulphur in oxygen
   (B) Reaction of copper with H_2SO_4
   (C) Roasting of sulphide ores
   (D) Burning of H_2S

1. ABCD

2. 

   (A) Hinsberg test
   (B) Iso-cyanide Test
   (C) $NaNO_2$, HCl, then β-Naphthol
   (D) NaOH

2. C

3. $SO_3 + (P) \longrightarrow (Q) \xrightarrow{H_2O} (P)$
   In the above reaction the unknown compounds are
   (A) P = $H_2S_2O_7$
   (B) Q = H_2SO_4
   (C) P = H_2SO_4
   (D) Q = $H_2S_2O_7$

3. CD

4. Which of the following substance(s) can react with phenol?
   (A) ICl
   (B) NO_2BF_4
   (C) ClF
   (D) OF_2

4. ABC

5. In the reaction sequence

$$X + Y \xrightarrow[\Delta]{NaOH} C_6H_5 - CH = \overset{\overset{CH_3}{|}}{C} - CHO$$

   (X) and (Y) can not be
   (A) C_6H_5 - CHO and CH_3CHO
   (B) C_6H_5 - CH_2 - CHO and CH_3CHO
   (C) C_6H_5 - CHO and CH_3CH_2CHO
   (D) $C_6H_5COCH_3$ and CH_3CHO

5. ABD

6. Which of the following orders are correct for property indicated in brackets?
   (A) $NH_3 > NF_3 > BF_3$ (dipole moment)
   (B) Cl > S > O > N (electron affinity)
   (C) Si > Mg > Al > Na (first ionization enthalpy)
   (D) $HClO_4 > HBrO_4 > HIO_4$ (pK_a values)

6. ABC

7. Which of the following ligand(s) can form back bond with metals or metal ions?
   (A) CO
   (B) CN^-
   (C) PPh_3
   (D) NO^+

7. ABCD

8. $Zn \mid Zn^{2+}(1\ M) \parallel Cu^{2+}(1\ M) \mid Cu$
The correct relations between the e.m.f of the above electrochemical cell is/are
$\left[E^0_{Zn^{2+}/Zn} = -0.76\,V \text{ and } E^0_{Cu^{2+}/Cu} = 0.34V\right]$
(A) $E_{Cell} > 0$ (B) $E^0_{Cell} > 0$
(C) $E_{Cell} = E^0_{Cell}$ (D) $E^0_{Cell} < 0$

8. ABC

This section contains **2 List-Match Sets**, each List-Match set has **2 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.

C1

	List - I		**List - II**
(I)	Order of reaction	(P)	Depends on concentration except first order reaction
(II)	Rate constant	(Q)	Assumed as independent of temperature
(III)	Half-life	(R)	May be negative
(IV)	Activation energy	(S)	Depends only on temperature
		(T)	Varies with enthalpy change of reaction
		(U)	Is zero for a zero order reaction

9. The correct matching between List-I and List-II
(A) I - S (B) II - T
(C) III - R (D) IV – Q

9. D

10. The correct matching between the above Lists is
(A) I - T (B) II - Q
(C) III – P (D) IV - R

10. C

C2

	List - I		**List - II**
(I)	Cr	(P)	Forms colourless complexes in +1 oxidation state
(II)	Cu	(Q)	Attain a half-filled d-electron configuration in +2 oxidation state
(III)	Mn	(R)	The M^+ and M^{3+} ions contain same number of unpaired electrons
(IV)	Fe	(S)	Has positive reduction potential
		(T)	Contains full-filled d-orbital configuration
		(U)	Contains maximum number of unpaired electrons in ground state

11. The correct matching between the above two lists is
(A) I - P (B) II - U
(C) III – Q (D) IV - S

11. C

12. The correct matching in the above lists is
(A) I - S (B) II - Q
(C) III – P (D) IV – R

12. D

(PART – B)

(Integer Type)

Part-C (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 **+4 marks** for correct answer and **there will be no negative marking.**

1. When gas (A) is passed to the brown aqueous solution of an iron salt(B), the solution becomes green due to formation of another iron salt(C). A pale yellow elemental precipitate(D) is also formed in the reaction. The solution of the reaction mixture forms a white precipitate with $AgNO_3$. The white precipitate dissolves in dilute NH_3. What is the molar mass of (C) in g mol^{-1}?
(atomic weight of iron = 56)

1. 127

2. 4 moles of glycol was added to 1610.85 g of water in a container. The resulting solution was cooled to -6°C. How much gram of ice is formed in the reaction?
[K_f of H_2O = 1.86 K Kg mol^{-1}]

2. 370.85

3. The molar conductance of an electrolyte MA in water at a certain concentration is 342.26 $ohm^{-1}cm^2mol^{-1}$. The value of $\Lambda^0_{M^+}$ and $\Lambda^0_{A^-}$ of MA are respectively 869.02 and 500.02 $ohm^{-1}cm^2mol^{-1}$. If the percentage dissociation of the electrolyte is x%, the value of 'x' is

3. 25

4. The half-life of a first order reaction is 4 minutes. How much time in minute is required for 75% transformation of the reactant into products?

4. 8

5. The molar ratio of titanium(Ti) to oxygen (O) in the diamagnetic stoichiometric oxide of titanium is x : y, the sum (x + y) is

5. 3

6. Consider the carbonyl $Fe_2(CO)_9$
If x = Number of bridging CO groups
y = Number of π-bonds present in ligands
z = Number of Fe – O bonds, then the sum (x + y + z) is

6. 21

Space of Rough Work

SECTION - III : MATHEMATICS

(PART – A)

(One or More Than One Options Correct Type)

This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

1. Area enclosed between the curves $|y| = 1 - x^2$ and $x^2 + y^2 = 1$ is
   (A) enclosed area is symmetric with respect to coordinate axis
   (B) $\pi - \frac{8}{3}$ sq. unit
   (C) $2\pi - \frac{8}{3}$ sq. unit
   (D) enclosed area is symmetric about $y = 2$ line

1. **AB**

2. Consider $C_1 : y = x^2$ and $C_2 : x^2 + y^2 = 2$ Then:
   (A) area bounded by C_1, C_2 and x – axis in first quadrant will be $\left(\frac{\pi}{4} - \frac{1}{6}\right)$ sq. units
   (B) area bounded by C_1, C_2 and y – axis in second quadrant will be $\left(\frac{7\pi}{4} + \frac{1}{6}\right)$ sq. units
   (C) area bounded by C_1 and C_2 in major segment will be $\left(\frac{3\pi}{2} - \frac{1}{3}\right)$ sq. units
   (D) area bounded by C_1 and C_2 in minor segment will be $\left(\frac{\pi}{2} - \frac{1}{3}\right)$ sq. units

2. **ACD**

3. The solution of equation $\frac{dy}{dx} = \frac{Ax + B}{Cy + D}$ represents:
   (A) a straight line if $A = C = 0$ and B, $D \neq 0$
   (B) a parabola if A = 2, C = 0, $D \neq 0$
   (C) a hyperbola if B = D = 0, A and $C \neq 0$
   (D) a rectangular hyperbola if B = D = 0, A = C = 2

3. **AB**

4. Let $A_\alpha = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then
   (A) $A_{\alpha+\beta} = A_\alpha A_\beta$ (B) $A_\alpha^{-1} = A_{-\alpha}$
   (C) $A_\alpha^{-1} = -A_\alpha$ (D) $A_\alpha^2 = -I$

4. **AB**

5. Which of the following values of α satisfy the equation

$$\begin{vmatrix} (1+\alpha)^2 & (1+2\alpha)^2 & (1+3\alpha)^2 \\ (2+\alpha)^2 & (2+2\alpha)^2 & (2+3\alpha)^2 \\ (3+\alpha)^2 & (3+2\alpha)^2 & (3+3\alpha)^2 \end{vmatrix} = -648\alpha \, ?$$

(A) –4 (B) 9
(C) –9 (D) 4

5. **BC**

6. Let X and Y be two arbitrary, 3×3, non – zero, skew symmetric matrices and Z be an arbitrary 3×3, non zero, symmetric matrix. Then which of the following matrices is (are) skew symmetric?

(A) $Y^3Z^4 - Z^4Y^3$ (B) $X^{44} + Y^{44}$
(C) $X^4Z^3 - Z^3X^4$ (D) $X^{23} + Y^{23}$

6. **CD**

7. If A is an invertible matrix, then which of the following is/are true?

(A) A is a null matrix (B) AdjA is non null matrix
(C) $|A| \neq 0$ (D) $A^{-1} = |A|\,\text{Adj.A}$

7. **BC**

8. If $x = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then the value of x^n is **NOT** equal to

(A) $\begin{bmatrix} 3n & -4n \\ n & -n \end{bmatrix}$ (B) $\begin{bmatrix} 2+n & 5-n \\ n & -n \end{bmatrix}$
(C) $\begin{bmatrix} 3^n & (-4)^n \\ 1^n & (-1)^n \end{bmatrix}$ (D) $\begin{bmatrix} 1+n & 5-n \\ n+2 & -n \end{bmatrix}$

8. **BCD**

This section contains **2 List-Match Sets**, each List-Match set has **2 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.

M1 The solution of the differential equations :

Column – I		**Column – II**	
(I)	$(x^2 + y)dx - xdy = 0$	(P)	$x^2 + 2xy - y^2 - 4x + 8y = c$
(II)	$y(1+xy)dx - xdy = 0$	(Q)	$x - \frac{y}{x} = c$
(III)	$y_1(y - x - 4) = x + y - 2$	(R)	$y^2 - 1 + cxy = 0$
(IV)	$xdy + ydx + y^2(xdy - ydx) = 0$	(S)	$x^2 + \frac{2x}{y} = c$

9. Which of the following is the correct combination

(A) (I) P (B) (I) Q (C) (II) P (D) (II) Q

9. B

10. Which of the following is the correct combination
(A) (III) P (B) (III) S (C) (IV) S (D) (IV) P

10. A

M2 Area under the curve

Column – I		**Column – II**	
(A)	$y = x^2, y = \lvert 2 - x^2 \rvert, y = 2$ and right of $x = 1$	(p)	$\pi - 2/3$
(B)	$x^2 + y^2 = 25, 4y = \lvert 4 - x \rvert^2$ and $x = 0, y \geq 0$	(q)	$25\sin^{-1}\frac{4}{5} + 4$
(C)	$y = x^2, y = \frac{2}{1+x^2}$	(r)	$25\left(\frac{\pi}{4} - \frac{2}{3}\right)$
(D)	$x^2 + y^2 = 10x, y^2 = 5x$	(s)	$\frac{4}{5}(5 - 3\sqrt{3})$

11. Which of the following is the correct combination
(A) (II) P (B) (II) Q (C) (II) R (D) (III) S

11. B

12. Which of the following is the correct combination
(A) (IV) P (B) (IV) Q (C) (IV) R (D) (IV) S

12. C

(PART – B)

(Integer Type)

Part-C (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 **+4 marks** for correct answer and **there will be no negative marking.**

1. If the line $y = mx$ bisects the area enclosed by the lines $x = 0, y = 0, x = \frac{3}{2}$ and the curve $y = 1 + 4x - x^2$ for $m = \frac{p}{q}$ (p, q$\in$ N, p & q are co-prime), then the value of 2p–3q =

1. **8**

2. The order of the differential equation of the family of parabolas with focus at origin and axis along x-axis is _____.

2. **1**

3. If $f(x) = \begin{vmatrix} 1+\sin^2 x & \cos^2 x & 4\sin 2x \\ \sin^2 x & 1+\cos^2 x & 4\sin 2x \\ \sin^2 x & \cos^2 x & 1+4\sin 2x \end{vmatrix}$, $f(a)$ and $f(b)$ be the least and greatest values of $f(x)$, then $f(b) - f(a) =$

3. 8

4. The area bounded by the curve $y = x^2 + 2x + 1$, the tangent at (1, 4) and the y-axis is A then the value of $\frac{1}{A}$ is

4. **3**

5. If $A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$ and $|A^3| = 125$, then the value of $|\alpha| =$

5. **3**

6. If $(1 + x^2)\frac{dy}{dx} = 1 + y^2, y(0) = 1$, then the value of $|y(2)|$ is

6. **3**