FIITJEE – JEE (Main)

BATCHES –1921_Pt-5

Physics, Chemistry & Mathematics

QP Code:

Time Allotted: 3 Hours **Maximum Marks: 300**

- 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.

Important 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. 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. No candidate is allowed to carry any textual material, printed or written, bits of papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices ext. except the Admit Card inside the examination hall / room.

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.
4. **Do not fold or make any stray marks on the Answer Sheet.**

C. Marking Scheme for All Two Parts:

(i) **Part-A (01-20) –** Contains Twenty (20) multiple choice objective questions which have four (4) options each and only one correct option. Each question carries **+4 marks** which will be awarded for every correct answer and **-1 mark** will be deducted for every incorrect answer.

(ii) **Part-B (01-05)** contains five (05) 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 :_____

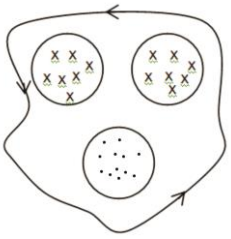
SECTION – I : PHYSICS

(PART – A)

Single Correct Questions

This section contains 20 Single Correct Questions out of which only one option is correct

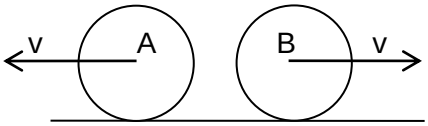
1. Figure shows three regions of magnetic field each of area A and in each region magnitude of magnetic field decreases at a constant rate α. If $\vec{E}$ is induced electric field then value of line integral $\oint \vec{E}.d\vec{r}$ along the given loop is equal to



(A) αA (B) $-\alpha A$ (C) $3\alpha A$ (D) $-3\alpha A$

1. **B,**

2. Two identical conducting rings A and B of radius R are in pure rolling over a horizontal conducting plane with same speed v but in opposite direction. A constant magnetic field B is present pointing inside the plane of paper. Then the potential difference between the highest points of the two rings is



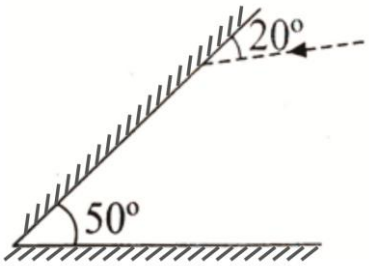
(A) zero (B) $2BvR$
(C) BvR (D) $4BvR$

2. **D,**

3. Huygen's conception of secondary waves
(A) helps us to find the focal length of a thick lens
(B) is a geometrical method to find the position of a wave-front at a later or an earlier instant
(C) is used to determine the velocity of light
(D) is used to explain polarization of light

3. **B**

4. The deviation suffered by ray after three successive reflections in situation is :



(a) 200^0 clockwise (b) 200^0 anticlockwise
(c) 220^0 anticlockwise (d) 220^0 clockwise

4. **D,**

5. Unit vector along a ray of light that is incident on a plane mirror is $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$ and unit vector along the normal to the mirror at the point incidence is $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$.unit vector along the reflected ray can be expressed as :

(a) $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}+\hat{k}\right)$ (b) $\frac{1}{\sqrt{3}}\left(-\hat{i}-\hat{j}-\hat{k}\right)$

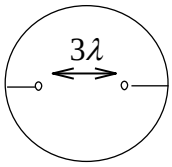
(c) $\frac{1}{\sqrt{3}}\left(-\hat{i}-\hat{j}+\hat{k}\right)$ (d) $\frac{1}{\sqrt{3}}\left(\hat{i}+\hat{j}-\hat{k}\right)$

5. **C,**

6. An object is moved at constant speed from infinity to the focus of a concave mirror , then
(a) image will move at constant speed from focus to infinity
(b) image will move slower in the beginning and faster later on, away from the mirror
(c) image will move faster in the beginning and slower later on , away from the mirror
(d) image will move away from the mirror in the beginning and towards the mirror later on but with a constant speed

6. **B,**

7. If two coherent sources are placed at a distance 3λ from each other symmetric to the centre of the circle shown in the figure, then number of bright fringes shown on the screen placed along the circumference is :



(a) 16 (b) 12
(c) 8 (d) 4

7. **B,**

8. Shape of wavefronts coming out from a point source, a long linear source and a spherical symmetric source placed at infinite distance are respectively:
(A) Conical, cylindrical and plane. (B) Circular, cylindrical and plane.
(C) Spherical, cylindrical and plane. (D) Spherical, cylindrical and spherical.

8. **C**

9. Huygen's principle is related to which of the following:
(A) Photoelectric effect (B) Electrostatic shielding
(C) Wave optics (D) Induced emf

9. **C**

10. A spherical surface of curvature R separates air (μ=1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The line PQ cuts the surface at a point O and PO = OQ. The distance PO is equal to
(A) 2R (B) 5R (C) 3R (D) 1.5R

10. **B,**

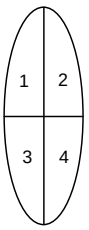
11. An object is moving towards a concave mirror of focal length 24 cm. When it is at a distance of 60 cm from the mirror it speed is 9 cm/s. The speed of its image at that instant, is
(A) 4 cm/s towards the mirror (B) 6 cm/s towards the mirror
(C) 4 cm/s away from the mirror (D) 6 cm/s away from the mirror

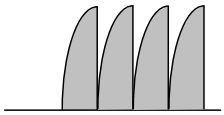
11. **C**

12. In a young's double slit experiment, slits are illuminated by a monochromatic source of wavelength $6000\,\overset{0}{A}$ and fringes are obtained. If screen is moved by a distance of 5 cm towards slits, change in fringe width is 3×10^{-5} m. Then separation between the slits will be
(A) 1 mm (B) 1.2 mm (C) 1.5 mm (D) 1.63 mm

12. **A,**

13. The given equi-convex lens is broken into four parts and rearranged as shown. If the initial focal length is f then after rearrangement, the equivalent focal length is





(A) f (B) f/2
(C) f/4 (D) 4f

13. **B**

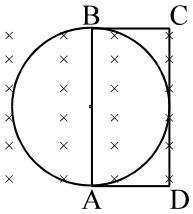
14. If w, x, y and z are mass, length, time and current respectively, then $\frac{x^2w}{y^3z}$ has dimensional formula same as
(A) electric potential (B) capacitance (C) electric field (D) permittivity

14. **A,**

15. An inductance L, a capacitance C and a resistance R may be connected to an AC source of angular frequency ω, in three different combinations of RC, RL and RLC in series. Assume that $\omega L = \frac{1}{\omega C}$.
The power drawn by the three combinations are P_1, P_2, P_3 respectively. Then,
(A) $P_1 > P_2 > P_3$ (B) $P_1 = P_2 < P_3$ (C) $P_1 = P_2 > P_3$ (D) $P_1 = P_2 = P_3$

15. **B,**

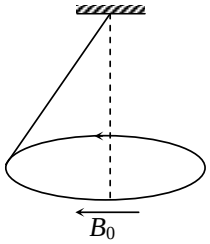
16. There exists a uniform but time varying magnetic field B = a + bt normal to plane of paper in a cylindrical region as shown. A rectangular conducting loop is placed as shown. Induced emf in branches AB and BC are



(A) $\pi R^2 b/2$, 0 (B) $2R^2 b$, 0
(C) 0, $\pi R^2 b/8$ (D) 0, $\pi R^2 b/4$

16. **C,**

17. A uniform current carrying ring of mass m and radius R is connected by a massless string as shown. A uniform magnetic field B_0 exist in the region to keep the ring in horizontal position, then the current in the ring is (l = length of string)



(A) $\frac{mg}{\pi RB_0}$ (B) $\frac{mg}{RB_0}$ (C) $\frac{mg}{3\pi RB_0}$ (D) $\frac{mgl}{\pi R^2 B_0}$

17. **A**

18. A coil of area 5 cm^2 and having 20 turns is placed in a uniform magnetic field of 10^3 gauss. The normal to the plane of the coil makes an angle of 60^o with the magnetic field. The flux in maxwell through the coil is

(A) 10^5 (B) 5×10^4

(C) 2×10^4 (D) 5×10^3

18. **B**

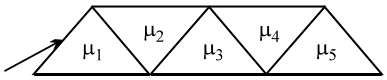
19. Two point sources P and Q are 24 cm apart. Where should a convex lens of focal length 9 cm be placed in between them so that the images of both sources are formed at the same place?

(A) 3 cm from P (B) 15 cm from Q

(C) 9 cm from Q (D) 18 cm from P

19. **D,**

20. The diagram shows five isosceles right angled prisms. A light ray incident at 90° at the first face emerges at same angle with the normal from the last face. Which of the following relations will hold regarding the refractive indices?



(A) $\mu_1^2+\mu_3^2+\mu_5^2=\mu_2^2+\mu_4^2$ (B) $\mu_1^2+\mu_3^2+\mu_5^2=1+\mu_2^2+\mu_4^2$

(C) $\mu_1^2+\mu_3^2+\mu_5^2=2+\mu_2^2+\mu_4^2$ (D) none

20. **C,**

(PART – B)

(Integer Type)

Part-C (01-05) contains five (05) 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. A compound microscope having objective lens of focal length 2 cm and eyepiece of focal length 2.5 cm, is adjusted for clear vision, for which the angular magnification is found to be 110. The tube length must be about (in cm)

1. **24.3,**

2. The current passing through a choke coil of 5 henry is decreasing at the rate of 2 A s^{-1}, The emf developing across the coil in volts is

2. **10**

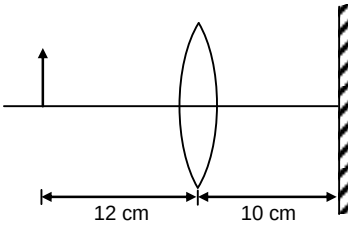
3. A glass plate of refractive index 1.2 is coated with a thin transparent layer of material with refractive index 1.5. Light of wavelength 600 nm is incident normally and constructive interference is obtained for reflected light. Minimum possible value of thickness of coating in 10^{-7} m is _____

3. **1,**

4. Two particles each of mass m and charge q, are attached to the two ends of a light rigid rod of length 2l. The rod is rotated at a constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is $\frac{q}{xm}$, where 'x' is

4. **2**

5. An object, a convex lens of focal length 20 cm and a plane mirror are arranged as shown in the figure. How far behind the mirror is the second image formed (in cm)



5. **40**

SECTION – II : CHEMISTRY

(PART – A)

Single Correct Questions

This section contains 20 Single Correct Questions out of which only one option is correct

1. Reaction of carbonate ions with dilute HCl produces
   (A) $CO + H_2O$ (B) $CO_2 + H_2O$
   (C) $CH_4 + CO_2$ (D) $Cl_2 + CO_2$
1. B

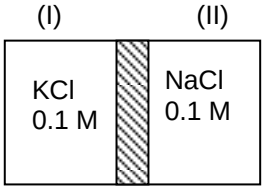
2. The oxide of nitrogen which reacts with NaOH solution giving both sodium nitrite and sodium nitrate is :
   (A) NO_2 (B) N_2O_5
   (C) N_2O_3 (D) NO
2. A

3. When concentrated H_2SO_4 is added to charcoal :
   (A) there is no reaction (B) water gas is formed
   (C) SO_2 and CO_2 are evolved (D) CO and SO_2 are evolved
3. C

4. Cl_2O_6 is an anhydride of
   (A) $HClO_3$ (B) $HClO_2$
   (C) $HClO_4$ (D) mixed anhydride of $HClO_3$ & $HClO_4$
4. D

5. Which of the following compound is expected to be coloured ?
   (A) Ag_2SO_4 (B) CuF_2
   (C) MgF_2 (D) CuCl
5. B

6. Anhydrous ferric chloride is prepared by :
   (A) heating hydrated ferric chloride at a high temperature in stream of air
   (B) heating metallic iron in a stream of dry chlorine gas.
   (C) reaction of ferric oxide with HCl
   (D) reaction of metallic iron with HCl.
6. B

7. 

   In above osmosis solvent water will flow form
   (A) (I) to (II) (B) (II) to (I)
   (C) No flow of H_2O is observed (D) solute will flow from (II) to (I)
7. B

8. Native sliver forms a water soluble complex with dilute aqueous solution of NaCN in the presence of
   (A) nitrogen (B) oxygen
   (C) carbon dioxide (D) argon
8. B

9. Which of the following substance does not produce O_2 gas on heating?

(A) O_3 (B) SO_3
(C) H_2SO_4 (D) H_2SO_3

9. D

10. The geometry of $[Ni(CO)_4]$ and $[Ni(PH_3)_2Cl_2]$ are :
(A) both square planar
(B) tetrahedral and square planar respectively
(C) both tetrahedral
(D) square planar and tetrahedral respectively

10. B

11. Which of the following substance has the highest value of spin-only magnetic moment?
(A) TiO (B) FeO
(C) NiO (D) ZnO

11. B

12. Which of the following solution of identical concentration has the highest value of molar conductance?
(A) NaCl (B) HCl
(C) KCl (D) LiCl

12. B

13. Which can easily form nascent oxygen atom on heating?
(A) HClO (B) $HClO_2$
(C) $HClO_3$ (D) $HClO_4$

13. A

14. What will be the hybridisation of Xe in XeF_2?
(A) sp^2 (B) sp^3d
(C) sp^3 (D) sp^3d^2

14. B

15. The correct order of equivalent conductance at infinite dilution of LiCl, NaCl and KCl is :
(A) LiCl > NaCl > KCl (B) KCl > NaCl > LiCl
(C) NaCl > KCl > LiCl (D) LiCl > KCl > NaCl

15. B

16. Rate of physisorption increases with
(A) decrease in temperature (B) increase temperature
(C) decrease in pressure (D) decrease in surface area

16. A

17. A negatively charged sol will require minimum amount of which electrolyte for its coagulation
(A) $NaNO_3$ (B) $Mg(NO_3)_2$
(C) $Al(NO_3)_3$ (D) $Th(NO_3)_4$

17. D

18. The gas which is most adsorbed on activated charcoal is :
(A) SO_2 (B) N_2
(C) O_2 (D) H_2

18. A

19. Which of the following 0.1M aqueous solution will have lowest freezing point?
[Assume 100% dissociation of salts]
(A) K_2SO_4 (B) NaCl
(C) NH_2CONH_2 (D) $C_6H_{12}O_6$

19. A

20. During depression of freezing point in a solution, the following are in equilibrium:
(A) liquid solvent, solid solvent (B) liquid solvent, solid solute
(C) liquid solute, solid solute (D) liquid solute, solid solvent

20. A

(PART – B)

(Integer Type)

Part-C (01-05) contains five (05) 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. The total number of lone pair of electron on Xe atom in XeF_4 is :

1. 2

2. The molarity of a glucose solution containing 36 g of glucose per 400 mL of the solution is-

2. 0.5

3. For a hypothetical reaction
$A + B \rightarrow$ products, the rate law is,
$r = k [B] [A]^o$, the overall order of reaction is –

3. 1

4. One cyanide complex of copper$[Cu(CN)_4]^{x-}$ shows strong Jahn-Teller distortion. What is the value of 'x'?

4. 3

5. In $[Co(NH_3)_4Cl_2]Cl$ the co-ordination number of cobalt is

5. 6

SECTION – I : MATHEMATICS

(**PART – A)**

Single Correct Questions

This section contains 20 Single Correct Questions out of which only one option is correct

1. Let $f(x)=|x-2|$ and $g(x)=f(f(x)), x\in[0,4]$. Then $\int_0^3 (g(x)-f(x))\,dx$ is equal to:

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

(C) 1 (D) 0

1. C

2. If $A=\begin{bmatrix}0 & 1 & -1\\ 2 & 1 & 3\\ 3 & 2 & 1\end{bmatrix}$, then $\left(A(\text{adj}\,A).A^{-1}\right)A$ is equal to

(A) $2\begin{bmatrix}3 & 0 & 0\\ 0 & 3 & 0\\ 0 & 0 & 3\end{bmatrix}$ (B) $\begin{bmatrix}-6 & 0 & 0\\ 0 & -6 & 0\\ 0 & 0 & -6\end{bmatrix}$

(C) $\begin{bmatrix}0 & 1/6 & -1/6\\ 2/6 & 1/6 & 3/6\\ 3/6 & 2/6 & 1/6\end{bmatrix}$ (D) None of these

2. A

3. If $A=\begin{bmatrix}\cos\theta & i\sin\theta\\ i\sin\theta & \cos\theta\end{bmatrix}$, $\left(\theta=\frac{\pi}{24}\right)$ and $A^5=\begin{bmatrix}a & b\\ c & d\end{bmatrix}$, where $i=\sqrt{-1}$, then, which one of the following is not true?

(A) $a^2 - c^2 = 1$ (B) $a^2-b^2=\frac{1}{2}$

(C) $0 \le a^2 + b^2 \le 1$ (D) $a^2 - d^2 = 0$

3. B

4. $\int_0^{\frac{\pi}{2}} \frac{\cos^3 x\,dx}{\sin^3 x+\cos^3 x}$ is equal to

(A) $\frac{\pi}{8}$ (B) $\frac{\pi}{4}$

(C) 0 (D) $\frac{\pi}{2}$

4. **B**

5. The area bounded by the curve $y = xe^{|x|}$, the lines $|x| = 1$ and $y = 0$ is

(A) 4 (B) 6

(C) 1 (D) 2

5. D

6. If A and B are symmetric matrices of the same order, then
(A) AB is a symmetric matrix (B) $A - B$ is a skew-symmetric matrix
(C) $AB + BA$ is a symmetric matrix (D) $AB - BA$ is a symmetric matrix

6. **C**

7. The solution of $\frac{dy}{dx} + \frac{y}{x} = x^2$ is
(A) $x + y = \frac{x^2}{2} + c$ (B) $x - y = \frac{1}{3}x^3 + c$
(C) $xy = \frac{1}{4}x^4 + c$ (D) $y - x = \frac{1}{4}x^4 + c$

7. C

8. The area bounded by the curves $y = 4x - x^2$ and $y = x^2 - x$ is divided by the x-axis into two parts which are in the ratio
(A) 30 : 1 (B) 121 : 4
(C) 31 : 1 (D) none of these

8. B

9. The differential equation of the family of curves $y = Ae^{3x} + Be^{5x}$, where A and B are arbitrary constants, is
(A) $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 15y = 0$ (B) $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$
(C) $\frac{d^2y}{dx^2} - \frac{dy}{dx} + y = 0$ (D) none of these

9. B

10. If $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$, then A^n is equal to $(n \in N)$
(A) $\begin{bmatrix} 1 & 2n \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 2 & n \\ 0 & 1 \end{bmatrix}$
(C) $\begin{bmatrix} 1 & 2n \\ 0 & -1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix}$

10. **A**

11. If AB = A and BA = B and I is a unit matrix then A^3 is equal to
(A) A (B) B
(C) I (D) none of these

11. **A**

12. The equation of the curve satisfying the differential equation $y(x + y^3)dx = x(y^3 - x)dy$ and passing through the point (4, 2) is
(A) $4x = 2y^3 + x^2y$ (B) $4x = 2y^3 - x^2y$
(C) $4x + 2y^3 = x^2y$ (D) $4x + 2y^3 + x^2y = 0$

12. C

13. The integral $\int_{-\frac{1}{2}}^{\frac{1}{2}}\left([x]+\ln\left(\frac{1+x}{1-x}\right)\right)dx$ equals where [.] denotes G.I.F.

(A) $-\frac{1}{2}$ (B) 0

(C) 1 (D) $2\ln\left(\frac{1}{2}\right)$

13. **A**

14. If α, β and γ are the roots of the equation $x^3+px+q=0$, then the determinant $\begin{vmatrix}\alpha & \beta & \gamma\\ \beta & \gamma & \alpha\\ \gamma & \alpha & \beta\end{vmatrix}$ is equal to

(A) p (B) q

(C) p^2-2q (D) none of these

14. **D**

15. If $f(x)=\begin{vmatrix}2\cos x & 1 & 0\\ 1 & 2\cos x & 1\\ 0 & 1 & 2\cos x\end{vmatrix}$, then $f'\left(\frac{\pi}{3}\right)=$

(A) $-\sqrt{3}$ (B) –4

(C) –3 (D) $-\sqrt{2}$

15. **A**

16. Let y = y(x) be the solution of the differential equation, $xy'-y=x^2(x\cos x+\sin x), x>0$. If $y(\pi)=\pi$, then $y''\left(\frac{\pi}{2}\right)+y\left(\frac{\pi}{2}\right)$ is equal to:

(A) $1+\frac{\pi}{2}+\frac{\pi^2}{4}$ (B) $2+\frac{\pi}{2}+\frac{\pi^2}{4}$

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

16. C

17. Value of $\int_0^2 x^2[x]dx$ is ([.] is GIF)

(A) 1 (B) $\frac{5}{3}$

(C) $\frac{7}{3}$ (D) $\frac{11}{3}$

17. **C**

18. The number of real values of x satisfying
$\begin{vmatrix} x & 3x+2 & 2x-1 \\ 2x-1 & 4x & 3x+1 \\ 7x-2 & 17x+6 & 12x-1 \end{vmatrix} = 0$ is
(A) 3 (B) 0
(C) More than three (D) 1

18. **C**

19. The solution of $\frac{dy}{dx} + \frac{y^2+y+1}{x^2+x+1} = 0$ is
(A) $\tan^{-1}(2x+1) + \tan^{-1}(2y+1) = c$ (B) $\tan^{-1}\frac{2x+1}{\sqrt{3}} + \tan^{-1}\frac{2y+1}{\sqrt{3}} = c$
(C) $\tan^{-1}\frac{2x}{\sqrt{3}} + \tan^{-1}\frac{2y}{\sqrt{3}} = c$ (D) $\tan^{-1}\frac{2x-1}{\sqrt{3}} + \tan^{-1}\frac{2y-1}{\sqrt{3}} = c$

19. **B**

20. The family of curves, in which the subtangent at any point to any curve is double the abscissa, is given by
(A) $x = cy^2$ (B) $y = -cx^2$
(C) $x^2 = cy^2$ (D) $y = cx$

20. **A**

(PART – B)

(NUMERICAL BASED)

Part-C (01-05) contains five (05) 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.**

21. A point *P* moves in the *xy*-plane in such a way that $[|x|] + [|y|] = 1$, where $[\cdot]$ denotes the greatest integer function. The area of the locus of point *P* is equal to

21. 8

22. If $A = \begin{bmatrix} 1 & -1 & 1 \\ 0 & 2 & -3 \\ 2 & 1 & 0 \end{bmatrix}$ and B = (adj A) and C = 5A, then $\frac{|\text{adj } B|}{|C|} =$

22. **1**

23. If the system of equations
$x - 2y + 3z = 9$
$2x + y + z = b$
$x - 7y + az = 24$,
has infinitely many solutions, then a – b is equal to _____.

23. 5

24. For any 2×2 matrix, if $A.(\text{adj}\,A) = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$. Then $|A|$, is

24. 10

25. The area of the region $\left[(x,y) : x^2 \le y \le |x|\right]$ is

25. 0.33