FIITJEE Phase Test (JEE-Advanced)

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-2 | **QP CODE:** | **PAPER - 1**

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.

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 Six (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** (**05–12)** contains (8) 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 (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)

SECTION – A

(Single Correct Answer Type)

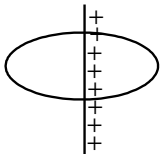
This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Magnetic flux linked with a stationary loop of resistance R varies with respect to time during the time period T has follows:
$\phi = aT\,(T - r)$
The amount of heat generated in the loop during that time.
(inductance of the coil is negligible) is

(A) $\frac{aT}{3R}$ (B) $\frac{a^2T^2}{3R}$ (C) $\frac{a^2T^2}{R}$ (D) $\frac{a^2T^3}{3R}$

1. **D**

2. A very long uniformly charged rod falls with a constant velocity V through the center of a circular loop. Then the magnitude of induced emf in loop is



(charge per unit length of rod = λ)

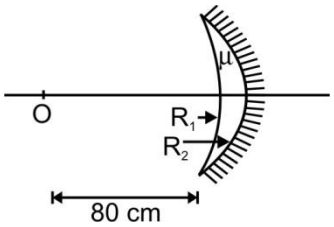
(A) $\frac{\mu_0}{2\pi}\lambda V^2$ (B) $\frac{\mu_0}{2}\lambda V^2$ (C) $\frac{\mu_0}{2\lambda}V$ (D) zero

2. **D**

3. In a Young's double–slit experiment, if the slits are of unequal width,
(A) fringes will not be formed
(B) the positions of minimum intensity will not be completely dark
(C) bright fringe will not be formed at the centre of the screen
(D) distance between two consecutive bright fringes will not be equal to the distance between two consecutive dark fringes

3. **B,**

4. If R_1 = 40 cm, R_2 = 80 cm and $\mu = 1.5$. If object is placed 80 cm from lens that is silvered back side ? then



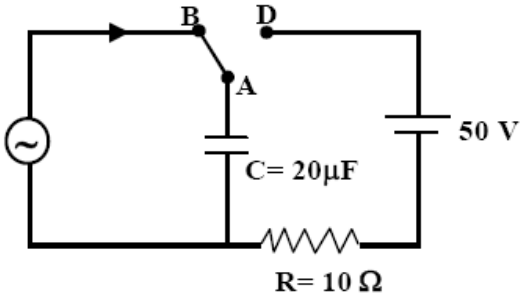
(a) size of image is finite (b) Image is at infinity
(c) Image is at 80 cm from lens (d) Image is at 120 cm from lens

4. **B,**

(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.**

5. At time t = 0, terminal A in the circuit shown in the figure is connected to B by a key and an alternating current $I(t) = I_0\cos(\omega t)$, with I_0 = 1A and ω = 500 rad/s starts flowing in it with the initial direction shown in the figure. At $t = \frac{7\pi}{6\omega}$, the key is switched from B to D. Now onwards only A and D are connected. A total charge Q flows from the battery to charge the capacitor fully. If C = 20 μF, R = 10 Ω and the battery is ideal with emf of 50 V, identify the correct statement(s).



(A) Magnitude of the maximum charge on the capacitor before $t = \frac{7\pi}{6\omega}$ is 1×10^{-3}C

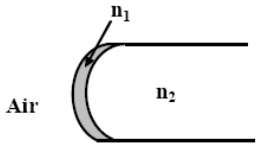
(B) The current in the left part of th circuit just before $t = \frac{7\pi}{6\omega}$ is clockwise

(C) Immediately after A is connected to D, the current in R is 10 A

(D) $Q = 2 \times 10^{-3}$C

5. **CD,**

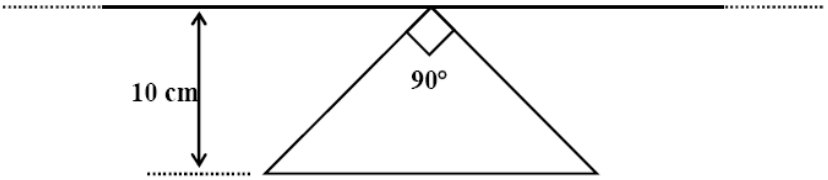
6. A transparent thin film of uniform thickness and refractive index n_1 = 1.4 is coated on the convex spherical surface of radius R at one end of a long solid glass cylinder of refractive index n_2 = 1.5, as shown in the figure. Rays of light parallel to the axis of the cylinder traversing through the film from air to glass get focused at distance f_1 from the film, while rays of light traversing from glass to air get focused at distance f_2 from the film. Then



(A) $|f_1| = 3R$ (B) $|f_1| = 2.8\ R$ (C) $|f_2| = 2R$ (D) $|f_2| = 1.4\ R$

6. **AC,**

7. A conducting loop in the shape of a right angled isosceles triangle of height 10 cm is kept such that the 90° vertex is very close to an infinitely long conducting wire (see the figure). The wire is electrically insulated from the loop. The hypotenuse of the triangle is parallel to the wire. The current in the triangular loop is in counterclockwise direction and increased at a constant rate of 10 A s^{-1}. Which of the following statement(s) is (are) true?



(A) The magnitude of induced emf in the wire is $\left(\frac{\mu_0}{\pi}\right)$ volt

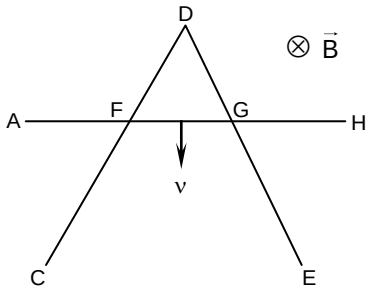
(B) If the loop is rotated at a constant angular speed about the wire, an additional emf of $\left(\frac{\mu_0}{\pi}\right)$ volt is induced in the wire

(C) The induced current in the wire is in opposite direction to the current along the hypotenuse

(D) There is a repulsive force between the wire and the loop

7. **AD,**

8. A long conducting wire AH is moved over a conducting triangular wire CDE with a constant velocity v in a uniform magnetic field $\vec{B}$ directed into the place of the paper. Resistance per unit length of each wire is r. Then



(A) A constant clockwise inducted current will flow in the closed loop
(B) An increasing anticlockwise induced current will flow in the closed loop
(C) A decreasing anticlockwise induced current will flow in the closed loop
(D) A constant anticlockwise induced current will flow in the closed loop

8. **D**

9. In which of the following case there will be induced emf
(A) A coil is placed in non-uniform magnetic field.
(B) A conducting rod is falling vertically pointing N-S direction.
(C) A satellite revolves around equator of earth.
(D) A conductor coil is placed in time varying magnetic field.

9. **D**

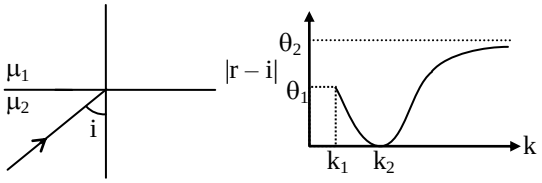
10. Polarized light
(A) is a different form of light
(B) can show interference pattern
(C) travels in any medium with a velocity slightly more than that for unpolarised light
(D) has direction of vibration restricted in some way

10. **BD,**

11. Which of the following is true for an ideal transformer
(A) Total magnetic flux linked with primary coil equals flux linked with secondary coil
(B) flux per turn in primary is equal to flux per turn in secondary
(C) induced emf in secondary coil equals induced emf in primary
(D) power associated with primary coil at any moment equals power associated with secondary coil

11. **BD,**

12. The figure shows a ray incident at an angle i = $\pi/3$. If the plot drawn the variation of | r – i | versus $\frac{\mu_1}{\mu_2}$ = k, (r = angle of refraction)



(A) the value of k_1 is $\frac{2}{\sqrt{3}}$
(B) the value of $\theta_1 = \pi/6$
(C) the value of $\theta_2 = \pi/3$
(D) the value of k_2 is 1

12. **BCD,**

(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. Two inductors L_1(inductance 1 mH, internal resistance 3Ω) and L_2(inductance 2 mH internal resistance 4Ω), and a resistor R (resistance 12Ω) are all connected in parallel across a 5V battery. The circuit is switched on at time t = 0. The ratio of the maximum to the minimum current (I_{max}/I_{min}) drawn from the battery is

1. **8,**

2. In an induction coil, the coefficient of mutual induction is 4 henry. If a current of 5 ampere in the primary coil is cut off in $\frac{1}{1500}$ s, the emf at the terminals of the secondary coil in kV is

2. **30**

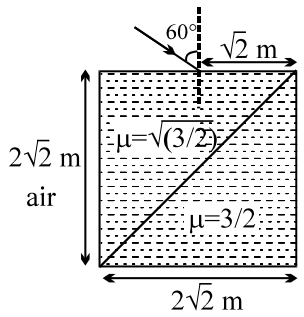
3. **In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4 A, then that in the secondary is –**

3. **2,**

4. The time taken to prepare a print by exposing a small sheet to a point light source of 60 W placed at a distance of 25 cm from the sheet is 5 s. If the distance is increased to 40 cm, the time taken to prepare a similar print will be

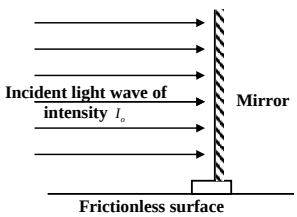
4. **12.8,**

5. A ray of light strikes a cubical slab as shown in the figure. Then the geometrical path length traversed by the light in the slab will be



5. **2,**

6. If a mirror with support of total mass 2 kg is kept on a frictionless surface and a light wave of intensity I_o is normally incident on it (as shown in figure) and the light is totally reflected back. If the mirror is accelerating with 1 m/s^2 and I_o is $x\times10^8\ W/m^2$. Find the value of *x*. (Surface area of mirror is $1.5m^2$ and the area of support is negligible, speed of light wave is $3\times10^8 m/s$).



6. **2,**

SECTION – II : CHEMISTRY

(PART – A)

SECTION – 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. Mixture of volatile components A and B has total vapour pressure (in torr): $p = 254 - 135\ x_A$, where x_A is the mole fraction of A in mixture hence p_A^o and p_B^o respectively are (in torr)
(A) 254, 119 (B) 119, 254
(C) 135, 254 (D) 154, 119

1. B

2. Which of the following complex ion has magnetic moment same as $\left[Cr\left(H_2O\right)_6\right]^{3+}$?
(A) $\left[Mn\left(H_2O\right)_6\right]^{4+}$ (B) $\left[Mn\left(H_2O\right)_6\right]^{3+}$
(C) $\left[Fe\left(H_2O\right)_6\right]^{3+}$ (D) $\left[Cu\left(H_3N\right)_4\right]^{2+}$

2. A

3. A gas 'X' is passed through water to form a saturated solution. The aqueous solution on treatment with the $AgNO_3$ gives a white precipitate. The saturated aqueous solution also dissolves magnesium ribbon with evolution of a colourless gas 'Y'. Identify 'X' and 'Y'
(A) X = CO_2, Y = Cl_2 (B) X = Cl_2, Y = CO_2
(C) X = Cl_2, Y = H_2 (D) X = H_2, Y = Cl_2

3. C

4. The two compounds $[Cr(NH_3)_5Br]Cl$ and $[Cr(NH_3)_5Cl]Br$ can be distinguished by reagent A and the two compounds exhibit isomerism (B). Then (A) and (B) are
(A) $AgNO_3$, ionisation (B) $AgNO_3$, coordination
(C) $BaCl_2$, ionisation (D) $BaCl_2$, coordination

4. 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.**

5. Which of the following can show coordination isomerism?
(A) $[Cu(NH_3)_4][PtCl_4]$ (B) $[Fe(NH_3)_6]_2[Pt(CN)_6]_3$
(C) $[Co(NH_3)_6][Cr(C_2O_4)_3]$ (D) $[Pt(en)_3](SO_4)_2$

5. AC

6. Which of the following substance(s) is/are dissolved in aqueous NH_3 solution?
(A) $Zn(OH)_2$ (B) $Al(OH)_3$
(C) AgCl (D) $Cu(OH)_2$

6. ACD

7. Which of the following statements is / are correct when a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with conc. H_2SO_4?
(A) A deep red vapour is evolved
(B) The red vapour when passed into NaOH solution gives a yellow solution of Na_2CrO_4
(C) Oxygen gas is evolved
(D) Chromyl chloride is formed

7. ABD

8. Which statement(s) is/are correct ?
(A) $[Ag(NH_3)_2]^+$ is linear with sp hybridisation of Ag+ ion.
(B) $NiCl_4^{2-}$, VO_4^{3-}, MnO_4^- have tetrahedral geometry.
(C) $\left[Cu(NH_3)_4\right]^{2+}$, $[Pt(NH_3)_4]^{2+}$, $[Ni(CN)_4]^{2-}$ have dsp^2 hybridisation of the metal ion.
(D) $Fe(CO)_5$ have bipyramidal structure with dsp^3 hybridisation of iron.

8. ABCD

9. Which among the following are diamagnetic?
(A) $[Fe(CN)_6]^{3-}$ (B) $[Fe(CN)_6]^{4-}$
(C) $[Ni(CN)_4]^{2-}$ (D) $[Ni(CO)_4$

9. BCD

10. Which of the following will give blue solution?
(A) Addition of $K_4[Fe(CN)_6]$ solution into $FeCl_3$ solution
(B) Addition of $CuSO_4$ in water
(C) Addition of aq. NH_3 into $Cu(NO_3)_2$ solution
(D) A solution containing Fe^{2+} ion with $K_3[Fe(CN)_6]$ solution

10. ABCD

11. Λ_m^∞ and Λ_{eq}^∞ are molar and equivalent conductivities at infinite dilution; λ is ionic conductivity at infinite dilution, then for potash alum:
(A) Λ_m^∞ (potash alum) = $2\times\lambda_{K^+}^\infty + 2\times\lambda_{Al^{3+}}^\infty + 4\times\lambda_{SO_4^{2-}}^\infty$
(B) Λ_{eq}^∞ (potash alum) = $\frac{1}{8}\times\Lambda_M^\infty$(potash alum)
(C) Λ_{eq}^∞ (potash alum) = $\frac{1}{4}\times\lambda_{K^+}^\infty + \frac{1}{4}\times\lambda_{Al^{3+}}^\infty + \frac{1}{2}\times\lambda_{SO_4^{2-}}^\infty$
(D) Λ_m^∞ (potash alum) = $\lambda_{K^+}^\infty + \lambda_{Al^{3+}}^\infty + \lambda_{SO_4^{2-}}^\infty$

11. ABC

12. In electrolysis of very dilute NaOH solution using platinum electrodes
(A) H_2 is evolved at cathode (B) H_2 is evolved at anode
(C) Na is obtained at cathode (D) O_2 is produced at anode

12. AD

(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. Four moles of glucose was added to 500 gram water at 1 atm. What will be the boiling point of water in the solution in degree celsius unit?
[K_b of water = 0.52 K Kg mol^{-1}]

1. 104.16

2. $Cr_2(SO_4)_3 \xrightarrow{NaOH} (P) \xrightarrow{H_2O_2} \underset{\text{Yellow solution}}{(Q)}$
If the oxidation number of chromium in Q is +x, x is

2. 6

3. What is the sum of the number of fluorine and iodine atoms present in the largest compound formed by them?

3. 8

4. The mole ratio of the two gases NO_2 and O_2 obtained on heating two moles of copper nitrate is x : y. The value of (x + y) is
4. 5

5. The mass of glucose (in gm) that should be dissolved in 50 g of water in order to produce the same lowering of vapour pressure as produced by dissolving 1 g of urea in the same quantity of water is
5. 3

6. How many electron(s) is/are present in the 3d orbitals of nickel in $[Ni(CO)_4]$?
6. 10

SECTION – III : MATHEMATICS

(PART – A)

SECTION – 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. The solution of $\left(x^4 - x\right)y' + \left(2x^3 + 1\right)y = 0$ is

   (A) $\left(x^2 + \frac{1}{x}\right) = \frac{c}{y}$ (B) $\left(x^2 - \frac{1}{x}\right) = \frac{c}{y}$

   (C) $\left(x^3 + \frac{1}{x}\right) = \frac{c}{y}$ (D) $\left(x + \frac{1}{x}\right) = \frac{c}{y}$

1. B

2. Let $f(x) = \begin{vmatrix} x^3 & \sin x & \cos x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$, where p is a constant. Then $\frac{d^3}{dx^3} f(x)$ at $x = 0$ is

   (A) p (B) $p + p^2$

   (C) $p + p^3$ (D) independent of p

2. D

3. Let $P = \left[a_{ij}\right]$ be a 3×3 matrix and let $Q = \left[b_{ij}\right]$, where $b_{ij} = 2^{i+j} a_{ij}$ for $1 \le i, j \le 3$. If the determinant of P is 2 then the determinant of the matrix Q is

   (A) 2^{10} (B) 2^{11}

   (C) 2^{12} (D) 2^{13}

3. D

4. Let M and N be two 3×3 non-singular skew symmetric matrices such that $MN = NM$. If P^T denotes the transpose of P, then $M^2N^2\left(M^TN\right)^{-1}\left(MN^{-1}\right)^T$ is equal to

   (A) M^2 (B) $-N^2$

   (C) $-M^2$ (D) none of these

4. D

(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.**

5. Let $f'(x) = f(x) + \int_{-10}^{10} f(x)\,dx$ then which of the following is are correct?

   (A) If $\lim_{x \to -\infty} f(x) = 0$

   (B) $f'(x) - f(x) = c$ (where c is a constant)

   (C) $f''(x) - f(x) = c$ (where c is a constant)

   (D) If $f(1) = 0$, then $f(x) = 0 \; \forall \, x \in R$

5. BCD

6. Value of θ lying between $\theta = 0$ and $\theta = \frac{\pi}{2}$ and satisfying $\begin{vmatrix} 1+\sin^2\theta & \cos^2\theta & 4\sin 4\theta \\ \sin^2\theta & 1+\cos^2\theta & 4\sin 4\theta \\ \sin^2\theta & \cos^2\theta & 1+4\sin 4\theta \end{vmatrix} = 0$ are

(A) $\frac{7\pi}{24}$ (B) $\frac{5\pi}{24}$

(C) $\frac{11\pi}{24}$ (D) $\frac{\pi}{24}$

6. AC

7. If the adjoint of a 3×3 matrix P is $\begin{bmatrix} 1 & 4 & 4 \\ 2 & 1 & 7 \\ 1 & 1 & 3 \end{bmatrix}$, then the possible value (s) of the determinant of P is (are)

(A) -2 (B) -1

(C) 1 (D) 2

7. **AD**

8. If A and B are two invertible matrices of the same order ; then adj(AB) is

(A) $|A|\,|B|\,(AB)^{-1}$ (B) $|B|\,|A|\,A^{-1}\,B^{-1}$

(C) $|B|\,|A|\,B^{-1}\,A^{-1}$ (D) (adj B) (adj A)

8. ACD

9. If f(x) and g(x) are functions such that f(x + y) = f(x), g(y) + g(x). f(y), then $\begin{vmatrix} f(\alpha) & g(\alpha) & f(\alpha+\theta) \\ f(\beta) & g(\beta) & f(\beta+\theta) \\ f(\gamma) & g(\gamma) & f(\gamma+\theta) \end{vmatrix}$ is independent of

(A) α (B) β

(C) γ (D) θ

9. ABCD

10. The differential equation representing the family of curves $y^2 = 2c\,(x + \sqrt{c}\,)$, where c is a positive parameter, is of

(A) order 1, (B) order 2

(C) degree 2 (D) degree 3

10. AD

11. The area enclosed between the curves $x^2 = y$ and $y^2 = x$ is given by

(A) area of region $\{(x,y) : x^2 \le y \le |x|\}$ (B) $\frac{1}{3}$

(C) $2\int_0^1 (x - x^2)\,dx$ (D) None of these

11. A,B,C

12. Let $A=\begin{bmatrix}0 & i\\ i & 0\end{bmatrix}$ where i = iota then

(A) $I+A+A^2+A^3+.....+A^{2012}=I$ (B) $I+A+A^2+A^3+.....+A^{2012}=A$

(C) $A^{4n+1}=A$ (D) $A^{4n+2}=-I$

12. ACD

(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.**

13. If $A=\begin{bmatrix}0 & 2b & c\\ a & b & -c\\ a & -b & c\end{bmatrix}$ is orthogonal then find 6.$|abc|$

13. 1

14. Let $f(x)=x^2+ax+b,\left(a^2<4b\right)$ area bounded by $y=f(x)$, x-axis and lines x = 0 to x = 1 is $\frac{1}{4k}\left(5f(1)-f(-1)+8f(0)\right)$sq.units then value of k is

14. 3

15. Area bounded by the curves $y=\left[\frac{x^2}{64}+2\right]$(where [.] denotes the greatest integer function), y=x-1 and x=0 above the x-axis is

15. 4 sq. Units

16. The area bounded by the curve f(x)=x+ sinx and its inverse between the ordinates x=0 to $x=2\pi$ is

16. 8

17. Let A is 3×3 skew symmetric matrix whose entries are either –1, 0, 1. If there are exactly three zeros, three one's and three (–1)'s then number of such matrices are

17. 8

18. Area enclosed between $y=\ln(x+e)$ and $x=\ln\left(\frac{1}{y}\right)$ and x – axis is --- ---

18. 2