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.

BATCH –NWCM822O1S_PT5

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 :_____

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. An accdident in nuclear laboratory resulted in deposition of a certain amount of radioactive material of half-life 18 days inside the laboratory. Tests revealted that the radiation was 64 times more than the permissible level required for safe operation of the laboratory. What is the minimum number of days after which the laboratory can be considered safe for use?
(A) 64 (B) 90 (C) 108 (D) 120

1. C

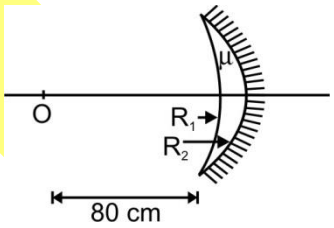
2. What is the essential distinction between X-rays and γ-rays
(A) γ-rays have shorter wavelength than X-rays
(B) γ-rays are extraterrestrial, X-rays are man-made
(C) γ-rays have less penetrating power than X-rays
(D) γ-rays originate from within an atomic nucleus, X-rays from outside an atomic nucleus.`

2. A

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



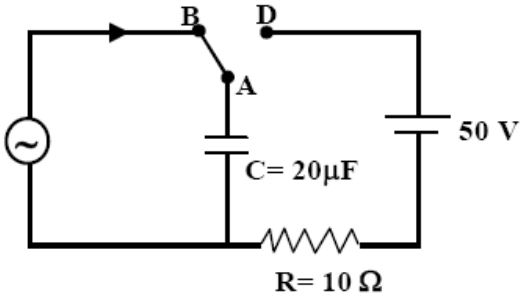
(a) size of image is finite (b) Image is at infinity
(c) Image is at 80 cm from lens (d) Image is at 120 cm from lens

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

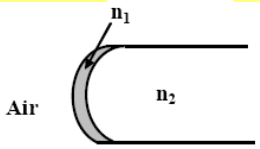
(B) The current in the left part of th circuit just before t = $\frac{7\pi}{6\omega}$ is clockwise

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

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

5. CD

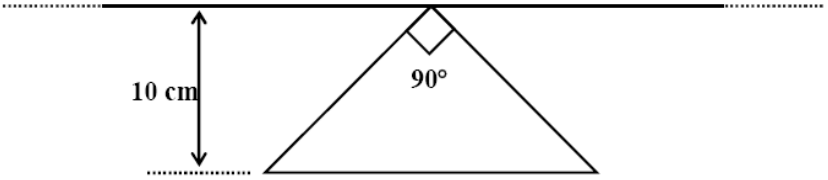
6. A transparent thin film of uniform thickness and refractive index n_1 = 1.4 is coated on the convex spherical surface of radius R at one end of a long solid glass cylinder of refractive index n_2 = 1.5, as shown in the figure. Rays of light parallel to the axis of the cylinder traversing through the 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. In a radioactive decay chain, $^{232}_{90}Th$ nucleus decays to $^{212}_{82}Pb$ nucleus. Let N_α and N_β be the number of α and β^- particles, respectively, emitted in this decay process. Which of the following statements is (are) true?

(A) $N_\alpha = 5$ (B) $N_\alpha = 6$ (C) $N_\beta = 2$ (D) $N_\beta = 4$

8. **AC**

9. In β-decay, the Q-value of the process is E. Then
(A) K.E. of a β-particle cannot exceed E.
(B) K.E. of anti neutrino emitted lies between Zero and E.
(C) N/Z ratio of the nucleus is altered.
(D) Mass number (A) of the nucleus is altered.

9. **ABC**

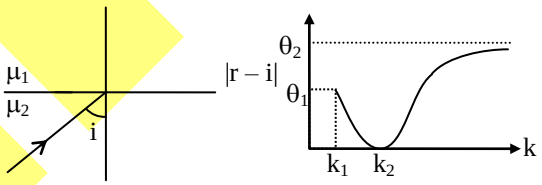
10. Polarized light
(A) is a different form of light
(B) can show interference pattern
(C) travels in any medium with a velocity slightly more than that for unpolarised light
(D) has direction of vibration restricted in some way

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. A hydrogen atom at rest is in ground state. It is struck by a He^+ ion in first excited state. Assuming the collision to be head on and the mass of He^+ to be four times that of hydrogen atom, find the least value of kinetic energy (in eV) of incoming particle which can excite both the particles to second excited state.

2. 98.25,

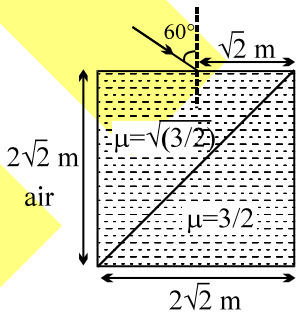
3. In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4 A, then that in the secondary is –

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

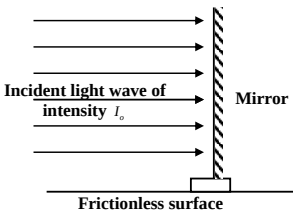
4. 12.8,

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 are (in torr)
(A) 254, 119 (B) 119, 254
(C) 135, 254 (D) 154, 119

1	B

2. For the electrochemical cell $M|M^+||X^-|X$ $E^o_{M^+|M} = 0.34$ V and $E^o_{x|x^-} = 0.22$ V. From this data, we can deduce that
(A) E_{cell} = 0.56 V (B) $E^o_{cell} = 0.12$ V
(C) $M^+ + X^- \rightarrow M + X$ is spontaneous (D) $M + X^- \rightarrow M^+ + X$ is spontaneous

2	C

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. $PH_3 + O_2 \longrightarrow (X)$
$\xrightarrow[\text{No air}]{\text{High Temperature}} (Y) + (Z)$
In the above reaction the product(s) are
(A) P_4O_6, white P_4, H_2 (B) H_3PO_4, red 'P', H_2
(C) P_4O_{10}, red 'P', H_2 (D) H_3PO_3, white P_4, H_2

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. The hcp and ccp structure for a given element would be expected to have
(A) same coordination number (B) same packing fraction
(C) same density (D) same edge length

5	AB

6. $X_2(s,\ell,g) + H_2O \underset{}{\overset{K_1}{\rightleftharpoons}} X_2(aq)$

$X_2(aq) \underset{}{\overset{K_2}{\rightleftharpoons}} H^+(aq) + X^-(aq) + HOX(aq)$

Choose the correct statement(s)

(A) K_1 is highest for Cl_2 (B) K_2 is highest for Br_2

(C) K_1 is highest for Br_2 (D) K_2 is highest for Cl_2

6	CD

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) Chlorine gas is evolved

(D) Chromyl chloride is formed

7	ABCD

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. Consider same concentration of two solutions of solutes X and Y. X behaves as univalent electrolyte while Y dimerises in solution. The correct statement(s) regarding the two solutions is/are

(A) boiling point of solution of X will be higher than that of Y

(B) the osmotic pressure of X will be higher than Y

(C) the freezing point of Y is higher than X

(D) the relative lowering of vapour pressure of the solutions will be same.

9	ABC

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. Δ_m^∞ and $\Delta_{eq.}^\infty$ are molar and equivalent conductivities at infinite dilution; λ is ionic conductivity at infinite dilution, then for potash alum:

(A) Δ_M^∞(potash alum) = $2\times\lambda_{K^+}^\infty + 2\times\lambda_{Al^{3+}}^\infty + 4\times\lambda_{SO_4^{2-}}^\infty$

(B) $\Delta_{eq.}^\infty$ (potash alum) = $\frac{1}{8}\times\Delta_M^\infty$(potash alum)

(C) $\Delta_{eq.}^\infty$ (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) Δ_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. The earliest source of nitrogen was $NaNO_3$. It was heated to produce a solid substance(X). (X) reacts with an ammonium salt(Y) to produce (Z). (Z) is decomposed to produce N_2 gas and H_2O. What is the molar mass of (Z) in g mol^{-1} unit?

1	64

2. The conductivity of a saturated solution of a sparingly soluble salt MX_2 is found to be $4 \times 10^{-5}\ \Omega^{-1}cm^{-1}$. If $\lambda_m^{\infty}\left(M^{2+}\right) = 100\ \Omega^{-1}cm^2mol^{-1}$ and $\lambda_m^{\infty}\left(X^{-}\right) = 50\ \Omega^{-1}cm^2mol^{-1}$, the solubility of the salt is $x \times 10^{-4}$ M, where value of x is

2	2

3. How many sulphide ion(s) is/are present in the unit cell of ZnS?

3	4

4. $4ClF_3 + 3N_2H_4 \longrightarrow$ Products
How many total number of moles of product(s) is/are formed in above reaction?

4	17

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 covalent bonds are present in nitrosyl azide?

6	7

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 smaller area included between the curves $\sqrt{x}+\sqrt{|y|}=1$ and $|x|+|y|=1$ is

(A) $\frac{1}{3}$ (B) $\frac{4}{3}$ (C) $\frac{2}{3}$ (D) $\frac{5}{3}$

1. C,

2. Which of the following transformation reduce the differential equation $\frac{dz}{dx}+\frac{z}{x}\log z = z(\log z)^2 f(x)$ into the form $\frac{du}{dx}+P(x)u=Q(x)$

(A) $u=\log z$ (B) $u=e^z$ (C) $u=(\log z)^{-1}$ (D) $u=(\log z)^2$

2. C,

3. A pair of unbiased dice is rolled together till a sum of either 5 or 7 is obtained. The probability that 5 comes before 7 is

(A) $\frac{2}{5}$ (B) $\frac{3}{5}$ (C) $\frac{4}{5}$ (D) none of these

3. A,

4. The distance of point B with position vector $\hat{i}+2\hat{j}+3\hat{k}$ from the line passing through the point A with position vector $4\hat{i}+2\hat{j}+2\hat{k}$ and parallel to the vector $2\hat{i}+3\hat{j}+6\hat{k}$ is

(A) $\sqrt{10}$ (B) $\sqrt{5}$ (C) $\sqrt{6}$ (D) $\sqrt{8}$

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. If l,m,n are the direction cosines of the line of shortest distance between the lines $\frac{x-3}{2}=\frac{y+15}{-7}=\frac{z-9}{5}$ and $\frac{x+1}{2}=\frac{y-1}{1}=\frac{z-9}{-3}$ then

(A) $3l-15m+n=0$ (B) $2l-7m+5n=0$ (C) $l=m=n=\frac{1}{\sqrt{3}}$ (D) $2l+m-3n=0$

5. BCD,

6. A bag contains b blue balls and r red balls. If two balls are drawn at random, the probability of drawing two red balls is five times the probability of drawing two blue balls. Furthermore, the probability of drawing one ball of each colour is six times the probability of drawing two blue balls then

(A) $b+r=9$ (B) $br=18$ (C) $|b-r|=4$ (D) $\frac{b}{r}=2$

6. AB,

7. Vector $\vec{A}$ and $\vec{B}$ satisfying the vector equation $\vec{A}+\vec{B}=\bar{a}$ and $\vec{A}\times\vec{B}=\bar{b}$ and $\bar{A}.\bar{a}=1$, where $\bar{a}$ and $\bar{b}$ are given vectors, are

(A) $\vec{A}=\dfrac{(\bar{a}\times\bar{b})-\bar{a}}{a^2}$ (B) $\vec{B}=\dfrac{(\bar{b}\times\bar{a})+(a^2-1)\bar{a}}{a^2}$

(C) $\vec{A}=\dfrac{(\bar{a}\times\bar{b})+\bar{a}}{a^2}$ (D) $\vec{B}=\dfrac{(\bar{b}\times\bar{a})-(a^2-1)\bar{a}}{a^2}$

7. CA:BC,

8. If maximum and minimum values of the determinant $\begin{vmatrix}1+\sin^2 x & \cos^2 x & \sin 2x\\ \sin^2 x & 1+\cos^2 x & \sin 2x\\ \sin^2 x & \cos^2 x & 1+\sin 2x\end{vmatrix}$ are α and β, then

(A) $\alpha+\beta^{99}=4$

(B) $\alpha^3-\beta^{17}=26$

(C) $(\alpha^{2n}-\beta^{2n})$ is always an even integer for $n\in N$

(D) A triangle can be constructed having its sides as $\alpha-\beta,\alpha+\beta,\alpha+3\beta$

8. ABC,

9. If the planes $bx-ay=n, cy-bz=l$ and $az-cx=m$ intersect in a line, then $al+bm+cn$ is equal to

(A) -1 (B) 0 (C) 1 (D) none of these

9. B,

10. Let $f_k(x)=\int_0^x(a_kt^2+b_kt+c_k)dt$ for $1\le k\le 3$ and $F(x)=\begin{vmatrix}f_1'(x) & f_2'(x) & f_3'(x)\\ f_1''(x) & f_2''(x) & f_3''(x)\\ f_1'''(x) & f_2'''(x) & f_3'''(x)\end{vmatrix}$

The curve $y=f(x)$ is (where $f(x)=F'(x)$)

(A) a straight line (B) a parabola (C) an ellipse (D) a hyperbola

11. A,

11. The solution of the differential equation $\dfrac{dy}{dx}=\dfrac{e^x}{2}\cdot\dfrac{e^{y^2/x}}{y}-\dfrac{1}{2}\left\{\dfrac{x}{y}-\dfrac{y}{x}\right\}$ can be

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

(C) $e^{\left[-e^{\left(\frac{x^2+y^2}{x}\right)}\right]+\frac{1}{2}}=x$ (D) $e^{\left[-e^{\frac{x^2+y^2}{2}}\right]-e^{-2}}=x$

11. AB,

12. The value of $\int_{\frac{1}{e}}^{\tan x}\dfrac{tdt}{1+t^2}+\int_{\frac{1}{e}}^{\cot x}\dfrac{dt}{t(1+t^2)}$ is

(A) $\dfrac{1}{2+\tan^2 x}$ (B) 1

(C) $\dfrac{\pi}{4}$ (D) $\dfrac{2}{\pi}\int_{-1}^{1}\dfrac{dt}{1+t^2}$

12. BD,

(PART – B)

(NUMERICAL BASED)

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. ABCDEF is a regular hexagon. If $|\overrightarrow{AB}|=4$ units then find $\frac{1}{2}|\overrightarrow{AD}+\overrightarrow{EB}+\overrightarrow{FC}|$.

1. 8,

2. Let a three – dimensional vector $\vec{V}$ satisfies the condition, $2\vec{V}+\vec{V}\times(\hat{i}+2\hat{j})=2\hat{i}+\hat{k}$. If $3|\vec{V}|=\sqrt{m}$, then find the value of m.

2. 6,

3. If the length of the projection of the line segment with points $(1,0,-1)$ and $(-1,2,2)$ to the plane $x+3y-5z=6$ is d, then find the value of $[d/2]$ where [.] represents greatest integral part.

3. 1,

4. If the curve satisfying $yy_1\sin x=\cos x(\sin x-y^2)$ passes through $\left(\frac{\pi}{2},2\right)$ then find the value of $\frac{9}{41}\left(y\left(\frac{\pi}{6}\right)\right)^2$.

4. 3,

5. If the dependent variable y is changed to 'z' by the substitution $y=\tan z$ and the differential equation $\frac{d^2y}{dx^2}=1+\frac{2(1+y)}{1+y^2}\left(\frac{dy}{dx}\right)^2$ is changed to $\frac{d^2z}{dx^2}=\cos^2 z+k\left(\frac{dz}{dx}\right)^2$, then find the value of k.

5. 2,

6. If $|a_2-a_3|=6$, then find the minimum value of $f(x)=\begin{vmatrix}1 & a_3 & a_2\\ 1 & a_3 & 2a_2-x\\ 1 & 2a_3-x & a_2\end{vmatrix}$.

6. 9,

FIITJEE COMMON TEST

BATCHES: Two Year CRP (1921) AB-LOT

PHASE TEST–5: PAPER-1

JEE ADVANCED LEVEL

ANSWER KEY

Paper Code
SET–A

ANSWER KEYS [SET – A]

	PHYSICS	C.CODE		CHEMISTRY	C.CODE		MATHEMATICS	C.CODE
1	C		1			1	C	
2	A		2			2	C	
3	B		3			3	A	
4	B		4			4	A	
5	CD		5			5	BCD	
6	AC		6			6	AB	
7	AD		7			7	BC	
8	AC		8			8	ABC	
9	ABC		9			9	B	
10	BD		10			10	A	
11	BD		11			11	AB	
12	BCD		12			12	BD	
	PART – B			PART – B			PART - B	
1	8		1			1	8	
2	98.25		2			2	6	
3	2		3			3	1	
4	12.8		4			4	3	
5	2		5			5	2	
6	2		6			6	9	

HINT OR SOLUTIONS
PHYSCIS
Part – A

1. C

Required activity = $\frac{\text{Initial activity}}{64} = \frac{\text{Initial activity}}{2^6}$

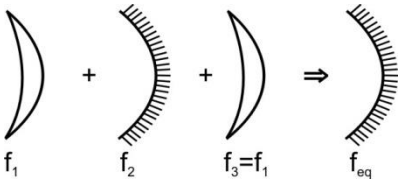
Time required = 6 half lives

= 6 × 18 days

= 108 days

2. A

4. B



Where $\frac{1}{f_1} = (1.5-1)\left(-\frac{1}{40}+\frac{1}{80}\right)$

$f_1 = -160\text{cm}$

$\frac{1}{f_{eq}} = \frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}$

$\frac{1}{f_{eq}} = -\frac{1}{160}+\frac{1}{40}-\frac{1}{160}$

$\therefore \frac{1}{f_{eq}} = \frac{1}{80}$

On solving by mirror equation

$\frac{1}{f_{eq}} = \frac{1}{v}+\frac{1}{u}$

$\frac{1}{-80} = \frac{1}{-80}+\frac{1}{v}$

$v = \infty$

5. CD

As current leads voltage by $\pi/2$ in the given circuit initially, then ac voltage can be represent as

$V = V_0 \sin \omega t$

$\therefore \quad q = CV_0 \sin \omega t = Q \sin \omega t$

where, $Q = 2 \times 10^{-3}$ C

- At $t = 7\pi/6\omega$; $I = -\frac{\sqrt{3}}{2} I_0$ and hence current is anticlockwise.
- Current 'i' immediately after $t = \frac{7\pi}{6\omega}$ is

$i = \frac{V_c + 50}{R} = 10$ A

- Charge flow $= Q_{final} - Q_{(7\pi/6\omega)} = 2 \times 10^{-6}$C

Hence C & D are correct options.

6. AC

For air to glass

$\frac{1.5}{f_1} = \frac{1.4-1}{R}+\frac{1.5-1.4}{R}$

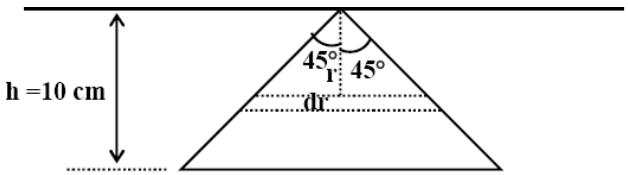
$\therefore \quad f_1 = 3R$

For glass to air.

$$\frac{1}{f_2} = \frac{1.4-1.5}{-R} + \frac{1-1.4}{-R}$$

$\therefore f_2 = 2R$

7. AD



$$\phi_{\ell w} = \int_0^h \frac{\mu_0 I}{2\pi r} 2r dr = \frac{\mu_0 I h}{\pi}$$

So, Mutual inductance $M_{\ell w} = \frac{\mu_0 h}{\pi}$

$$\therefore \varepsilon_w = \frac{\mu_0 h}{\pi}\frac{di}{dt} = \frac{\mu_0}{\pi}$$

Due to rotation there is no change in flux through the wire, so there is no extra induced emf in the wire. From Lenz's Law, current in the wire is rightward so repulsive force acts between the wire and loop.

8. AC

$$^{232}_{90}Th \longrightarrow ^{212}_{82}Pb + N_\alpha\alpha + N_\beta\beta$$

No. of $\alpha = \frac{232-212}{4} = 5$

No. of $\beta^- = 2$(from conservation of charge)

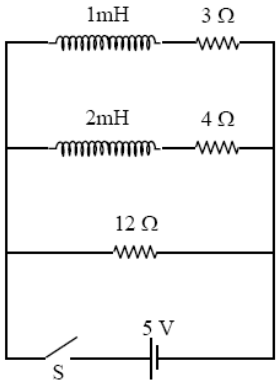
(PART – B)

1. 8

At t = 0, current will flow only in 12 Ω resistance

$$\therefore \quad I_{min} = \frac{5}{12}$$

At $t \to \infty$ both L_1 and L_2 behave as conducting wires



$$\therefore \quad R_{eff} = \frac{3}{2}$$

$$I_{max} = \frac{10}{3}$$

$$\frac{I_{max}}{I_{min}} = 8$$

2. 98.25 eV
3. 2
4. 12.8 s
5. 2

MATHEMATICS

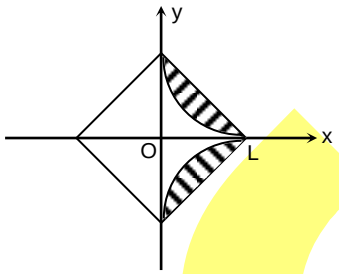
1. required area

$= 2\int_0^1 (1-x)-(1+x-2\sqrt{x})dx$

$= 4\int_0^1 (\sqrt{x}-x)dx = 4\left(\frac{2}{3}x^{3/2}-\frac{x^2}{2}\right)\Big|_0^1 = 4\left(\frac{2}{3}-\frac{1}{2}\right)$

$= \frac{4}{6}(4-3)$

$= \frac{4}{6} = \frac{2}{3}$



2. $\frac{dz}{dx}+\frac{z}{x}\log z = z(\log z)^2 f(x)$

$\Rightarrow \quad \frac{1}{z(\log z)^2}\frac{dz}{dx}+\frac{1}{\log z}.\frac{1}{x} = f(x)$

if $\frac{1}{\log z} = u \quad \Rightarrow \quad -\frac{1}{(\log z)^2}.\frac{1}{z}\frac{dz}{dx} = \frac{du}{dx}$

$\Rightarrow \quad \frac{1}{z(\log z)^2}.\frac{dz}{dx} = -\frac{du}{dx}$

$\Rightarrow \quad -\frac{du}{dx}+\frac{1}{x}u = f(x)$

$\Rightarrow \quad \frac{du}{dx}+\left(-\frac{1}{x}\right)u = -f(x)$

$\Rightarrow$ required transformation is $u = \frac{1}{\log z}$

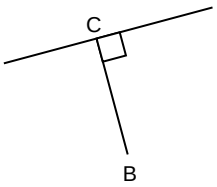
4. If $\bar{r} = 4\hat{i}+2\hat{j}+2\hat{k}+\lambda(2\hat{i}+3\hat{j}+6\hat{k})$

point C can be taken as

$\bar{r} = (2\lambda+4)\hat{i}+(3\lambda+2)\hat{j}+(6\lambda+2)\hat{k}$

$\{[(2\lambda+4)\hat{i}+(3\lambda+2)\hat{j}+(6\lambda+2)\hat{k})]-(\hat{i}+2\hat{j}+3\hat{k})\}\cdot(2\hat{i}+3\hat{j}+6\hat{k})$

$(2\lambda+3)\cdot 2+3\lambda\cdot 3+(6\lambda-1)\cdot 6 = 0 \Rightarrow \quad \lambda = 0$



More than one Correct Type

5. Line of shortest distance is parallel to vector

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -7 & 5 \\ 2 & 1 & -3 \end{vmatrix} = 16\hat{i}+16\hat{j}+16\hat{k}$

$\Rightarrow \quad l = m = n = \frac{1}{\sqrt{3}}$

$2l-7m+5n = 0$

$2l+m-3n = 0$

7. $\vec{A}+\vec{B} = \bar{a}$, $\vec{A}\times\vec{B} = \bar{b}$ and $\bar{A}.\bar{a} = 1$

$\bar{A}.\bar{a}+\bar{B}.\bar{a} = a^2 \quad ..(1)$

$\bar{a}\times(\vec{A}\times\vec{B}) = \bar{a}\times\vec{b}$

$(\bar{a}.\bar{B})\bar{A}-(\bar{a}.\bar{A})\bar{B} = \bar{a}\times\vec{b}$

$(a^2-\bar{A}.\bar{a})\bar{A}-(\bar{a}.\bar{A})(\bar{a}-\bar{A}) = \bar{a}\times\bar{b}$

from (1)

$\Rightarrow \quad (a^2-1)\bar{A}-\bar{a}+\bar{A}=\bar{a}\times\bar{b}$

$\Rightarrow \quad a^2\bar{A}-\bar{a}=\bar{a}\times\bar{b} \quad \Rightarrow \quad \bar{A}=\dfrac{\bar{a}\times\bar{b}+\bar{a}}{a^2}$

$$\vec{B}=\bar{a}-\frac{\bar{a}\times\bar{b}+\bar{a}}{a^2}=\frac{(a^2-1)\bar{a}-\bar{a}\times\bar{b}}{a^2}$$

$$=\frac{\bar{b}\times\bar{a}+(a^2-1)\bar{a}}{a^2}$$

8. $$\begin{vmatrix}1+\sin^2 x & \cos^2 x & \sin 2x\\ \sin^2 x & 1+\cos^2 x & \sin 2x\\ \sin^2 x & \cos^2 x & 1+\sin 2x\end{vmatrix}_{C_1\longrightarrow C_1+C_2}$$

$$=\begin{vmatrix}2 & \cos^2 x & \sin 2x\\ 2 & 1+\cos^2 x & \sin 2x\\ 1 & \cos^2 x & 1+\sin 2x\end{vmatrix}$$

$$=2(1+\sin 2x+\cos^2 x+\cos^2 x\sin 2x-\cos^2 x\sin 2x)-2(\cos^2 x+\cos^2 x\sin 2x-\cos^2 x.\sin 2x)$$

$$+1(\cos^2 x.\sin 2x-\sin 2x-\sin 2x\cos^2 x)$$

$$=2+2\sin 2x+2\cos^2 x-2\cos^2 x-\sin 2x$$

$$=\sin 2x+2$$

$1\le \sin x+2\le 3 \qquad \alpha=3,\beta=1$

$\alpha+\beta^{99}=3+1=4,\alpha^3-\beta^{17}=27-1=26$

$\alpha^{2n}-\beta^{2n}=9^n-1=8(9^{n-1}+9^{n-2}.....1)$ = even integer.

9. Any plane passing through $bx-ay=n, cy-bz=l$ is $(bx-ay-n)+\lambda(cy-bz-l)=0$

$$bx+(\lambda c-a)y-b\lambda z-(\lambda l+n)=0 \quad \ldots(i)$$

If this plane is $az-cx=m \qquad \ldots(ii)$

$\lambda c-a=0 \qquad \Rightarrow \qquad \lambda=\dfrac{a}{c}$

Putting $\lambda=\dfrac{a}{c}$ in (i)

$$bx-\frac{ab}{c}z=\left(\frac{al}{c}+n\right)=0$$

$$\Rightarrow \quad bcx-abz-(al+cn)=0$$

$$\Rightarrow \quad cx-az-\left(\frac{al+cn}{b}\right)=0$$

Comparing with equation (ii) $\dfrac{al+cn}{b}=-m \Rightarrow \quad al+bm+cn=0$

10. $f_k'(x)=q_kx^2+b_kx+c_k$

$f_k''(x)=2a_kx+b_k$

$f_k'''(x)=2a_k$

$$F(x)=\begin{vmatrix}a_1x^2+b_1x+c_1 & a_2x^2+b_2x+c_2 & a_3b^2+b_3x+c_3\\ 2a_1x+b_1 & 2a_2x+b_2 & 2a_3x+b_3\\ 2a_1 & 2a_2 & 2a_3\end{vmatrix}$$

$$f(x)=F'(x)=\begin{vmatrix}2a_1x+b_1 & 2a_2x+b_2 & 2a_3x+b_3\\ 2a_1x+b_1 & 2a_2x+b_2 & 2a_3x+b_3\\ 2a_1 & 2a_2 & 2a_3\end{vmatrix}+\begin{vmatrix}a_1x^2+b_1x+c_1 & a_2x^2+b_2x+c_2 & a_3x^2+b_3x+c_3\\ 2a_1 & 2a_2 & 2a_3\\ 2a_1 & 2a_2 & 2a_3\end{vmatrix}$$

$$+\begin{vmatrix}a_1x^2+b_1x+c_1 & a_2x^2+b_2x+c_2 & a_3x^2+b_3x+c_3\\ 2a_1x+b_1 & 2a_2x+b_2 & 2a_3x+b_3\\ 0 & 0 & 0\end{vmatrix}=0$$

$y=f(x)$ is a straight line.

Integer type

1. $\frac{1}{2}|\overrightarrow{AD}+\overrightarrow{EB}+\overrightarrow{FC}|$

$=\frac{1}{2}|\overrightarrow{OD}-\overrightarrow{OA}+\overrightarrow{OB}-\overrightarrow{OE}+\overrightarrow{OC}-\overrightarrow{OF})$

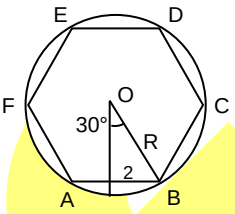
$\frac{1}{2}|2\overrightarrow{OD}+2\overrightarrow{OB}+2\overrightarrow{OC}|$

$=|\overrightarrow{OD}+\overrightarrow{OB}+\overrightarrow{OC}|$

$=\sqrt{OD^2+OB^2+OC^2+2\overrightarrow{OD}\cdot\overrightarrow{OB}+2\overrightarrow{OB}\cdot\overrightarrow{OC}+2\overrightarrow{OD}\cdot\overrightarrow{OC}}$

$=\sqrt{R^2+R^2+R^2+2R^2\times\text{Cos}2\pi/3+2R^2\cos\pi/3+2R^2\cos\pi/3}$

$=\sqrt{4R^2}=2R=2\cdot\frac{2}{\sin 30^\circ}=8$



2. $2\vec{v}+\vec{v}\times(\hat{i}+2\hat{j})=2\hat{i}+\hat{k}$

Squaring both sides

$4\vec{v}^2+[\vec{v}\times(\hat{i}+2\hat{j})]^2+2\vec{v}.[\vec{v}\times(\hat{i}+2\hat{j})]=5$

$\Rightarrow \quad 4|\bar{v}|^2+|\bar{v}|^2|\hat{i}+2\hat{j}|^2\sin^2\theta+0=5$

$\Rightarrow \quad 4|\bar{v}|^2+5|\bar{v}|^2\sin^2\theta=5$

$\Rightarrow \quad |\bar{v}|^2=\frac{5}{4+5\sin^2\theta}$

$\Rightarrow \quad 9|\bar{v}|^2=\frac{45}{4+5\sin^2\theta}=m$ (an positive integer)

$\Rightarrow \quad 4+5\sin^2\theta$ is factor of 5 that is possible if and only if $\sin^2\theta=1$

$\Rightarrow \quad 9|\bar{v}|^2=5 \quad \Rightarrow \quad 3|\bar{v}|=\sqrt{5} \quad \Rightarrow m=5$

3. (1,0,-1) is the point lying on plane $x+3y-5z=6$ any line passing through $(-1,2,2)$ and $\perp$ to given plane is

$$\frac{x+1}{1}=\frac{y-2}{3}=\frac{z-2}{-5}$$

any point on this line is $(\lambda-1,3\lambda+2,2-5\lambda)$ if this is foot of $\perp$ from $(-1,2,2,)$ to the given plane then

$(\lambda-1)+3(3\lambda+2)-5(2-5\lambda)=6$

$9\lambda+\lambda+25\lambda+6-10-1=6$

$\Rightarrow \quad \lambda=\frac{11}{35}$

Co-ordinates of foot of perpendicular

$$\left(\frac{11}{35}-1,\frac{33}{35}+2,2-\frac{11}{7}\right)=\left(-\frac{24}{35},\frac{103}{35},\frac{3}{7}\right)$$

4. $y\sin x\frac{dy}{dx}=\cos x\sin x-y^2\cos x$

$\Rightarrow \quad y\sin x\frac{dy}{dx}+y^2\cos x=\cos x\sin x$

$\Rightarrow \quad y\frac{dy}{dx}+\cot x.y^2=\cos x$

Let $y^2 = t \quad \Rightarrow \quad ydy = \frac{1}{2}dt$

$\frac{1}{2}\frac{dt}{dx} + \cot x.y^2 = \cos x \quad \Rightarrow \quad \frac{dt}{dx} + (2\cot x)t = 2\cos x$

$\Rightarrow$ It's solution is given as

$t \cdot e^{\int 2\cot x dx} = \int 2\cos x.e^{\int 2\cot x dx}dx$

$\Rightarrow \quad t.e^{\ln \sin^2 x} = 2\int \cos x.e^{\ln \sin^2 x}dx$

$\Rightarrow \quad t.\sin^2 x = 2\int \cos x.\sin^2 x dx$

$= \frac{2}{3}\sin^3 x + c$

$\Rightarrow y^2.\sin^2 x = \frac{2}{3}\sin^3 x + c$ putting $x + \frac{\pi}{2}, y = 2$

$\Rightarrow 4.1 = \frac{2}{3}.1 + c \quad \Rightarrow c = 4 - \frac{2}{3} = \frac{10}{3}$

$\Rightarrow y^2 \sin^2 x = \frac{2}{3}\sin^3 x + \frac{10}{3}$

$\Rightarrow \left(y\left(\frac{\pi}{6}\right)\right)^2 \sin^2 \frac{\pi}{6} = \frac{2}{3}\sin^3 \frac{\pi}{6} + \frac{10}{3}$

$\Rightarrow \left(y\left(\frac{\pi}{6}\right)\right)^2 = \frac{1}{3} + \frac{40}{3} = \frac{41}{3} = 0$

$\frac{9}{41}\left(y\left(\frac{\pi}{6}\right)\right)^2 = \frac{9}{41} \times \frac{41}{3} = 3$

5. $y = \tan z \Rightarrow \quad \frac{dy}{dx} = \sec^2 z\frac{dz}{dx}$

$\Rightarrow \quad \frac{d^2y}{dx^2} = \sec^2 z.\frac{d^2z}{dx^2} + 2\sec z.\sec z\tan z\left(\frac{dz}{dx}\right)^2$

$= 1 + 2\frac{(1+\tan z)}{\sec^2 z}.\sec^4 z\left(\frac{dz}{dx}\right)^2$

$= 1 + 2\sec^2 z\left(\frac{dz}{dx}\right)^2 + 2\tan z\sec^2 z\left(\frac{dz}{dx}\right)^2$

$\Rightarrow \quad \frac{d^2z}{dx^2} = \cos^2 z + 2\left(\frac{dz}{dx}\right)^2$

$\Rightarrow$ k=2

6. $f(x) = \begin{vmatrix} 0 & 0 & -a_2 + x \\ 1 & a_3 & 2a_2 - x \\ 1 & 2a_3 - x & a_2 \end{vmatrix}$

$= (x - a_2)(2a_3 - x - a_3) = -(x - a_2)(x - a_3)$

Maximum value of $f(x) = -\left(\frac{a_2 + a_3}{2} - a_2\right)\left(\frac{a_2 + a_3}{2} - a_3\right)$

$= -\left(\frac{a_3 - a_2}{2}\right)\left(\frac{a_2 - a_3}{2}\right)$

$= \left(\frac{a_2 - a_3}{4}\right)^2 = \frac{36}{4} = 9$