FIITJEE Phase Test (JEE-Advanced)

BATCH –NWCM2022-A-Lot_PT5

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 :_____

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.**

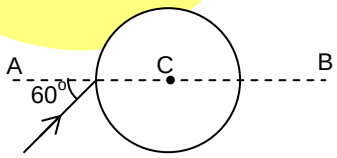
1. In LCR series AC circuit, the voltage across each of the components L, C and R is 50 V rms. The voltage across the LC combination (rms) will be
   (A) 50 V (B) $50\sqrt{2}$V
   (C) 100 V (D) zero volt

1. **D**

2. Light of wavelength 3500A^o is incident on two metals A and B, A of work function 4.2 eV and B of work function 1.19 eV respectively. The photoelectrons will be emitted by
   (A) metal A only (B) metal B only
   (C) both A and B (D) neither metal A nor metal B

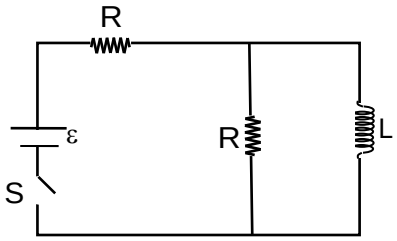
2. **B**

3. A ray of light falls on a transparent sphere with centre of C as shown in figure. The ray emerges from the sphere parallel to line AB. The refractive index of the sphere is
   (A) $\sqrt{3/2}$ (B) $2/\sqrt{3}$
   (C) 2 (D) $\sqrt{3}$



3. **D**

4. In the given circuit switch S is closed at t = 0, then the rate of change of current through the inductor initially is
   (A) 0
   (B) ε/L
   (C) $\varepsilon/2L$
   (D) $2\varepsilon/L$

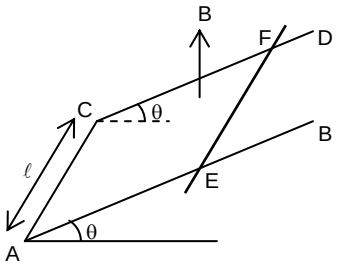


4. **C**

(One or More Than One Options Correct Type)

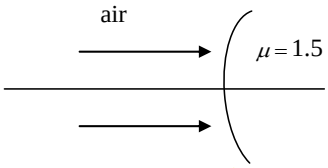
This section contains **8 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. AB and CD are smooth parallel rails, separated by a distance ℓ, and inclined to the horizontal at an angle θ. A uniform magnetic field of magnitude B, directed vertically upwards, exists in the region. EF is a conductor of mass m, carrying a current i. For EF to be in equilibrium,
   (A) i must flow from E to F (B) $Bi\ell = mg\tan\theta$
   (C) $Bi\ell = mg\sin\theta$ (D) $Bi\ell = mg$



5. **AB**

6. Parallel rays of light are falling on convex spherical surface of radius of curvature R = 20 cm. Refractive index of the medium is $\mu = 1.5$. After refraction from the spherical surface parallel rays :



(A) actually meet at some point.
(B) appears to meet after extending the refracted rays backwards.
(C) meet (or appears to meet) at a distance of 30 cm from the spherical surface.
(D) meet (or appears to meet) at a distance of 60 cm from the spherical surface.

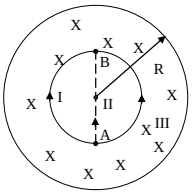
6. **AD**

7. Radiations of monochromatic waves of wavelength 400 nm are made incident on the surface of metals Zn, Fe and Ni of work functions 3.4 eV, 4.8 eV and 5.9 eV respectively (take hc = 12400 eV-Å):

(A) maximum KE associated with photoelectrons from the surface of any metal is 0.3 eV.
(B) no photoelectrons are emitted from the surface of Ni.
(C) if the wavelength of source of radiation is doubled then KE of photoelectrons is also doubled.
(D) photoelectrons will be emitted from the surface of all the three metals if the wavelength of incident radiations is less than 200 nm

7. **BD**

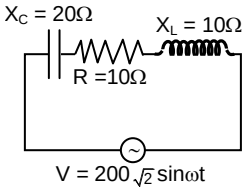
8. Magnetic field is present in a circular region of radius 'R'. assume the field depends on time t as given by $B = \alpha_o t$ (α_o is a positive constant). Charge Q_o is moved in this region from A to B through different paths as shown below. If W_I, W_{II} and W_{III} are work done by the induced electric field in path I, II, III in moving a positive charge



(A) $\frac{W_I}{W_{III}} = -1$ (B) $\frac{W_{II}}{W_I} = 0$
(C) W_{II} is greater than zero . (D) W_{III} is positive

8. **ABD**

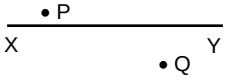
9. In the LCR circuit shown in figure:



(A) current will lead the voltage
(B) rms value of current is 20 A
(C) power factor of the circuit is $\frac{1}{\sqrt{2}}$
(D) Peak voltage drop across resistance is 100 V

9. **AC**

10. Two points P and Q lie on either side of an axis XY as shown. It is desired to produce an image of P at Q using a spherical mirror, with XY as the optic axis. The mirror must be



(A) converging (B) diverging
(C) positioned to the left of P (D) None of these .

10. **AC**

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

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

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

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

11. **BCD**

12. A transparent slab of thickness t and refractive index μ is inserted in front of upper slit of YDSE apparatus. The wavelength of light used is λ. Assume that there is no absorption of light by the slab. Select the correct statement(s):
(A) The intensity of dark fringes will be 0, if slits are identical
(B) The change in optical path due to insertion of plate is μt
(C) The change in optical path due to insertion of plate is $(\mu - 1)t$
(D) For making intensity zero at the centre of screen, the thickness of slab could be $\frac{5\lambda}{2(\mu-1)}$

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.**

1. A spot is placed on the bottom of a slab made of transparent material of refractive index 1.5. The spot is viewed vertically from the top when it seems to be raised by 2.1 cm. Then the height of the slab in cm is :

1. **6.30**

2. The current in the coil of self-inductance 3H is increasing according to $I = 2 \sin t^2$. (All parameters in S.I. Units). Find the amount of energy (in Joules) spent during the period when the current changes 0 to 5 ampere.

2. **37.50**

3. An inductor of inductance 100 mH is connected across a charged capacitor of capacitance 0.5 μF and the resulting LC circuit is set oscillating at its natural frequency. Let Q denote the instantaneous charge on the capacitor and I the current in the circuit. It is found that the maximum value of charge is 200 μC. When charge = 30 μC, the value of $\left|\frac{dI}{dt}\right|$ is x As^{-1}. Find the value of 'x'.

3. **600.00**

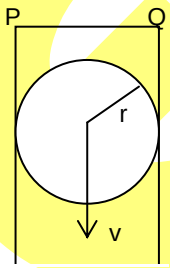
4. A double-slit interference pattern is formed on a screen in a Young's double slit experiment performed with light consisting of two wavelengths λ_1 = 6000Å and λ_2 = 4800Å. It is observed that the maximum of the 16th order corresponding to λ = 6000 Å coincides with a maximum of the nth order corresponding to λ = 4800 Å. The value of n is _____.

4. **20.00**

5. In a photoelectric experiment using a sodium surface, you find a stopping potential of 1.85 V for a wavelength of 300 nm and a stopping potential of 0.82 V for a wavelength of 400 nm. The value of the work function of sodium in eV from the above data is _____.

5. **2.27**
Range: 2.24 to 2.30

6. A vertical ring of radius 10 cm and resistance 3Ω slips vertically between two frictionless and resistance less vertical rails which are joined at top. There is uniform magnetic field of 10 Tesla perpendicular to plane of ring and the rails. When speed of ring is 10 m/s, current induced in section PQ in Amperes is _____.



6. **26.67**
Range: 26.64 to 26.70

SECTION – II : CHEMISTRY

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. In the spinel $MgAl_2O_4$, the Mg^{2+} ions are present
   (A) at the body centre of a B.C.C unit cell (B) at the corners of a F.C.C unit cell
   (C) at some of the voids of F.C.C unit cell (D) at the face centre of H.C.P unit cell

1. C

2. What is the hybridization of Mn in $[Mn(H_2O)_6]^{2+}$ ion?
   (A) d^2sp^3 (B) sp^3d^2
   (C) dsp^2 (D) sp^2d

2. B

3. In natural gas sulphur exists as
   (A) H_2S (B) SO_2
   (C) COS (D) CH_3SH

3. A

4. The rhombic sulphur becomes paramagnetic upon
   (A) reacting with O_2 (B) heating to vapour state
   (C) reacting with H_2O (D) heating to monoclinic sulphur

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. 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) $Cu(OH)_2$

5. ACD

6. Which of the following compound(s) contain chromium at its highest oxidation state?
   (A) CrO_5 (B) CrO_2Cl_2
   (C) $Cr(CO)_6$ (D) $[Cr(NH_3)_4Cl_2]Cl$

6. AB

7. Which of the following metal ion(s) contain(s) electron(s) in their e_g orbitals in their octahedral complex with strong field ligands?
   (A) Co^{2+} (B) Ni^{2+}
   (C) Cr^{3+} (D) Mn^{2+}

7. AB

8. Which of the following conductance(s) depend(s) on concentration of solutions?
   (A) Specific conductance (B) Equivalent conductance
   (C) Molar conductance at infinite dilution (D) Equivalent conductance at infinite dilution

8. AB

9. Which of the following substance(s) is/are neither added nor formed in the blast furnace during extraction of iron?
(A) $CaCO_3$ (B) $MgSO_4$
(C) $FeSiO_3$ (D) CO

9. BC

10. $P_4O_6 + O_3 \xrightarrow{195\ K} (X) \xrightarrow{238K} P_4O_{10} + O_2$
Choose correct statement(s) regarding the structure of (X). It contains
(A) four P = O bonds (B) twenty P – O bonds
(C) eight O – O bonds (D) no P – P bond

10. BCD

11. Which show stereoisomers?
(A) $[Co(NH_3)_3Cl_3]$ (B) $[Co(NH_3)_4Cl_2]Cl$
(C) $K[Co(NH_3)_2Cl_4]$ (D) $[Co(NH_3)_5Cl]Cl_2$

11. ABC

12. Which of the following acid(s) is/are stronger than HBrO?
(A) $HBrO_3$ (B) HClO
(C) $HClO_3$ (D) HBr

12. ABCD

(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 oxidation number of iron in the brown ring complex is +x, the value of x is:

1. 1

2. What is the van't Hoff factor of aluminium sulphate if its degree of dissociation(α) is 0.5?

2. 3

3. The density of a metal is 20 g/cm^3 and its atomic mass is 12.046 and the edge length of its unit cell is 1 $\overset{o}{A}$. How many effective number of atoms of the solid are present in the unit cell?

3. 1

4. The specific conductance of a conductometric cell is 2×10^{-2} ohm^{-1} cm^{-1}. What will be the cell constant of the cell in cm^{-1} unit when its resistance is 100 ohm?

4. 2

5. If the ratio of number of electrons present in the t_{2g} and e_g orbitals of Ni in $[Ni(H_2O)_6]^{2+}$ ion is x : y, what is the value of $\left(\frac{x+y}{5}\right)$?

5. 0.8

6. Arsenic forms compounds in +3 and +5 oxidation states. It becomes toxic in +x oxidation state. What is the value of x, out of 3 and 5?

6. 3

SECTION – III : MATHEMATICS

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 area of the region for which $0 < y < 3 - 2x - x^2$ and $x > 0$ is

(A) $\int_1^3 (3 - 2x - x^2)dx$ (B) $\int_0^3 (2 - 2x - x^2)dx$

(C) $\int_0^1 (3 - 2x - x^2)dx$ (D) $\int_{-1}^3 (2 - 2x - x^2)dx$

1 C

2. Given a system of equations in x, y, z: $x + y + z = 6$; $x + 2y + 3z = 10$ and $x + 2y + az = b$. If this system has infinite number of solutions, then

(A) $a = 3, b = 10$ (B) $a = 3, b \neq 10$

(C) $a \neq 3, b = 10$ (D) $a \neq 3, b \neq 10$

2 A

3. The equation $x + 2y + 3z = 1$, $x - y + 4z = 0$, $2x + y + 7z = 1$ have

(A) one solution only (B) two solutions only

(C) no solution (D) infinitely many solution

3 D

4. If A_m represents the area bounded by the curve $y = \ln x^m$, the x-axis and the lines $x = 1$ and $x = e$, then $A_m + m A_{m-1}$ is

(A) m (B) m^2

(C) $m^2/2$ (D) m^2-1

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 Let ABC be a triangle with AB = 4, AC = 5, BC = 6. Let BD, CE and AF are altitudes of ΔABC and they intersect at H. Then correct option is(are)

(A) $\overrightarrow{AH} = \frac{1}{7}\overrightarrow{AB} + \frac{3}{35}\overrightarrow{AC}$ (B) $\overrightarrow{AH} = \frac{3}{7}\overrightarrow{AB} + \frac{11}{35}\overrightarrow{AC}$

(C) $\overrightarrow{AF} = \frac{5}{8}\overrightarrow{AB} + \frac{3}{8}\overrightarrow{AC}$ (D) $\overrightarrow{AF} = \frac{15}{8}\overrightarrow{AB} + \frac{11}{8}\overrightarrow{AC}$

5. AC

6. Let A, B, C, D be four 3 × 3 materices with real entries such that AC – BD = I_3 and AD + BC = O_3 where $I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $O_3 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

Then correct option is(are):

(A) DA + CB = I_3 (B) CA = I_3 + DB

(C) DA + CB = O_3 (D) CA + DB = O_3

6. BC

7. Let A, B, C be 2 × 2 matrices with real entries and det (A) = det (B) = det (C) = 1. Further $A^2 + B^2 = C^2$. Let x, y, z denote trace of A, B, C respectively. Correct option is(are) (I is an identity matrix of order 2 × 2)

(A) $A^2 = x A - I$ (B) $A^2 = x A + I$

(C) $x^2 + y^2 = z^2$ (D) $x^2 + y^2 = 2 + z^2$

7. AD

8. 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) $A_\alpha^2 = -I$

8. AB

9. Let $\vec{a}$ and $\vec{b}$ be two non – collinear unit vectors. If $\vec{u} = \vec{a} - (\vec{a}.\vec{b})\vec{b}$ and $\vec{v} = (\vec{a} \times \vec{b})$, then $|\vec{v}|$ is

(A) $|\vec{u}|$ (B) $|\vec{u}| + |\vec{u}.\vec{a}|$

(C) $|\vec{u}| + |\vec{u}.\vec{b}|$ (D) $\vec{u} + \vec{u}.(\vec{a} + \vec{b})$

9 AC

10. 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

10 BC

11. 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) $X^{23} + Y^{23}$

11 CD

12. 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) $A^{-1} = |A|\,\text{Adj.A}$

12 BC

(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. 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

13. 3

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

14. 3

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

15. 3

16. The vectors $\vec{AB} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{BC} = -\hat{i} - 2\hat{k}$ are the adjacent sides of parallelogram. The acute angle between its diagonals is $\frac{\pi}{k}$ then k is

16. 4

17. If $\vec{a} = \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} + \hat{k}$ are given vectors, then the value of $|\vec{b}|^2$ where $\vec{b}$ satisfies $\vec{a} \times \vec{b} + \vec{c} = 0$ and $\vec{a}.\vec{b} = 3$ is

17. 6

18. The order of the differential equation whose general solution is given by $y = (c_1 + c_2)\cos(x + c_3) + c_4 e^{x+c_5}$ where c_1, c_2, c_3, c_4, c_5 arbitrary constants is

18. 3