FIITJEE (JEE-Advanced)

BATCHES – NWCMSR122A1, NWSW122A1, NWCMSR122B1, NWCMSW122B1, CSO (ONLINE) BATCHES

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - 1 | **QP Code:** | **TEST - 5**

Time Allotted: 3 Hours **Maximum Marks: 198**

- 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. Each **Section** is further divided into **Two Parts**: **Part-A & B** in the OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil 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 (01-06) –** Contains six (06) 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 (07-12) –** Contains seven (06) multiple choice questions which have **One or More** correct answer.
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
Zero Marks: **0** If none of the bubbles is darkened.
***Negative Marks*: –1 In all other cases.**
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

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

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION-1 : PHYSICS

PART – A

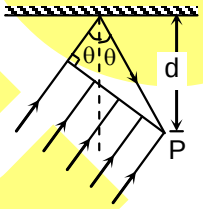
(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. In YDSE, water is filled in the space between the slits and screen. Then,
(A) fringe pattern shifts upward but fringe width remains unchanged.
(B) fringe width decreases and fringe pattern shifts upward.
(C) fringe width remains unchanged and central fringe does not shift.
(D) fringe width decreases and central maxima does not shift.

1. **D**

2. A plane wave front of light is incident on a plane mirror. Intensity is maximum at *P* when



(A) $\cos\theta = \frac{\lambda}{2d}$ (B) $\cos\theta = \frac{3\lambda}{4d}$

(C) $\sec\theta - \cos\theta = \frac{3\lambda}{4d}$ (D) $\sec\theta - \cos\theta = \frac{\lambda}{2d}$

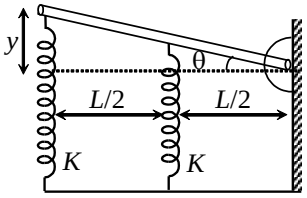
2. **B**

3. The equation of a particle executing SHM is given by $x = 3\cos\left(\frac{\pi}{2}\right)t$ cm, where t is in second. The distance travelled by the particle in the first 8.5 s is

(A) $\left(24 + \frac{3}{\sqrt{2}}\right)$cm (B) $\left(27 - \frac{3}{\sqrt{2}}\right)$cm (C) $\left(24 - \frac{3}{\sqrt{2}}\right)$cm (D) $\left(27 + \frac{3}{\sqrt{2}}\right)$cm

3. **B**

4. A long uniform rod of length L, mass M is free to rotate in a horizontal plane about a vertical axis through its end. Two springs of constant K each are connected as shown. On equilibrium, the rod was horizontal. The frequency of oscillation will be



(A) $\frac{1}{2\pi}\sqrt{\frac{15K}{M}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{15}{4M}}$ (C) $\frac{1}{2\pi}\sqrt{\frac{3K}{4M}}$ (D) $\frac{1}{2\pi}\sqrt{\frac{15K}{4M}}$

4. **D**

5. A source of sound of single frequency ν_0 flies along a straight line which is at a finite distance from the observer. Then the observer hears
(A) a frequency ν_0 at the instant when the source is nearest to him.
(B) a frequency greater than ν_0 at the instant when the source is nearest to him.
(C) a frequency ν_0 at an instant later than the instant of nearest position of the source.
(D) during the fly past, the increase in frequency is not equal to the decrease in the frequency.

5. **A**

6. The power of sound from a speaker is raised from 10 mW to 500 mW. What is the power increased in (decibel) dB as compared to initial original power is (log 50 = 1.69)
(A) 1.6 dB (B) 50 dB
(C) 16.9 dB (D) 6.9 dB

6. **C**

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. The (x, y) co-ordinates of the corners of a square plate are (0,0), (L,0), (L,L) and (0, L). The edges of the plate are clamped and transverse standing waves are set up in it. If u (x, y) denotes the displacement of the plate at the point (x, y) at some instant of time, the possible expression(s) for u is (are) (a = positive constant)

(A) $a\cos(\pi x/2L)\cos(\pi y/2L)$ (B) $a\sin(\pi x/L)\sin(\pi y/L)$

(C) $a\sin(\pi x/L)\sin(2\pi y/L)$ (D) $a\cos(2\pi x/L)\sin(\pi y/L)$

7. **BC**

8. Two waves travelling in opposite directions produce a standing wave. The individual wave functions are given by $y_1 = 4\sin(3x - 2t)$ and $y_2 = 4\sin(3x + 2t)$ cm, where x and y are in cm

(A) The maximum displacement of the motion at $x = \frac{3\pi}{4}$ cm is 4 cm.

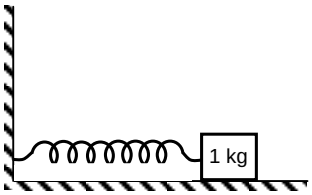
(B) The maximum displacement of the motion at $t = \frac{\pi}{6}$ sec is $4\sqrt{2}$ cm.

(C) Nodes are formed at x values given by 0, $\pi/3$, $2\pi/3$, π, $4\pi/3$, …….

(D) Antinodes are formed at x values given by $\pi/6$, $\pi/2$, $5\pi/6$, $7\pi/6$, …….

8. **CD**

9. In the system as shown mass of the block is 1 kg and spring constant is 25 N/m. The maximum kinetic energy of the block is 50 J.



(A) the amplitude of oscillation is 2 m.

(B) at half of the amplitude, kinetic energy of the block is 37.5 J.

(C) at half of the amplitude, potential energy of the spring is 12.5 J.

(D) at half of the amplitude, potential energy of the spring is 20 J.

9. **ABC**

10. Density of liquid varies with depth as $\rho = \alpha h$. A small ball of density ρ_o is released from the free surface of the liquid. Then

(A) the ball will execute SHM of amplitude $\frac{\rho_o}{\alpha}$

(B) the mean position of the ball will be at a depth $\frac{\rho_o}{2\alpha}$ from the free surface

(C) the ball will sink to a maximum depth of $\frac{2\rho_o}{\alpha}$

(D) all of the above

10. **AC**

11 In Young's double-slit experiment, two wavelengths of light are used simultaneously where $\lambda_2 = 2\lambda_1$. In the fringe pattern observed on the screen,

(A) maxima of wavelength λ_2 can coincide with minima of wavelength λ_1.

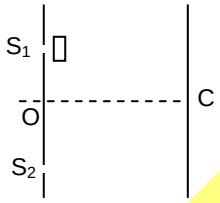
(B) fringe width of λ_2 will be double that of fringe width of λ_1.

(C) nth order minima of λ_2 will coincide with (2n – 1)th order maxima of λ_1.

(D) none of the above

11 **BC**

12. A YDSE is performed in a medium of refractive index μ_1. In front of one of the slits say S_1 as shown a thin glass slab of refractive index $\mu_2(<\mu_1)$ is kept. If initially (without glass slab) the central maxima was formed on the central line OC then

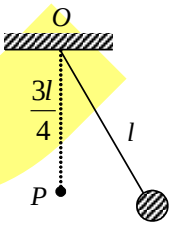


(A) central maxima will shift upwards (after glass slab used).
(B) central maxima will shift downwards (after glass slab used).
(C) the waves reaching on the screen at C from S_1 will lead the waves reaching from S_2.
(D) the waves reaching C from S_1 will lag from the waves reaching from S_2.

12. **BC**

PART – B
(Numerical based)

1. A pendulum has time period T for small oscillations. An obstacle P is situated below the point of suspension O at a distance $\frac{3l}{4}$. The pendulum is released from rest. Throughout the motion the moving string makes small angle with vertical. If the time after which the pendulum returns back to its initial position is $\frac{nT}{4}$. Then find the value of 'n'.



1. **3**

2. A transverse wave is described by the equation $y = y_0 \sin\left[2\pi\left(ft - \frac{x}{\lambda}\right)\right]$. The maximum particle velocity is equal to four times the wave velocity if $\lambda = n\pi y_0$. Then find the value of 'n'

2. **0.50**

3. In YDSE experiment if the screen is shifted by a distance of 0.5 m away from the slit, the position of 3rd maxima is 3×10^{-4} m. If the distance between the slits is 2×10^{-3} m and the wavelength used in the experiment is 100 n mm then find the value of 'n'.

3. **4**

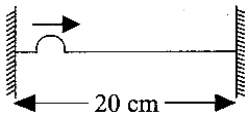
4. A thin sheet of glass (μ=1.5) of thickness 6 microns introduced in the path of one of interfering beams of a double slit experiment shifts the central fringes to a position previously occupied by fifth bright fringe. If the wavelength of the light used is $\frac{k}{5}\mu m$ then find the value of 'k'.

4. **3**

5. S_1 and S_2 are two loudspeakers with the same frequency of 165 Hz and their individual intensity at P is 1. 6 x 10^{-3} and 2.5 x 10^{-3} w/m^2 respectively. Where P is a point at a distance 4 m from S_1 and 3m from S_2. If they vibrate in same phase the intensity at P when S_1 and S_2 both are on S_1 and S_2 on is χ x 10^{-4} w/m^2. Find χ.
(take velocity of sound = 330 m/s).

5. **1**

6. A string of length 20 cm and linear mass density 0.40 g/cm is fixed at both ends and is kept under a tension of 16 N. A wave pulse is produced at t = 0 near an end as shown in figure which travels towards the other end. When will the string have the shape shown in the figure again? (in × 10^{-2} s)



6. **2**

SECTION-2 : CHEMISTRY

PART – A

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. In the cell reaction

Ag | AgI (sat. soln) | AgI(s) | Ag $\left[E_R^0 = -0.141V, E_L^0 = 0.739\,V\right]$

The solubility product of AgI at 298 K is

(A) $\approx 10^{-16}$ (B) $\approx 10^{-14}$

(C) $\approx 10^{-12}$ (D) $\approx 10^{-17}$

1. A

2. Correct order for the lattice energy of following compounds

$TiCl_2$, VCl_2, $CrCl_2$ and $MnCl_2$ is:

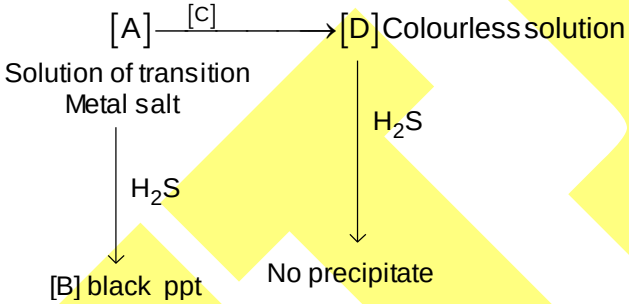
I II III IV

(A) I < II < III < IV (B) I < IV < II < III

(C) IV < III < II < I (D) I < IV < III < II

2. B

3. In the given scheme



[A], [C] and [D] are respectively

(A) Fe^{3+}, CN^-, $[Fe(CN)_6]^{3-}$ (B) Cu^{2+}, CN^-, $[Cu(CN)_4]^{3-}$

(C) Co^{2+}, CN^-, $[Co(CN)_6]^{3-}$ (D) Ni^{2+}, CN^-, $[Ni(CN)_4]^{2-}$

3. B

4. For the concentration cell

M | M^+(aq, 0.01 mol dm^{-3}) || M^+(aq, 0.1 mol dm^{-3}) | M

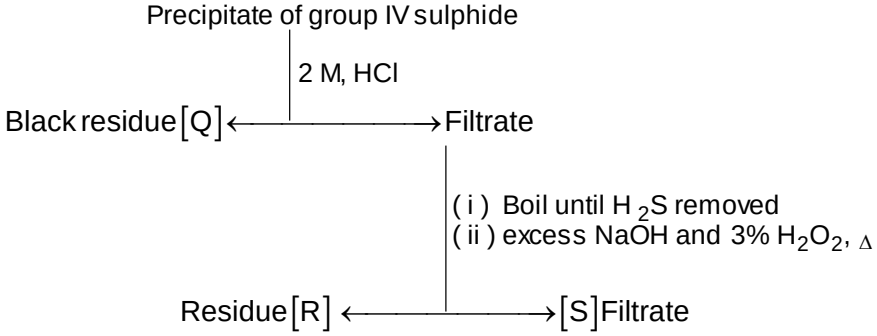
The EMF (E) of the cell at a temperature(T) equals

(A) $2.303\frac{RT}{F}$ (B) $-2.303\frac{RT}{F}$

(C) $E^0_{M^+M} + 2.303\frac{RT}{F}$ (D) $E^0_{M^+M} - 2.303\frac{RT}{F}$

4. A

5. Precipitate of group IV sulphide



Residue [Q] and [R] are respectively

(A) CoS and MnO_2 (B) CoS and $Ni(OH)_3$

(C) MnS and $Ni(OH)_3$ (D) NiS and $Zn(OH)_2$

5. A

6. On addition of a solution of $AgNO_3$ to a solution of $Na_2S_2O_3$ it turns black on standing due to the formation of

(A) Ag (B) Ag_2S

(C) $Ag_2S_2O_3$ (D) Ag_2SO_4

6. B

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. Select the correct statement/s

(A) $K_2Cr_2O_7$ cannot be used as primary standard (in titration), because it is not easy to purify and dry it

(B) $Na_2Cr_2O_7$ cannot be used as primary standard (in titration), it cannot remain unaltered in air during weighing

(C) $Na_2Cr_2O_7$ is soluble in water

(D) Reaction with standard solution of $K_2Cr_2O_7$ during titration is stoichiometric and instantaneous

7. **BCD**

8. Electrolysis of $CuSO_4$(aq) solution using copper electrodes will yield

(A) H_2 at cathode (B) Cu^{2+} at anode

(C) O_2(g) at anode (D) Cu(s) at cathode

8. **BD**

9. Which of the following pair can be separated using aq.NH_3(excess)

(A) Cd^{2+} and Cu^{2+} (B) Bi^{3+} and Cu^{2+}

(C) Hg_2^{2+} and Ag^+ (D) Mn^{2+} and Zn^{2+}

9. **BCD**

10. Select the incorrect statement/s.

(A) Λ_M^0 of weak electrolyte can be obtained from extrapolation methode in Λ_M vs $\sqrt{C}$ plot.

(B) Abnormally high conductivities of H^+ and OH^- ions is due to their small size.

(C) λ_M^0 of a species remains unaffected by pressure

(D) Conductometric titration of $AgNO_3$ vs KCl is carried out at lower temperature to avoid adsorption

10. **ABCD**

11. Which of the following can liberate brown fumes with conc.H_2SO_4?
(A) $NaNO_2$ (B) NaCl
(C) KBr (D) KNO_3

11. **ACD**

12. Which of the metal oxide yield metal on heating?
(A) HgO (B) Au_2O_3
(C) PbO (D) Ag_2O

12. **ABD**

PART – B
(Numerical based)

13. Standard electrode potential of Fe^{2+}/Fe and Fe^{3+}/Fe are 0.44V and -0.036V. The $E^{o}_{Fe^{3+}/Fe^{2+}}$ is ___V.

13. 0.77

14. $Pt(H_2)/H^+(pH = 4)$
E_{ox} of the above half cell is _____V.

14. 0.24

15. 0.2 M KOH solution is electrolysed for 1.5 hr using a current of 8A. How many mol of O_2 were produced at the anode?

15. 0.11

16. The spin magnetic moment of Ce^{3+} (Z = 58) ion in B.M is ____

16. 1.73

17. The equivalent mass of $KMnO_4(M_o = 158)$ in weakly basic medium is

17. 52.67

18. The oxidation state of central metal atom in Nesseler's reagent used for detection of NH_4^+ is

18. 2.0

SECTION-3 : MATHEMATICS

PART – A

(Single Correct Choice Type)

This section contains **6 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. The value of $\cot\left(\operatorname{cosec}^{-1}\frac{5}{3}+\tan^{-1}\frac{2}{3}\right)$ is

(A) $\frac{6}{17}$ (B) $\frac{3}{17}$

(C) $\frac{4}{17}$ (D) $\frac{5}{17}$

1. **A**

2. If $0 \le x < 2\pi$, then the number of real values of x, which satisfy the equation $\cos x+\cos 2x+\cos 3x+\cos 4x=0$ is:

(A) 5 (B) 7

(C) 9 (D) 3

2. **B**

3. If A and B are square matrices of same order such that AB = B and BA = A, then A^2+B^2 is always equal to:

(A) 2AB (B) 2BA

(C) $A+B$ (D) AB

3. **C**

4. For a matrix $A=\begin{bmatrix}1 & 2r-1\\ 0 & 1\end{bmatrix}$, the value of $\prod_{r=1}^{50}\begin{bmatrix}1 & 2r-1\\ 0 & 1\end{bmatrix}$ is equal to

(A) $\begin{bmatrix}1 & 100\\ 0 & 1\end{bmatrix}$ (B) $\begin{bmatrix}1 & 4950\\ 0 & 1\end{bmatrix}$

(C) $\begin{bmatrix}1 & 5050\\ 0 & 1\end{bmatrix}$ (D) $\begin{bmatrix}1 & 2500\\ 0 & 1\end{bmatrix}$

4. **D**

5. If A and B are symmetric matrices of the same order, then

(A) AB is a symmetric matrix (B) A – B is skew – symmetric matrix

(C) AB + BA is a symmetric matrix (D) AB – BA is a symmetric matrix

5. **C**

6. If $\operatorname{cosec}A + \cot A = \frac{11}{2}$, then tan A is equal to

(A) $\frac{111}{44}$ (B) $\frac{44}{117}$

(C) $\frac{44}{125}$ (D) $\frac{117}{125}$

6. **B**

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

7. The general solution of the equation $\sec 4\theta - \sec 2\theta = 2$ is $\theta =$

(A) $(2n+1)\frac{\pi}{2}$ (B) $(2n+1)\frac{\pi}{5}$

(C) $(2n+1)\frac{\pi}{3}$ (D) $(2n+1)\frac{\pi}{10}$

7. **AD**

8. At $x = \frac{3}{2}$, the value is real for

(A) $\tan^{-1} x$ (B) $\operatorname{cosec}^{-1} x$

(C) $\cos^{-1} 2x$ (D) none of these

8. **AB**

9. If a square matrix $A = [a_{ij}]$, $a_{ij} = i^2 - j^2$ is of even order, than:

(A) A is a skew matrix

(B) $|A|$ is a perfect square of an integer

(C) A is symmetric and $|A| = 0$

(D) A is neither symmetric nor skew symmetric

9. **AB**

10. Suppose $a_1, a_2, \ldots$ are real numbers with $a_i \neq 0$. If $a_1, a_2, a_3, \ldots$ are in A.P. with non – zero common difference then:

(A) $A = \begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix}$ is singular

(B) the system of equations $a_1x + a_2y + a_3z = 0,\ a_4x + a_5y + a_6z = 0,\ a_7x + a_8y + a_9z = 0$ has an infinite numbers of solutions

(C) $B = \begin{bmatrix} a_1 & ia_2 \\ ia_2 & a_1 \end{bmatrix}$ is singular (where $i = \sqrt{-1}$)

(D) the system of equations $a_1x + a_2y + a_3z = 0,\ a_4x + a_5y + a_6z = 0,\ a_7x + a_8y + a_9z = 0$ has a unique solution.

10. **AB**

11. Suppose ABCD (in order) is a quadrilateral inscribed in a circle. Which of the following is/are always true?

(A) $\sec B = \sec D$ (B) $\cot A + \cot C = 0$

(C) $\operatorname{cosec} A = \operatorname{cosec} C$ (D) $\tan B + \tan D = 0$

11. **BC**

12. If $\left(\frac{\sin\theta}{\sin\phi}\right)^2 = \frac{\tan\theta}{\tan\phi} = \sqrt{3}$, then

(A) $\tan\phi = \frac{1}{\sqrt{3}}$ or $\frac{-1}{\sqrt{3}}$ (B) $\tan\phi = \sqrt{3}$ or $-\sqrt{3}$

(C) $\tan\theta = \frac{1}{\sqrt{3}}$ or $\frac{-1}{\sqrt{3}}$ (D) $\tan\theta = \sqrt{3}$ or $-\sqrt{3}$

12. **AD**

PART – B
(Numerical based)

1. The number of solutions of the equation $\tan x + \tan\left(x + \frac{\pi}{3}\right) + \tan\left(x + \frac{2\pi}{3}\right) = 0$ in $(-\pi, \pi)$ is

1. **5**

2. If $\tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{4} + \tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{n} = \frac{\pi}{4}$, then the last digit of n is

2. **7**

3. If $\tan(\alpha - \beta) = \sin 2\beta$, then value of $\frac{\tan\alpha + \tan\beta}{\tan 2\beta}$ equals _____

3. **2**

4. If $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 = 3$, then $\cos\theta_1 + \cos\theta_2 + \cos\theta_3 =$

4. **0**

5. If $90^\circ < A < 180^\circ$ and $\sin A = \frac{4}{5}$, then $\tan\left(\frac{A}{2}\right)$ is equal to:

5. **2**

6. If A is an idempotent non – zero matrix and I is an identity matrix of the same order, find the value of n, $n \in N$, such that $(A + I)^n = I + 127A$.

6. **7**

ANSWERS

SECTION-1 : PHYSICS

PART – A

PART – B

SECTION – 2 : CHEMISTRY

PART – A

PART – B

SECTION – 3 : MATHEMATICS

PART – A

PART – B