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JEE (MAIN & ADV.) / XI & XII / NTSE / KVPY / OLYMPIAD

TALENT SEARCH EXAMINATION

Time : 2 Hours **(Class XII)__PATNA STAGE - 1** **Maximum Marks : 180**

Name : _____ **Reg. No.:** ☐☐☐☐☐☐☐☐

INSTRUCTIONS

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.

[A] General :

1. Attempt ALL the questions. Answer have to be marked on the **OMR** sheets
2. This question paper contains 45 questions.
3. The question paper consists of **THREE Parts Physics (Q.No. 1 to 15), Chemistry (Q.No.16 to 30), Mathematics (Q.No. 31 to 60),**
4. Blank spaces are provided at the bottom of each page for rough work. No additional sheets will be provided for rough work.
5. Balnk paper, clipboard, log tabes, silde rules, calculators, cellular phones, pagers and electronic gadgets in any form are **NOT** allowed.
6. Do not Tamper / multilate the **OMR sheet** or this booklet.
7. Do not break the seals of the question-paper booklet before instructed to do so by the invigilator.
8. SUBMIT the OMR sheet to the invigilator after completing the test & take away the test paper with you.

[B] Filling of OMR Sheet

9. In all the parts, each question will have 4 choices out of which **only one choice is correct**
10. Use only Black/Blue ball point pen for filling the OMR sheet.
11. On the OMR sheet, darken the appropriate bubble for each character of your name, Registration No., Phone No. etc.

[C] Marking Scheme

12. For each correct response you will **be awarded 5 marks** and **zero mark** in all other cases
13. There is no negative marking in STAGE-1 exam.

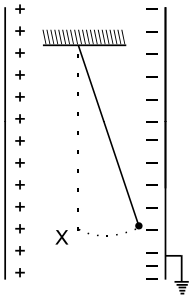
Best of Luck

PART - I (PHYSICS)

(SINGLE CORRECT ANSWER TYPE)

This section contains **(1-15) multiple choice questions.** Each questions has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Q.1 A simple pendulum has a length ℓ, mass of bob m. The bob is given a charge q coulomb. The pendulum is suspended between the vertical plates of charged parallel plate capacitor. Which produces a uniform electric field of strength E between the plates, then assuming that it does not collide with the plate calculate the time period T =

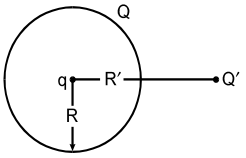


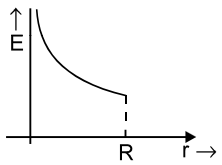
(A) $2\pi\sqrt{\frac{\ell}{g}}$ (B) $2\pi\sqrt{\left\{\frac{\ell}{g+\frac{qE}{m}}\right\}}$ (C) $2\pi\sqrt{\left\{\frac{\ell}{g-\frac{qE}{m}}\right\}}$ (D) $2\pi\sqrt{\frac{\ell}{\sqrt{g^2+\left(\frac{qE}{m}\right)^2}}}$

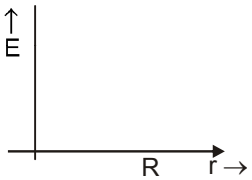
Q.2 A charged particle of charge q and mass m is released from rest in an uniform electric field E. Neglecting the effect of gravity, the kinetic energy of the charged particle after time 't' seconds is

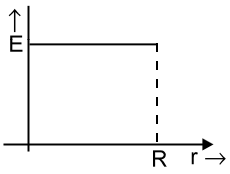
(A) $\frac{Eqm}{t}$ (B) $\frac{E^2q^2t^2}{2m}$ (C) $\frac{2E^2t^2}{mq}$ (D) $\frac{Eq^2m}{2t^2}$

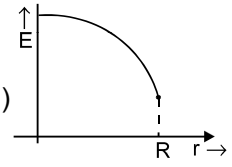
Q.3 A charge 'q' is placed at the centre of a conducting spherical shell of radius R, which is given a charge Q. An external charge Q′ is also present at distance R′ (R′ > R) from 'q'. Then the resultant field will be best represented for region r < R by:
[where r is the distance of the point from q]



(A) 

(B) 

(C) 

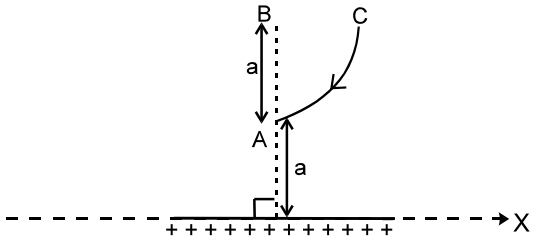
(D) 

Q.4 Two spherical conductors of radii 4 m and 5 m are charged to the same potential. If σ_1 and σ_2 are the respective values of the surface charge densities on the two conductors, then the ratio $\frac{\sigma_1}{\sigma_2}$ is

(A) $\frac{5}{4}$ (B) $\frac{4}{5}$ (C) $\frac{25}{16}$ (D) $\frac{16}{25}$

Space for rough works

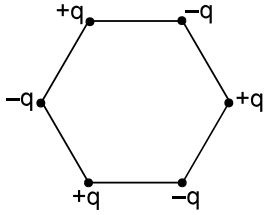
Q.5 For an infinite line of charge having charge density λ lying along x-axis, the work required in moving charge from C to A along arc CA is :



(A) $\frac{q\lambda}{\pi\varepsilon_0}\log_e\sqrt{2}$ (B) $\frac{q\lambda}{4\pi\varepsilon_0}\log_e\sqrt{2}$

(C) $\frac{q\lambda}{4\pi\varepsilon_0}\log_e 2$ (D) $\frac{q\lambda}{2\pi\varepsilon_0}\log_e\frac{1}{2}$

Q.6 Six charges of magnitude + q and –q are fixed at the corners of a regular hexagon of edge length a as shown in the figure. The electrostatic interaction energy of the charged particles is :



(A) $\frac{q^2}{\pi\in_0 a}\left[\frac{\sqrt{3}}{8}-\frac{15}{4}\right]$ (B) $\frac{q^2}{\pi\in_0 a}\left[\frac{\sqrt{3}}{2}-\frac{9}{4}\right]$

(C) $\frac{q^2}{\pi\in_0 a}\left[\frac{\sqrt{3}}{4}-\frac{15}{2}\right]$ (D) $\frac{q^2}{\pi\in_0 a}\left[\frac{\sqrt{3}}{2}-\frac{15}{8}\right]$

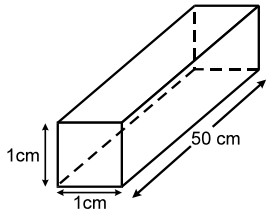
Q.7 A rectangular carbon block has dimensions 1.0 cm × 1.0 cm × 50 cm. Resistances are measured, first across two square ends and then across two rectangular ends, respectively. If resistivity of carbon is $3.5 \times 10^{-5}\ \Omega$-m, then values of measured resistances respectively are:

(A) $17.5 \times 10^{-2}\ \Omega$, $7 \times 10^{-5}\ \Omega$

(B) $7 \times 10^{-5}\ \Omega$, $7.5 \times 10^{-2}\ \Omega$

(C) $17.5 \times 10^{-4}\ \Omega$, $7 \times 10^{-7}\ \Omega$

(D) $7.5\ \Omega$, $7 \times 10^{-2}\ \Omega$



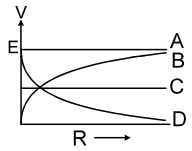
Q.8 A cell of emf E having an internal resistance r is connected to an external resistance R. The potential difference V across the resistance R varies with R as shown in figure by the curve :

(A) A

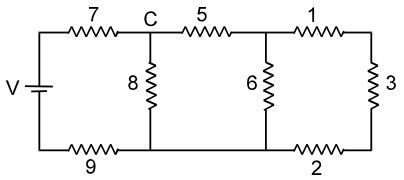
(B) B

(C) C

(D) D



Q.9 In the ladder network shown, current through the resistor $3\ \Omega$ is 0.25 A. The input voltage 'V' is equal to

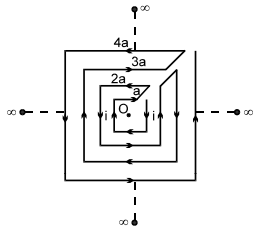


(A) 10 V (B) 20 V

(C) 5 V (D) 7.5 V

Space for rough works

Q.10 Determine the magnetic field at the centre of the current carrying wire arrangement shown in the figure. The arrangement extends to infinity. (The wires joining the successive squares are along the line passing through the centre)



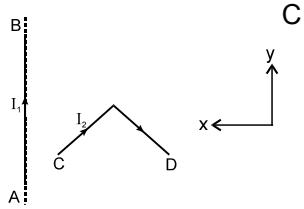
(A) $\frac{\mu_0 i}{\sqrt{2}\,\pi a}$ (B) 0

(C) $\frac{2\sqrt{2}\,\mu_0 i}{\pi a}\ln 2$ (D) None of these

Q.11 Axis of a solid cylinder of infinite length and radius R lies along y-axis it carries a uniformly distributed current 'i' along +y direction. Magnetic field at a point $\left(\frac{R}{2}, y, \frac{R}{2}\right)$ is :-

(A) $\frac{\mu_0 I}{4\pi R}(\hat{i}-\hat{k})$ (B) $\frac{\mu_0 i}{2\pi R}(\hat{j}-\hat{k})$ (C) $\frac{\mu_0 i}{4\pi R}\hat{j}$ (D) $\frac{\mu_0 I}{4\pi R}(\hat{i}+\hat{k})$

Q.12 In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying current I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The resultant force on the wire CD is:



(A) zero
(B) towards negative x-axis
(C) towards positive y-axis
(D) None of these

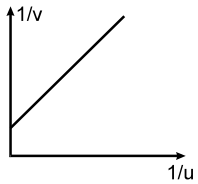
Q.13 A person's eye level is 1.5 m. He stands in front of a 0.3m long plane mirror which is 0.8 m above the ground. The length of the image he sees of himself is:

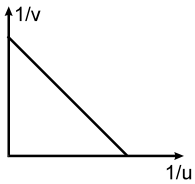
(A) 1.5m (B) 1.0m (C) 0.8m (D) 0.6m

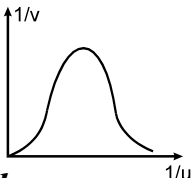
Q.14 How much water should be filled in a container of 21 cm in height, so that it appears half filled (of total height of the container) when viewed from the top of the container ?
(Assume near normal incidence and μ_w=4/3)

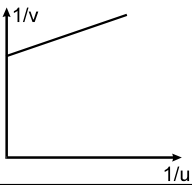
(A) 8.0 cm (B) 10.5 cm (C) 12.0 cm (D) 14.0 cm

Q.15 An object is placed at a distance u from a converging lens and its real image is received on a screen placed at a distance of v from the lens. If f is the focal length of the lens, then the graph between 1/v versus 1/u is:

(A) 

(B) 

(C) 

(D) 

Space for rough works

PART - II (CHEMISTRY)

(SINGLE CORRECT ANSWER TYPE)

This section contains **(16-30) multiple choice questions.** Each questions has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Q.16 The tetrahedral voids formed by ccp arrangement of Cl^- ions in rock salt structure are

(A) Occupied by Na^+ ions (B) Occupied by Cl^- ions

(C) Occupied by either Na^+ or Cl^- ions (D) Vacant

Q.17 An ionic compound AB has ZnS type structure. If the radius A^+ is 22.5 pm, then the ideal radius of B^- would be

(A) 54.35 pm (B) 100 pm (C) 145.16 pm (D) None of these

Q.18 r_{Na^+} = 95 pm and r_{Cl^-} =181 pm in NaCl (rock salt) structure. What is the shortest distance between Na^+ ions?

(A) 778.3 pm (B) 276 pm (C) 195.7 pm (D) 390.3 pm

Q.19 For an ideal binary liquid solution with $P_A^\circ > P_B^\circ$, which relation between X_A (mole fraction of A in liquid phase) and Y_A(mole fraction of A in vapour phase) is correct?

(A) $Y_A < Y_B$ (B) $X_A > X_B$ (C) $\frac{Y_A}{Y_B} > \frac{X_A}{X_B}$ (D) $\frac{Y_A}{Y_B} < \frac{X_A}{X_B}$

Q.20 The Van't Hoff factor for a dilute aqueous solution of glucose is

(A) zero (B) 1.0 (C) 1.5 (D) 2.0

Q.21 The vapour pressure of a solution of a non-volatile electrolyte B in a solvent A is 95% of the vapour pressure of the solvent at the same temperature. If the molecular weight of the solvent is 0.3 times the molecular weight of solute, the weight ratio of the solvent and solute are

(A) 0.15 (B) 5.7 (C) 0.2 (D) 4.0

Q.22 Assuming each salt to be 90 % dissociated, which of the following will have highest boiling point?

(A) Decimolar $Al_2(SO_4)_3$

(B) Decimolar $BaCl_2$

(C) Decimolar Na_2SO_4

(D) A solution obtained by mixing equal volumes of (B) and (C)

Q.23 Which of the following plots represents an ideal binary mixture?

(A) Plot of P_{total} v/s $1/X_B$ is linear (X_B = mole fraction of 'B' in liquid phase).

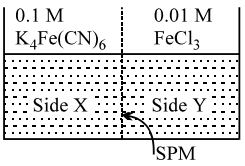
(B) Plot of P_{total} v/s Y_A is linear (Y_B = mole fraction of 'A' in vapour phase)

(C) Plot of $\frac{1}{P_{total}}$ v/s Y_A is linear

(D) Plot of $\frac{1}{P_{total}}$ v/s Y_B is non linear

Space for rough works

Q.24 $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ in aqueous solution gives blue colour. These are separated by a semipermeable membrane AB as shown. Due to osmosis there is



(A) blue colour formation in side X.

(B) blue colour formation in side Y.

(C) blue colour formation in both of the sides X and Y.

(D) no blue colour formation.

Q.25 During depression of freezing point in a solution, the following are in equilibrium

(A) liquid solvent-solid solvent (B) liquid solvent-solid solute

(C) liquid solute-solid solute (D) liquid solute-solid solvent

Q.26 When HgI_2 is added to an aqueous solution of Potassium iodide, the freezing point

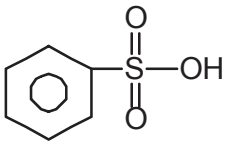
(A) decreases (B) Increases

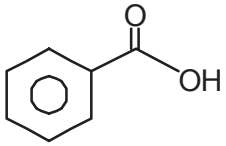
(C) Remains the same (D) Cannot predict

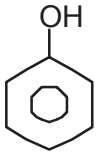
Q.27 $(CH_3)_3C.MgCl$ on reaction with D_2O produces :

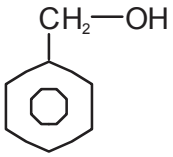
(A) $(CH_3)_3CD$ (B) $(CH_3)_3COD$ (D) $(CD_3)_3CD$ (D) $(CD_3)_3COD$

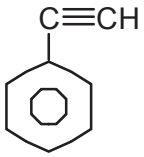
Q.28 Compare acidic strength :

(i) 

(ii) 

(iii) 

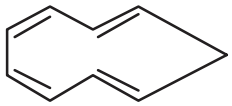
(iv) 

(v) 

(A) i > ii > iii > iv > v (B) i > iii > ii >iv > v

(C) iii > i > ii > iv > v (D) ii > i > iii > iv > v

Q.29 To convert cyclononatetraene in aromatic ion, the process needed is



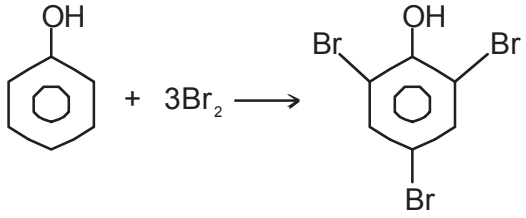
(A) addition of one more π-bond

(B) addition of two more π-bond

(C) loss of $H^{\oplus}$ from sp^3 - hybridized carbon

(D) loss of $H^{\oplus}$ from sp^2 - hybridized carbon

Space for rough works

Q.30  + 3HBr. This reaction is an example of :

(A) nucleophilic addition
(B) nucleophilic substitution
(C) electrophilic addition
(D) electrophilic substitution

PART - III (MATHEMATICS)

(SINGLE CORRECT ANSWER TYPE)

This section contains **(31-45) multiple choice questions.** Each questions has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Q.31 If $0 < \cos^{-1} x < 1$ and $1 + \sin(\cos^{-1} x) + \sin^2(\cos^{-1} x) + \sin^3(\cos^{-1} x) + \ldots\ldots \infty = 2$, then x equals

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

Q.32 If $x = \cos^{-1}(\cos 4)$; $y = \sin^{-1}(\sin 3)$ then which of the following holds ?

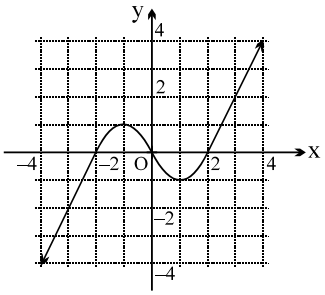
(A) $x - y = 1$ (B) $x + y + 1 = 0$ (C) $x + 2y = 2$ (D) $\tan(x + y) = -\tan 7$

Q.33 Let f be a function satisfying $f(xy) = \frac{f(x)}{y}$ for all positive real numbers x and y. If $f(30) = 20$, then the value of f (40) is

(A) 15 (B) 20 (C) 40 (D) 60

Q.34 The graph of the function y = g (x) is shown.

The number of solutions of the equation $\left|\,|g(x)| - 1\,\right| = \frac{1}{2}$, is



(A) 4 (B) 5

(C) 6 (D) 8

Space for rough works

Q.35 Given $I_1 = \lim_{x\to\pi/4} \cos^{-1}\left[\sec\left(x-\frac{\pi}{4}\right)\right]$; $I_2 = \lim_{x\to\pi/4} \sin^{-1}\left[\operatorname{cosec}\left(x+\frac{\pi}{4}\right)\right]$;

$I_3 = \lim_{x\to\pi/4} \tan^{-1}\left[\cot\left(x+\frac{\pi}{4}\right)\right]$; $I_4 = \lim_{x\to\pi/4} \cot^{-1}\left[\tan\left(x-\frac{\pi}{4}\right)\right]$

where [x] denotes greatest integer function then which of the following limits exist?

(A) I_1 and I_2 only (B) I_1 and I_3 only (C) I_1 and I_4 only (D) All of them

Q.36 Let the function f, g and h be defined as follows :

$$f(x) = \begin{cases} x\sin\left(\frac{1}{x}\right) & \text{for } -1\le x\le 1 \text{ and } x\neq 0 \\ 0 & \text{for } x = 0 \end{cases}$$

$$g(x) = \begin{cases} x^2\sin\left(\frac{1}{x}\right) & \text{for } -1\le x\le 1 \text{ and } x\neq 0 \\ 0 & \text{for } x = 0 \end{cases}$$

$h(x) = |x|^3$ for $-1 \le x \le 1$

Which of these functions are differentiable at x = 0?

(A) f and g only (B) f and h only (C) g and h only (D) None of these

Q.37 Let g is the inverse function of f & $f'(x) = \frac{x^{10}}{(1+x^2)}$. If g(2) = a then $g'(2)$ is equal to

(A) $\frac{5}{2^{10}}$ (B) $\frac{1+a^2}{a^{10}}$ (C) $\frac{a^{10}}{1+a^2}$ (D) $\frac{1+a^{10}}{a^2}$

Q.38 The angle between the tangent lines to the graph of the function $f(x) = \int_2^x (2t-5)dt$ at the points where the graph cuts the x-axis is

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$

Q.39 A and B are two given matrices such that the order of A is 3×4 , if A'B and BA′ are both defined then

(A) order of B' is 3 × 4 (B) order of B'A is 4 × 4

(C) order of B'A is 3 × 3 (D) B'A is undefined

Space for rough works

Q.40 Let a determinant is given by $A = \begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix}$ and suppose det. A = 6. If $B = \begin{vmatrix} p+x & q+y & r+z \\ a+x & b+y & c+z \\ a+p & b+q & c+r \end{vmatrix}$ then

(A) det. B = 6 (B) det. B = – 6 (C) det. B = 12 (D) det. B = – 12

Q.41 If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$, then the value of $x^{100} + y^{100} + z^{100} - \frac{9}{x^{101} + y^{101} + z^{101}}$ is equal to -

(A) 0 (B) 3 (C) – 3 (D) 9

Q.42 Let f (x) = $\begin{vmatrix} x^3 & \cos x & \sin x \\ 6 & -1 & 0 \\ p & p^2 & p^3 \end{vmatrix}$ where p is a constant . Then $\frac{d^3}{dx^3}$ [f (x)] at x = 0 is

(A) p (B) $p + p^3$ (C) $p + p^2$ (D) Independent of p

Q.43 If f'(c) changes sign from negative to positive as x passes through c, then -

(A) f(c) is neither a maximum nor a minimum value of f(x)

(B) f(c) is a maximium value of f(x)

(C) f(c) is a minimum value of f(x)

(D) f(c) is either a maximum or a minimum value of f(x)

Q.44 If $\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ and A_2, B_2, C_2 are respectively cofactors of a_2, b_2, c_2 then $a_1A_2 + b_1B_2 + c_1C_2$ is equal to -

(A) $-\Delta$ (B) 0 (C) Δ (D) None of these

Q.45 If A is a square matrix, then A– A′ is -

(A) unit matrix (B) null matrix

(C) symmetric matrix (D) a skew symmetric matrix

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ANSWER KEY

1.	(D)	2.	(B)	3.	(A)	4.	(A)	5.	(A)
6.	(D)	7.	(A)	8.	(B)	9.	(A)	10.	(C)
11.	(A)	12.	(D)	13.	(D)	14.	(D)	15.	(B)
16.	(D)	17.	(B)	18.	(D)	19.	(C)	20.	(B)
21.	(B)	22.	(A)	23.	(C)	24.	(D)	25.	(A)
26.	(B)	27.	(A)	28.	(A)	29.	(C)	30.	(D)
31.	(A)	32.	(D)	33.	(A)	34.	(D)	35.	(A)
36.	(C)	37.	(B)	38.	(D)	39.	(B)	40.	(C)
41.	(A)	42.	(D)	43.	(C)	44.	(B)	45.	(D)

Space for rough works