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ALL INDIA RANKS IN JEE-ADV 2022

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JEE MAIN (JAN) 2023 (31-01-2023-Session-2)

MATHEMATICS, PHYSICS & CHEMISTRY

Jee-Main_31-JAN-2023_Shift-02

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point **Pen** only.

2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of 90 questions. The maximum marks are **300.**

5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry** and **Mathematics** having **30 questions** in each subject and subject having **two sections.**

(I) Section –I contains 20 **multiple choice** questions with only one correct option.

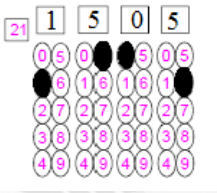
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

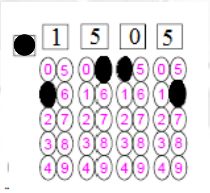
(II) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.

- The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and if answer is from **10.5** and less than **11** round off is **11).**

To cancel any attempted question bubble on the question number box.

For example: To cancel attempted question 21. Bubble on 21 as shown below





Question Answered for Marking **Question Cancelled for Marking**

Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**

7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.

8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.

9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**

10. **Do not fold of make any stray marks on the Answer Sheet**

PHYSICS **Max Marks: 100**

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

01. Match List I with List II

List – I	**List - II**
A) Angular momentum	I) $\left[ML^2T^{-2}\right]$
B) Torque	II) $\left[ML^{-2}T^{-2}\right]$
C) Stress	III) $\left[ML^2T^{-1}\right]$
D) Pressure gradient	Iv) $\left[ML^{-1}T^{-2}\right]$

Choose the correct answer from the options given below.

1) $A-IV, B-II, C-I, D-III$ **2)** $A-II, B-III, C-IV, D-I$

3) $A-III, B-I, C-IV, D-II$ **4)** $A-I, B-IV, C-III, D-II$

Key: 3

Sol: (A) angular momentum, $J = mvr$

$\left[J\right] = MLT^{-1}L = ML^2T^{-1}$

(B) Torque, $\tau = Fr_{\perp}$

$\left[\tau\right] = MLT^{-2}L = ML^2T^{-2}$

(C) Stress, $\sigma = \frac{F}{A}$

$\left[\sigma\right] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

(D) Pressure gradient $= \frac{dp}{dx} = \frac{ML^{-1}T^{-2}}{L} = ML^{-2}T^{-2}$

02. Under the same load, wire A having length 5.0 m and cross section $2.5\times10^{-5}\ m^2$ stretches uniformly by the same amount as another wire B of length 6.0 m and a cross section of $3.0\times10^{-5}\ m^2$ stretches. The ratio of the Young's modulus of wire A to that of wire B will be:

1) 1:4 **2)** 1:1 **3)** 1:10 **4)** 1:2

Key: 2

Sol: $Y=\dfrac{F\ell}{A\Delta^{le}}$

Extension of local is same $\therefore y\propto\dfrac{\ell}{A}$

$$\frac{y_A}{y_B}=\frac{\ell_A}{\ell_B}\times\frac{A_B}{A_A}=\frac{5}{6}\times\frac{3\times10^{-5}}{2.5\times10^{-5}}$$

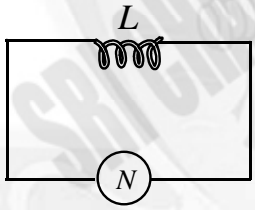
$$\frac{y_A}{y_B}=1\Rightarrow1:1$$

03. An alternating voltage source $V=260\sin(628t)$ is connected across a pure inductor of 5 mH. Inductive reactance in the circuit is:

1) 3.14Ω **2)** 6.28Ω **3)** 0.318Ω **4)** 0.5Ω

Key: 1

Sol:



$V=260\sin(628)t$

$L=5mH,\omega=628\ rad/s$

Inductive reactance, $X_L=\omega L$

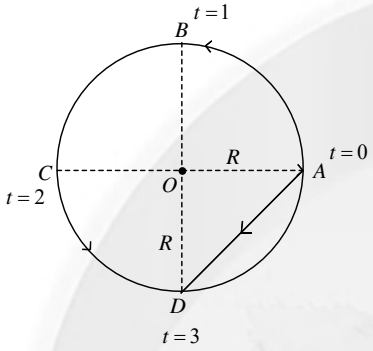
$X_L=628\times5\times10^{-3}=3.14\Omega$

04. A body is moving with constant speed, in a circle of radius 10 m. the body completes one revolutions in 4s. At the end of 3rd second, the displacement of body (in m) from its starting point

1) 15π **2)** $10\sqrt{2}$ **3)** 30 **4)** 5π

Key: 2

Sol:



Speed, v = constant Radius, R = 10 m T = Time period = 4s

At the end of 3rd second, particle will be at D (Starts from A)

$\therefore$ displacement $S = \sqrt{2}\,R = \sqrt{2}\times 10 = 10\sqrt{2}\ m$

05. Considering a group of positive charges, which of the following statements is correct?

1) Net potential of the system cannot be zero at a point but net electric field can be zero at that point.

2) Net potential of the system at appoint can be zero but net electric field cann't be zero at that point.

3) Both the net potential and the net electric field cannot be zero at a point.

4) Both the net potential and the net field can be zero at a point.

Key: 1

Sol: Due to all positive charges, potential can never be zero, but field can be zero. Example at mid point of 2 equal the charges.

06. The H amount of thermal energy is developed by a resistor in 10 s when a current of 4A is passes through it. If the current is increased to 16A, the thermal energy developed by the resistor in 10s will be:

1) $\frac{H}{4}$ **2)** H **3)** 4H **4)** 16H

Key: 4

Sol: $H = i^2Rt$ $\qquad \frac{H_1}{H_2} = \frac{i_1^2}{i_2^2}\frac{R_1}{R_2}\frac{t_1}{t_2}\left(R_1 = R_2\right)$

$\frac{H}{H_2} = \frac{4^2}{16^2}\times\frac{10}{10}$ $\qquad \left(t_1 = t_2 = 10s\right)$ $\qquad \frac{H}{H_2} = \frac{1}{16} \Rightarrow H_2 = 16H$

07. For a solid rod, the Young's modulus of elasticity is $3.2\times10^{11} Nm^{-2}$ and density is $8\times10^{3}\ kg\ m^{-3}$. The velocity of longitudinal wave in the rod will be

1) $3.65\times10^{3}\ ms^{-1}$ **2)** $18.96\times10^{3}\ ms^{-1}$

3) $14.75\times10^{3}\ ms^{-1}$ **4)** $6.32\times10^{3}\ ms^{-1}$

Key: 4

Sol: in solids, velocity of sound $V=\sqrt{\frac{Y}{\rho}}$

$Y=3.2\times10^{11}\ N/m^2,\ \rho=8\times10^{3}\ kg/m^3$

$$V=\sqrt{\frac{3.2\times10^{11}}{8\times10^{3}}}=2\times\sqrt{10}\times10^{3}=2\times3.16\times10^{3}=6.32\times10^{3}\ m/s$$

08. A long conducting wire having a current I flowing through it, is bent into a circular coil of N turns. Then it is vent into a circular coil of n turns. The magnetic field is calculated at the centre of coils in both the cases. The ratio of the magnetic field in first case to that of second case is:

1) $n:N$ **2)** $N:n$ **3)** $N^2:n^2$ **4)** $n^2:N^2$

Key: 3

Sol: At centre of circular coil $B=\frac{\mu_0 Ni}{2R}$

1st case $\ell=N2\pi R_1\Rightarrow R_1=\frac{\ell}{2\pi N}$

$$B_1=\frac{\mu_0 NI}{2\ell}(2\pi N)$$

$$B_1=\frac{\mu_0\pi N^2}{\ell}I$$

2nd case $B_2=\frac{\mu_0 nI}{2\frac{\ell}{2\pi n}}=\frac{\mu_0\pi n^2 I}{\ell}$

$$\frac{B_1}{B_2}=\frac{N^2}{n^2}$$

09. The radius of electron's second stationary orbit in Bohr's atom is R. the radius of 3rd orbit will be

1) $\frac{R}{3}$ **2)** $9R$ **3)** $2.25R$ **4)** $3R$

Key: 3

Sol: Bohr's atom = hydrogen atom

$$r_n = \frac{n^2h^2 \in_0}{\pi mze^2}$$

$$z = 1 \Rightarrow r_n \propto n^2$$

$$\frac{r_2}{r_3} = \frac{(2)^2}{(3)^2}$$

$$\frac{R}{r_3} = \frac{4}{9} \Rightarrow r_3 = \frac{9R}{4} = 2.25R$$

10. If the two metals A and B are exposed to radiation of wavelength 350 nm. The work functions of metals A and B are 4.8 eV and 2.2 eV. Then choose the correct option.

1) Both metals A and B will emit photo-electrons

2) Metal B will not emit photo-electrons

3) Both metals A and B will not emit photo-electrons

4) Metal A will not emit photo-electrons

Key: 2

Sol: Threshold wavelength $\lambda_0 = \frac{hc}{\phi_0} \Rightarrow \lambda_0 = \frac{12400}{\phi_0(eV)} A^0$

$\phi_0 \Rightarrow$ work function

For A: $\lambda_0 = \frac{12400}{4.8} = 2583A^0 = 258.3nm$

For B: $\lambda_0 = \frac{12400}{2.2} = 5636A^0 = 563.6nm$

For photo electric emission to take place wavelength of incident radiation $\lambda < \lambda_0$

Given $\lambda = 350\ nm$

$\lambda < (\lambda_0)_B$

$\therefore$ only B emit photo electrons