

## FINAL JEE-MAIN EXAMINATION – APRIL, 2024

**(Held On Monday 08<sup>th</sup> April, 2024)**

**TIME : 9 : 00 AM to 12 : 00 NOON**

### PHYSICS

### TEST PAPER WITH ANSWER

#### SECTION-A

31. Three bodies A, B and C have equal kinetic energies and their masses are 400 g, 1.2 kg and 1.6 kg respectively. The ratio of their linear momenta is :

- (1)  $1 : \sqrt{3} : 2$                       (2)  $1 : \sqrt{3} : \sqrt{2}$   
 (3)  $\sqrt{2} : \sqrt{3} : 1$                       (4)  $\sqrt{3} : \sqrt{2} : 1$

Ans. (1)

32. Average force exerted on a non-reflecting surface at normal incidence is  $2.4 \times 10^{-4} \text{N}$ . If  $360 \text{ W/cm}^2$  is the light energy flux during span of 1 hour 30 minutes. Then the area of the surface is:

- (1)  $0.2 \text{ m}^2$                               (2)  $0.02 \text{ m}^2$   
 (3)  $20 \text{ m}^2$                               (4)  $0.1 \text{ m}^2$

Ans. (2)

33. A proton and an electron are associated with same de-Broglie wavelength. The ratio of their kinetic energies is:

(Assume  $h = 6.63 \times 10^{-34} \text{ J s}$ ,  $m_e = 9.0 \times 10^{-31} \text{ kg}$  and  $m_p = 1836 \text{ times } m_e$ )

- (1)  $1 : 1836$                               (2)  $1 : \frac{1}{1836}$   
 (3)  $1 : \frac{1}{\sqrt{1836}}$                               (4)  $1 : \sqrt{1836}$

Ans. (1)

34. A mixture of one mole of monoatomic gas and one mole of a diatomic gas (rigid) are kept at room temperature ( $27^\circ\text{C}$ ). The ratio of specific heat of gases at constant volume respectively is:

- (1)  $\frac{7}{5}$                                       (2)  $\frac{3}{2}$   
 (3)  $\frac{3}{5}$                                       (4)  $\frac{5}{3}$

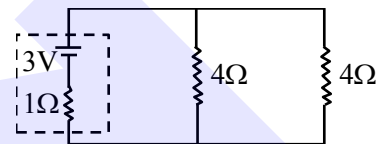
Ans. (3)

35. In an expression  $a \times 10^b$  :

- (1) a is order of magnitude for  $b \leq 5$   
 (2) b is order of magnitude for  $a \leq 5$   
 (3) b is order of magnitude for  $5 < a \leq 10$   
 (4) b is order of magnitude for  $a \geq 5$

Ans. (2)

36. In the given circuit, the terminal potential difference of the cell is :



- (1) 2 V                                      (2) 4 V  
 (3) 1.5 V                                      (4) 3 V

Ans. (1)

37. Binding energy of a certain nucleus is  $18 \times 10^8 \text{ J}$ . How much is the difference between total mass of all the nucleons and nuclear mass of the given nucleus:

- (1)  $0.2 \mu\text{g}$                               (2)  $20 \mu\text{g}$   
 (3)  $2 \mu\text{g}$                                       (4)  $10 \mu\text{g}$

Ans. (2)

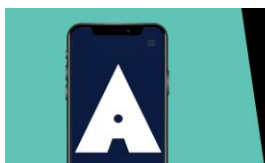
38. Paramagnetic substances:

- A. align themselves along the directions of external magnetic field.  
 B. attract strongly towards external magnetic field.  
 C. has susceptibility little more than zero.  
 D. move from a region of strong magnetic field to weak magnetic field.

Choose the **most appropriate** answer from the options given below:

- (1) A, B, C, D                              (2) B, D Only  
 (3) A, B, C Only                              (4) A, C Only

Ans. (4)



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39. A clock has 75 cm, 60 cm long second hand and minute hand respectively. In 30 minutes duration the tip of second hand will travel x distance more than the tip of minute hand. The value of x in meter is nearly (Take  $\pi = 3.14$ ) :

- (1) 139.4 (2) 140.5  
(3) 220.0 (4) 118.9

Ans. (1)

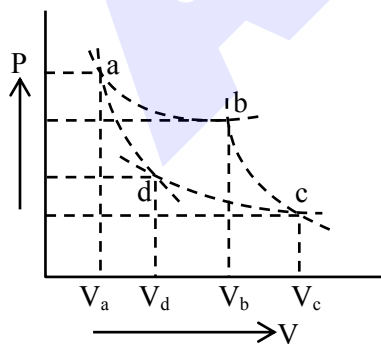
40. Young's modulus is determined by the equation given by  $Y = 49000 \frac{M}{\ell} \frac{\text{dyne}}{\text{cm}^2}$  where M is the mass and  $\ell$  is the extension of wire used in the experiment. Now error in Young modulus(Y) is estimated by taking data from M- $\ell$  plot in graph paper. The smallest scale divisions are 5 g and 0.02 cm along load axis and extension axis respectively. If the value of M and  $\ell$  are 500 g and 2 cm respectively then percentage error of Y is :

- (1) 0.2 % (2) 0.02 %  
(3) 2 % (4) 0.5 %

Ans. (3)

41. Two different adiabatic paths for the same gas intersect two isothermal curves as shown in P-V diagram. The relation between the ratio  $\frac{V_a}{V_d}$  and the

ratio  $\frac{V_b}{V_c}$  is:



(1)  $\frac{V_a}{V_d} = \left(\frac{V_b}{V_c}\right)^{-1}$  (2)  $\frac{V_a}{V_d} \neq \frac{V_b}{V_c}$

(3)  $\frac{V_a}{V_d} = \frac{V_b}{V_c}$  (4)  $\frac{V_a}{V_d} = \left(\frac{V_b}{V_c}\right)^2$

Ans. (3)

42. Two planets A and B having masses  $m_1$  and  $m_2$  move around the sun in circular orbits of  $r_1$  and  $r_2$  radii respectively. If angular momentum of A is L and that of B is 3L, the ratio of time period  $\left(\frac{T_A}{T_B}\right)$  is:

- (1)  $\left(\frac{r_2}{r_1}\right)^{\frac{3}{2}}$  (2)  $\left(\frac{r_1}{r_2}\right)^3$   
(3)  $\frac{1}{27} \left(\frac{m_2}{m_1}\right)^3$  (4)  $27 \left(\frac{m_1}{m_2}\right)^3$

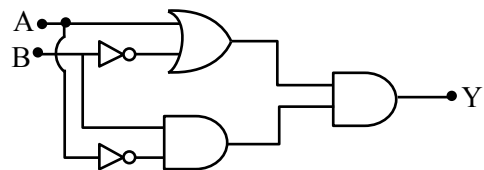
Ans. (3)

43. A LCR circuit is at resonance for a capacitor C, inductance L and resistance R. Now the value of resistance is halved keeping all other parameters same. The current amplitude at resonance will be now:

- (1) Zero (2) double  
(3) same (4) halved

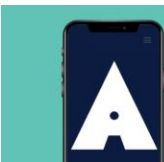
Ans. (2)

44. The output Y of following circuit for given inputs is :



- (1)  $A \cdot B(A + B)$   
(2)  $A \cdot B$   
(3) 0  
(4)  $\bar{A} \cdot B$

Ans. (3)



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45. Two charged conducting spheres of radii  $a$  and  $b$  are connected to each other by a conducting wire. The ratio of charges of the two spheres respectively is:

- (1)  $\sqrt{ab}$  (2)  $ab$   
 (3)  $\frac{a}{b}$  (4)  $\frac{b}{a}$

Ans. (3)

46. Correct Bernoulli's equation is (symbols have their usual meaning) :

- (1)  $P + mgh + \frac{1}{2}mv^2 = \text{constant}$   
 (2)  $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$   
 (3)  $P + \rho gh + \rho v^2 = \text{constant}$   
 (4)  $P + \frac{1}{2}\rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

Ans. (2)

47. A player caught a cricket ball of mass 150 g moving at a speed of 20 m/s. If the catching process is completed in 0.1 s, the magnitude of force exerted by the ball on the hand of the player is:

- (1) 150 N (2) 3 N  
 (3) 30 N (4) 300 N

Ans. (3)

48. A stationary particle breaks into two parts of masses  $m_A$  and  $m_B$  which move with velocities  $v_A$  and  $v_B$  respectively. The ratio of their kinetic energies ( $K_B : K_A$ ) is :

- (1)  $v_B : v_A$  (2)  $m_B : m_A$   
 (3)  $m_B v_B : m_A v_A$  (4) 1 : 1

Ans. (1)

49. Critical angle of incidence for a pair of optical media is  $45^\circ$ . The refractive indices of first and second media are in the ratio:

- (1)  $\sqrt{2} : 1$  (2) 1 : 2  
 (3) 1 :  $\sqrt{2}$  (4) 2 : 1

Ans. (1)

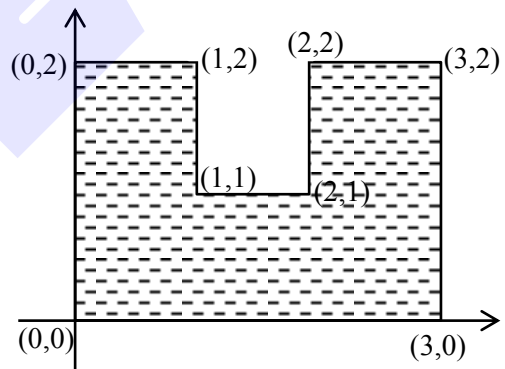
50. The diameter of a sphere is measured using a vernier caliper whose 9 divisions of main scale are equal to 10 divisions of vernier scale. The shortest division on the main scale is equal to 1 mm. The main scale reading is 2 cm and second division of vernier scale coincides with a division on main scale. If mass of the sphere is 8.635 g, the density of the sphere is:

- (1) 2.5 g/cm<sup>3</sup> (2) 1.7 g/cm<sup>3</sup>  
 (3) 2.2 g/cm<sup>3</sup> (4) 2.0 g/cm<sup>3</sup>

Ans. (4)

**SECTION-B**

51. A uniform thin metal plate of mass 10 kg with dimensions is shown. The ratio of  $x$  and  $y$  coordinates of center of mass of plate in  $\frac{n}{9}$ . The value of  $n$  is \_\_\_\_\_.



Ans. (15)

52. An electron with kinetic energy 5 eV enters a region of uniform magnetic field of 3  $\mu$ T perpendicular to its direction. An electric field  $E$  is applied perpendicular to the direction of velocity and magnetic field. The value of  $E$ , so that electron moves along the same path, is \_\_\_\_\_ NC<sup>-1</sup>.

(Given, mass of electron =  $9 \times 10^{-31}$  kg, electric charge =  $1.6 \times 10^{-19}$ C)

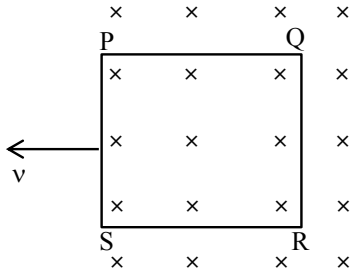
Ans. (4)



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53. A square loop PQRS having 10 turns, area  $3.6 \times 10^{-3} \text{ m}^2$  and resistance  $100 \ \Omega$  is slowly and uniformly being pulled out of a uniform magnetic field of magnitude  $B = 0.5 \text{ T}$  as shown. Work done in pulling the loop out of the field in  $1.0 \text{ s}$  is \_\_\_\_\_  $\times 10^{-6} \text{ J}$ .



Ans. (3)

54. Resistance of a wire at  $0 \text{ }^\circ\text{C}$ ,  $100 \text{ }^\circ\text{C}$  and  $t \text{ }^\circ\text{C}$  is found to be  $10 \ \Omega$ ,  $10.2 \ \Omega$  and  $10.95 \ \Omega$  respectively. The temperature  $t$  in Kelvin scale is \_\_\_\_\_.

Ans. (748)

55. An electric field,  $\vec{E} = \frac{2\hat{i} + 6\hat{j} + 8\hat{k}}{\sqrt{6}}$  passes through the surface of  $4 \text{ m}^2$  area having unit vector  $\hat{n} = \left( \frac{2\hat{i} + \hat{j} + \hat{k}}{\sqrt{6}} \right)$ . The electric flux for that surface is \_\_\_\_\_ V m.

Ans. (12)

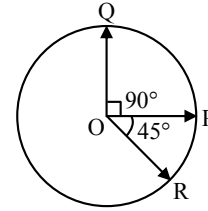
56. A liquid column of height  $0.04 \text{ cm}$  balances excess pressure of soap bubble of certain radius. If density of liquid is  $8 \times 10^3 \text{ kg m}^{-3}$  and surface tension of soap solution is  $0.28 \text{ Nm}^{-1}$ , then diameter of the soap bubble is \_\_\_\_\_ cm.  
(if  $g = 10 \text{ ms}^{-2}$ )

Ans. (7)

57. A closed and an open organ pipe have same lengths. If the ratio of frequencies of their seventh overtones is  $\left( \frac{a-1}{a} \right)$  then the value of  $a$  is \_\_\_\_\_.

Ans. (16)

58. Three vectors  $\vec{OP}$ ,  $\vec{OQ}$  and  $\vec{OR}$  each of magnitude  $A$  are acting as shown in figure. The resultant of the three vectors is  $A\sqrt{x}$ . The value of  $x$  is \_\_\_\_\_.



Ans. (3)

59. A parallel beam of monochromatic light of wavelength  $600 \text{ nm}$  passes through single slit of  $0.4 \text{ mm}$  width. Angular divergence corresponding to second order minima would be \_\_\_\_\_  $\times 10^{-3} \text{ rad}$ .

Ans. (6)

60. In an alpha particle scattering experiment distance of closest approach for the  $\alpha$  particle is  $4.5 \times 10^{-14} \text{ m}$ . If target nucleus has atomic number 80, then maximum velocity of  $\alpha$ -particle is \_\_\_\_\_  $\times 10^5 \text{ m/s}$  approximately.

$$\left( \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ SI unit, mass of } \alpha \text{ particle} = 6.72 \times 10^{-27} \text{ kg} \right)$$

Ans. (156)



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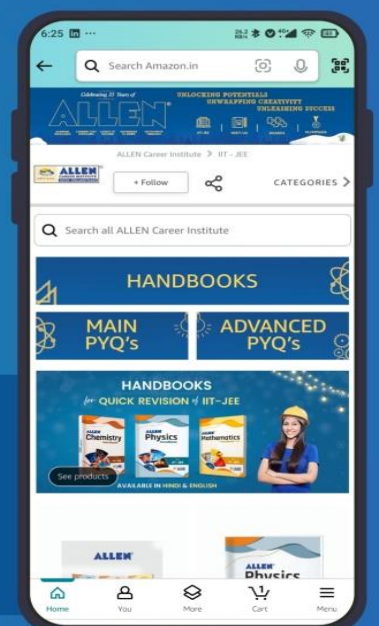
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