JEE Main Physics Sample Paper-5

Duration: 1 Hour **Maximum Marks: 100**

Instructions

- This paper contains TWO sections: **Section A** (MCQs) and **Section B** (Numerical).
- Section A contains 20 Multiple Choice Questions.
- Section B contains 5 Numerical Value Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Section A — Multiple Choice Questions

Q1. The stopping potential for photoelectrons is 4.8V when light of wavelength λ is incident. If the wavelength is doubled, the stopping potential becomes 1.6V. The threshold wavelength is: [JEE Main 2024]

(A) 2λ

(B) 4λ

(C) 6λ

(D) 8λ

Q2. In a nuclear reactor, the function of the moderator is to: [JEE Main 2023]

(A) Absorb neutrons

(B) Accelerate neutrons

(C) Slow down neutrons

(D) Stop the chain reaction

Q3. The ratio of the radius of the $n = 3$ orbit to the $n = 1$ orbit in a Hydrogen atom is: [JEE Main 2022]

(A) 3 : 1

(B) 1 : 3

(C) $9 : 1$

(D) $1 : 9$

Q4. An electron and a photon have the same energy E. The ratio of their de Broglie wavelengths (λ_e/λ_p) is proportional to: [JEE Main 2025]

(A) $E^{1/2}$

(B) $E^{-1/2}$

(C) E

(D) E^0

Q5. Two identical capacitors are first connected in parallel and then in series. The ratio of their equivalent capacitances (C_p/C_s) is: [JEE Main 2024]

(A) $2 : 1$

(B) $4 : 1$

(C) $1 : 2$

(D) $1 : 4$

Q6. The electric potential at a point on the axis of an electric dipole at a distance r from its center varies as: [JEE Main 2021]

(A) $1/r$

(B) $1/r^2$

(C) $1/r^3$

(D) r^2

Q7. A dielectric slab of constant K is inserted between the plates of an isolated charged capacitor. The energy stored in the capacitor: [JEE Main 2023]

(A) Increases K times

(B) Decreases K times

(C) Remains constant

(D) Becomes zero

Q8. The temperature coefficient of resistance of a wire is 0.00125 per °C. At 300K its resistance is 1Ω. At what temperature will the resistance be 2Ω? [JEE Main 2022]

(A) 1154K

(B) 1100K

(C) 1400K

(D) 1127K

Q9. In a Wheatstone bridge, if the battery and galvanometer are interchanged, the deflection in the galvanometer will: [JEE Main 2025]

(A) Change

(B) Remain unchanged

(C) Depend on resistance values

(D) Become zero

Q10. A cell of EMF E and internal resistance r is connected to an external resistance R. Maximum power is delivered to R when: [JEE Main 2024]

(A) $R = r$

(B) $R = r/2$

(C) $R = 2r$

(D) $R = 0$

Q11. The magnetic field at the center of a circular current-carrying loop of radius R is B. The magnetic field at a distance R from the center on the axis is: [JEE Main 2021]

(A) $B/2$

(B) $B/4$

(C) $B/(2\sqrt{2})$

(D) $B/8$

Q12. A transformer works on the principle of: [JEE Main 2023]

(A) Self Induction

(B) Mutual Induction

(C) Eddy Currents

(D) Magnetic resonance

Q13. In an LCR series circuit, at resonance, the phase difference between current and voltage is: [JEE Main 2022]

(A) $\pi/2$

(B) $\pi/4$

(C) 0

(D) π

Q14. A convex lens of focal length 20cm is placed in contact with a concave lens of focal length 40cm. The power of the combination is: [JEE Main 2024]

(A) +2.5D

(B) −2.5D

(C) +5D

(D) −5D

Q15. In YDSE, if the width of one slit is slightly increased, then: [JEE Main 2025]

(A) Bright fringes become brighter

(B) Dark fringes become darker

(C) Fringe width increases

(D) Sharpness of fringes decreases

Q16. The Brewster's angle for a glass slab ($n = \sqrt{3}$) is: [JEE Main 2021]

(A) 30°

(B) 45°

(C) 60°

(D) 90°

Q17. If the pressure of an ideal gas is decreased by 10% isothermally, the volume increases by approximately: [JEE Main 2023]

(A) 10%

(B) 9%

(C) 11.1%

(D) 20%

Q18. A particle executes SHM with amplitude A. At what displacement from the mean position is the Kinetic Energy equal to Potential Energy? [JEE Main 2022]

(A) $A/2$

(B) $A/\sqrt{2}$

(C) $A/\sqrt{3}$

(D) A^2

Q19. A disc of mass M and radius R rolls down an inclined plane without slipping. The ratio of its rotational kinetic energy to total kinetic energy is: [JEE Main 2024]

(A) 1 : 2

(B) 1 : 3

(C) 2 : 3

(D) 1 : 4

Q20. The escape velocity on Earth is 11.2km/s. On a planet with double the radius and same density as Earth, it will be: [JEE Main 2025]

(A) 11.2km/s

(B) 22.4km/s

(C) 5.6km/s

(D) 44.8km/s

Section B — Numerical Value Questions

Q21. A wire of length L and resistance R is stretched to triple its length. The new resistance is $n \times R$. Find n. [JEE Main 2024]

Q22. A Carnot engine works between 600K and 300K. Its efficiency in percentage is _____%. [JEE Main 2023]

Q23. The threshold frequency for a metal is 10^{15} Hz. If light of frequency 2×10^{15} Hz hits the metal, the maximum kinetic energy of electrons is $k \times h \times 10^{15}$. Find k. [JEE Main 2025]

Q24. Two lenses of power +12D and −2D are placed in contact. The focal length of the combination is _____ cm. [JEE Main 2022]

Q25. A bullet of mass 10g moving at 400m/s hits a wooden block and stops after 20cm. The average resistive force exerted by the block is _____ N. [JEE Main 2024]

Detailed Solutions

Q1.

Solution

Concept: Photoelectric equation:

$$eV_s = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

Solution: For wavelength λ:

$$e(4.8) = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \quad ...(1)$$

For 2λ:

$$e(1.6) = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0} \quad ...(2)$$

Subtract:

$$e(3.2) = \frac{hc}{\lambda} - \frac{hc}{2\lambda} = \frac{hc}{2\lambda}$$

$$\Rightarrow \frac{hc}{\lambda} = 6.4e$$

Substitute in (1):

$$4.8e = 6.4e - \frac{hc}{\lambda_0} \Rightarrow \frac{hc}{\lambda_0} = 1.6e$$

$$\lambda_0 = 4\lambda$$

Answer: (B)

Q2.

Solution

Concept: Moderator reduces neutron speed.

Solution: Fast neutrons produced in fission are slowed to thermal neutrons to increase probability of further fission.

Answer: (C)

Q3.

Solution

Concept: Bohr radius:

$$r_n \propto n^2$$

Solution:

$$\frac{r_3}{r_1} = \frac{3^2}{1^2} = 9$$

Answer: (C)

Q4.

Solution

Concept:

$$\lambda = \frac{h}{p}$$

Solution: Electron:

$$\lambda_e = \frac{h}{\sqrt{2mE}} \propto \frac{1}{\sqrt{E}}$$

Photon:

$$\lambda_p = \frac{hc}{E} \propto \frac{1}{E}$$

$$\frac{\lambda_e}{\lambda_p} \propto \frac{1/\sqrt{E}}{1/E} = E^{1/2}$$

Answer: (A)

Q5.

Solution

Concept: Capacitor combinations.

Solution: Parallel:

$$C_p = C + C = 2C$$

Series:

$$\frac{1}{C_s} = \frac{1}{C} + \frac{1}{C} = \frac{2}{C} \Rightarrow C_s = \frac{C}{2}$$

$$\frac{C_p}{C_s} = 4$$

Answer: (B)

Q6.

Solution

Concept: Dipole potential on axis:

$$V = \frac{1}{4\pi\epsilon_0}\frac{p}{r^2}$$

Solution: Thus potential varies as:

$$V \propto \frac{1}{r^2}$$

Answer: (B)

Q7.

Solution

Concept: Energy:

$$U = \frac{Q^2}{2C}$$

Solution: Isolated capacitor $\rightarrow Q$ constant

$$C' = KC \Rightarrow U' = \frac{Q^2}{2KC} = \frac{U}{K}$$

Answer: (B)

Q8.

Solution

Concept:

$$R = R_0(1 + \alpha\Delta T)$$

Solution:

$$2 = 1(1 + 0.00125(T - 300))$$

$$1 = 0.00125(T - 300) \Rightarrow T - 300 = 800 \Rightarrow T = 1100K$$

Answer: (B)

Q9.

Solution

Concept: Balanced Wheatstone bridge.

Solution: Interchanging battery and galvanometer does not disturb balance condition.

Answer: (B)

Q10.

Solution

Concept: Maximum power transfer:

$$R = r$$

Solution:

$$P = \frac{E^2 R}{(R+r)^2}$$

Maximizing gives $R = r$.

Answer: (A)

Q11.

Solution

Concept:

$$B_{axis} = \frac{B}{2\sqrt{2}}$$

Answer: (C)

Q12.

Solution

Concept: Transformer works on mutual induction.

Answer: (B)

Q13.

Solution

Concept: At resonance:

$$\phi = 0$$

Answer: (C)

Q14.

Solution

Concept: Power adds.

Solution:

$$P = \frac{1}{20} - \frac{1}{40} = \frac{1}{40} \Rightarrow f = 40cm$$

Answer: (A)

Q15.

Solution

Concept: Fringe visibility decreases with unequal intensity.

Answer: (D)

Q16.

Solution

Concept:

$$\tan\theta_B = n$$

Solution:

$$\tan\theta = \sqrt{3} \Rightarrow \theta = 60^\circ$$

Answer: (C)

Q17.

Solution

Concept:

$$PV = \text{constant}$$

Solution:

$$V \propto \frac{1}{P} \Rightarrow \frac{1}{0.9} = 1.111 \Rightarrow 11.1\%$$

Answer: (C)

Q18.

Solution

Concept:

$$KE = PE$$

Solution:

$$\frac{1}{2}kx^2 = \frac{1}{2}k(A^2 - x^2) \Rightarrow x = \frac{A}{\sqrt{2}}$$

Answer: (B)

Q19.

Solution

Concept: Rolling energy.

Solution:

$$KE_{total} = \frac{1}{2}mv^2 + \frac{1}{2}\frac{1}{2}mv^2 = \frac{3}{4}mv^2$$

$$\frac{KE_{rot}}{total} = \frac{1/4}{3/4} = \frac{1}{3}$$

Answer: (B)

Q20.

Solution

Concept:

$$v_e \propto R \text{ (same density)}$$

Solution:

$$v_{new} = 2 \times 11.2 = 22.4$$

Answer: (B)

Q21.

Solution

Concept: Resistance of a wire:

$$R = \rho \frac{L}{A}$$

When wire is stretched, volume remains constant:

$$AL = \text{constant}$$

Solution: New length:

$$L' = 3L$$

Since volume is constant:

$$A'L' = AL \Rightarrow A' = \frac{A}{3}$$

New resistance:

$$R' = \rho \frac{L'}{A'} = \rho \frac{3L}{A/3}$$

$$R' = 9\rho \frac{L}{A} = 9R$$

Answer: (9)

Q22.

Solution

Concept: Efficiency of Carnot engine:

$$\eta = 1 - \frac{T_2}{T_1}$$

Solution: Given:

$$T_1 = 600K, \quad T_2 = 300K$$

$$\eta = 1 - \frac{300}{600} = 1 - 0.5 = 0.5$$

$$\eta = 50\%$$

Answer: (50)

Q23.

Solution

Concept: Photoelectric equation:

$$K_{\max} = h(\nu - \nu_0)$$

Solution: Given:

$$\nu = 2 \times 10^{15}, \quad \nu_0 = 1 \times 10^{15}$$

$$K_{\max} = h(2-1) \times 10^{15}$$

$$K_{\max} = h \times 10^{15}$$

Comparing with:

$$K_{\max} = k \times h \times 10^{15}$$

$$k = 1$$

Answer: (1)

Q24.

Solution

Concept: Power of lenses in contact:

$$P = P_1 + P_2$$

Solution: Given:

$$P_1 = +12D, \quad P_2 = -2D$$

$$P = 12 - 2 = 10D$$

Focal length:

$$f = \frac{1}{P} = \frac{1}{10}\,\text{m} = 0.1\,\text{m}$$

$$f = 10\,\text{cm}$$

Answer: (10)

Q25.

Solution

Concept: Work-energy theorem:

$$W = \Delta KE$$

Solution: Given:

$$m = 10g = 0.01kg, \quad v = 400\,m/s, \quad d = 20cm = 0.2m$$

Initial kinetic energy:

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(0.01)(400)^2$$

$$KE = 0.005 \times 160000 = 800J$$

Work done by resistive force:

$$F \cdot d = KE$$

$$F \cdot 0.2 = 800$$

$$F = \frac{800}{0.2} = 4000N$$

Answer: (4000)

Answer Key — Section A

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	C	4	A	5	B
6	B	7	B	8	B	9	B	10	A
11	C	12	B	13	C	14	A	15	D
16	C	17	C	18	B	19	B	20	B

Answer Key — Section B

Q	Ans	Q	Ans
21	9	22	50
23	1	24	10
25	4000		