

JEE Main Physics Sample Paper-2

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.** A particle of mass m moves in circular path of radius r , centripetal acceleration $a_c = k^2 r t^2$. Power delivered: [JEE Main 2024]
- (A) $mk^2 r^2 t$
(B) $mk^2 r^2 t^2$
(C) $mk^2 r t$
(D) Zero
- Q2.** Ratio of magnetic field at center of circular loop to the field at distance $x = R\sqrt{3}$ on its axis: [JEE Main 2023]
- (A) 8:1
(B) 4:1
(C) 2:1
(D) $\sqrt{2} : 1$
- Q3.** A glass slab of thickness 3 cm and refractive index 1.5 is placed on an ink mark. Apparent raise of ink mark: [JEE Main 2022]
- (A) 1 cm



- (B) 2 cm
- (C) 1.5 cm
- (D) 0.5 cm

Q4. In adiabatic expansion, temperature drops to $1/4$ of initial value. Most probable speed becomes: [JEE Main 2025]

- (A) Halved
- (B) Doubled
- (C) One-fourth
- (D) Unchanged

Q5. Radioactive materials X_1, X_2 have decay constants 10λ and λ . Same initial nuclei. Time for $N_1/N_2 = 1/e$: [JEE Main 2021]

- (A) $1/(11\lambda)$
- (B) $1/(9\lambda)$
- (C) $11/(10\lambda)$
- (D) $1/(10\lambda)$

Q6. In a parallel plate capacitor, separation changes from d to $2d$ while battery remains connected. Work done by external agent: [JEE Main 2024]

- (A) $\epsilon_0 AV^2/(2d)$
- (B) $\epsilon_0 AV^2/(4d)$
- (C) $-\epsilon_0 AV^2/(4d)$
- (D) Zero

Q7. A step-up transformer is connected to 220 V line. Load current is 2 A, turns ratio is 1:25, efficiency is 100%. Primary current: [JEE Main 2023]

- (A) 50 A
- (B) 25 A
- (C) 0.08 A
- (D) 12.5 A

Q8. Work function of a metal is 4.0 eV. Longest wavelength of incident light for photoelectric emission: [JEE Main 2022]



- (A) 310 nm
- (B) 400 nm
- (C) 540 nm
- (D) 220 nm

Q9. Magnetic susceptibility of a paramagnetic substance at -73°C is 0.0075. Its susceptibility at 127°C is: [JEE Main 2025]

- (A) 0.00375
- (B) 0.0150
- (C) 0.0050
- (D) 0.01125

Q10. If error in radius is 2%, then error in volume is: [JEE Main 2024]

- (A) 2%
- (B) 4%
- (C) 6%
- (D) 8%

Q11. A particle starts from rest and has acceleration $a = 4t + 3$. Velocity at $t = 2$ s is: [JEE Main 2021]

- (A) 14 m/s
- (B) 10 m/s
- (C) 12 m/s
- (D) 16 m/s

Q12. Two soap bubbles of radii a and b combine to form a bubble of radius c . Then: [JEE Main 2023]

- (A) $c^2 = a^2 + b^2$
- (B) $c = a + b$
- (C) $c^3 = a^3 + b^3$
- (D) $c^2 = b^2 - a^2$



Q13. A long wire is bent into a circular loop of one turn and produces magnetic field B at center. If bent into n turns, field at center becomes: [JEE Main 2022]

- (A) nB
- (B) n^2B
- (C) $2nB$
- (D) $2n^2B$

Q14. In an LCR series circuit at resonance: [JEE Main 2024]

- (A) Phase difference is $\pi/2$
- (B) Impedance is maximum
- (C) Current is in phase with voltage
- (D) Voltage across inductor is zero

Q15. Two coherent sources have intensity ratio 1:4. Then I_{max}/I_{min} is: [JEE Main 2025]

- (A) 9:1
- (B) 3:1
- (C) 5:1
- (D) 25:9

Q16. Escape velocity of a planet is v_e . If both mass and radius of planet are doubled, new escape velocity is: [JEE Main 2021]

- (A) v_e
- (B) $2v_e$
- (C) $v_e/2$
- (D) $\sqrt{2}v_e$

Q17. For a CE amplifier, input resistance is $200\ \Omega$, load resistance is $20\ \text{k}\Omega$, and $\beta = 100$. Voltage gain is: [JEE Main 2023]

- (A) 1000
- (B) 5000
- (C) 10000



(D) 2000

Q18. A simple pendulum of length L is given maximum angular displacement θ . Maximum kinetic energy is: [JEE Main 2022]

(A) $mgL(1 - \cos \theta)$

(B) $mgL \sin \theta$

(C) mgL

(D) $mgL \cos \theta$

Q19. Internal energy of 1 mole of an ideal gas depends on: [JEE Main 2024]

(A) Pressure alone

(B) Volume alone

(C) Temperature alone

(D) None of these

Q20. A metal rod of length 1 m rotates with angular velocity 5 rad/s in magnetic field $B = 0.2$ T. Induced emf is: [JEE Main 2025]

(A) 0.5 V

(B) 1.0 V

(C) 0.2 V

(D) 0.1 V



Section B — Numerical Questions

- Q21.** A light bulb is rated 100 W, 220 V. Resistance is $X \Omega$: [JEE Main 2024]
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- Q22.** For a mass 1 kg attached to spring of spring constant 100 N/m, time period is $X\pi/5$ s. Find X : [JEE Main 2023]
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- Q23.** In photoelectric experiment, $f = 8 \times 10^{14}$ Hz and work function is 2.0 eV. Maximum kinetic energy is $X \times 10^{-19}$ J. Find X : [JEE Main 2025]
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- Q24.** Radius of second Bohr orbit is $X \times 10^{-10}$ m. Given $r_1 = 0.53 \text{ \AA}$. Find X : [JEE Main 2022]
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- Q25.** A force $\vec{F} = (2\hat{i} + 3\hat{j} + 4\hat{k})$ N acts through displacement (1, 1, 1) m. Work done is X J. Find X : [JEE Main 2024]
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Detailed Solutions

Q1.

Solution

Concept: Power in circular motion is due to tangential force only.**Formula:**

$$a_c = \frac{v^2}{r}$$

Solution: Given

$$a_c = k^2 r t^2$$

So,

$$\frac{v^2}{r} = k^2 r t^2 \Rightarrow v^2 = k^2 r^2 t^2 \Rightarrow v = k r t$$

Now tangential acceleration is

$$a_t = \frac{dv}{dt} = k r$$

Tangential force,

$$F_t = m a_t = m k r$$

Hence power delivered,

$$P = F_t v = (m k r)(k r t) = m k^2 r^2 t$$

Final Answer: (A)

Answer: (A)

Q2.

Solution

Concept: Magnetic field at center of a circular loop and on its axis.**Formula:**

$$B_{\text{center}} = \frac{\mu_0 I}{2R}, \quad B_{\text{axis}} = \frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$$

Solution: At center,

$$B_c = \frac{\mu_0 I}{2R}$$

At

$$x = R\sqrt{3}$$

$$B_x = \frac{\mu_0 I R^2}{2(R^2 + 3R^2)^{3/2}} = \frac{\mu_0 I R^2}{2(4R^2)^{3/2}} = \frac{\mu_0 I R^2}{2(8R^3)} = \frac{\mu_0 I}{16R}$$

Therefore,

$$B_c : B_x = \frac{\mu_0 I}{2R} : \frac{\mu_0 I}{16R} = 8 : 1$$

Final Answer: (A)

Answer: (A)

Q3.

Solution**Concept:** Apparent depth through refracting slab.**Formula:**

$$\text{Apparent depth} = \frac{\text{Real depth}}{\mu}$$

Solution: Real depth

$$= 3 \text{ cm}$$

Refractive index

$$\mu = 1.5$$

So apparent depth is

$$\frac{3}{1.5} = 2 \text{ cm}$$

Hence apparent raise

$$= 3 - 2 = 1 \text{ cm}$$

Final Answer: (A)

Answer: (A)

Q4.

Solution**Concept:** Most probable speed varies as square root of temperature.**Formula:**

$$v_{mp} \propto \sqrt{T}$$

Solution: Given,

$$T_2 = \frac{T_1}{4}$$

Hence,

$$\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

So most probable speed becomes half.

Final Answer: (A)

Answer: (A)

Q5.

Solution**Concept:** Radioactive decay law.**Formula:**

$$N = N_0 e^{-\lambda t}$$

Solution: For first material,

$$N_1 = N_0 e^{-10\lambda t}$$

For second material,

$$N_2 = N_0 e^{-\lambda t}$$

Thus,

$$\frac{N_1}{N_2} = e^{-10\lambda t + \lambda t} = e^{-9\lambda t}$$

Given

$$\frac{N_1}{N_2} = \frac{1}{e} = e^{-1}$$

So,

$$9\lambda t = 1 \Rightarrow t = \frac{1}{9\lambda}$$

Final Answer: (B)

Answer: (B)

Q6.

Solution**Concept:** For battery connected capacitor, voltage remains constant.**Formula:**

$$U = \frac{1}{2} CV^2, \quad C = \frac{\epsilon_0 A}{d}$$

Solution: Initially,

$$U_i = \frac{1}{2} \frac{\epsilon_0 A}{d} V^2$$

Finally when separation becomes $2d$,

$$U_f = \frac{1}{2} \frac{\epsilon_0 A}{2d} V^2 = \frac{\epsilon_0 AV^2}{4d}$$

Work done by external agent in separating the plates equals

$$W = U_i - U_f?$$

For constant voltage, attractive force opposes separation and required external work is positive:

$$W = \int_d^{2d} \frac{1}{2} \frac{\epsilon_0 AV^2}{x^2} dx = \frac{1}{2} \epsilon_0 AV^2 \left[\frac{1}{d} - \frac{1}{2d} \right] = \frac{\epsilon_0 AV^2}{4d}$$

Final Answer: (B)

Answer: (B)

Q7.

Solution**Concept:** Ideal transformer with power conservation.**Formula:**

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}, \quad V_p I_p = V_s I_s$$

Solution: Turns ratio

$$\frac{N_p}{N_s} = 1 : 25$$

Hence,

$$\frac{V_s}{V_p} = 25$$

Given

$$V_p = 220 \text{ V}$$

So,

$$V_s = 25 \times 220 = 5500 \text{ V}$$

Given secondary current

$$I_s = 2 \text{ A}$$

At 100% efficiency,

$$V_p I_p = V_s I_s$$

$$220 I_p = 5500 \times 2$$

$$I_p = \frac{11000}{220} = 50 \text{ A}$$

Final Answer: (A)

Answer: (A)

Q8.

Solution**Concept:** Threshold wavelength for photoelectric effect.**Formula:**

$$\lambda_{\max} = \frac{hc}{\phi}$$

Using

$$hc = 1240 \text{ eV nm}$$

Solution: Given work function

$$\phi = 4.0 \text{ eV}$$

So,

$$\lambda_{\max} = \frac{1240}{4} = 310 \text{ nm}$$

Final Answer: (A)

Answer: (A)

Q9.

Solution**Concept:** Curie's law for paramagnetic substance.**Formula:**

$$\chi T = \text{constant}$$

Solution: At

$$-73^\circ\text{C} = 200 \text{ K}$$

and

$$127^\circ\text{C} = 400 \text{ K}$$

So,

$$\chi_1 T_1 = \chi_2 T_2$$

$$0.0075 \times 200 = \chi_2 \times 400$$

$$\chi_2 = \frac{0.0075 \times 200}{400} = 0.00375$$

Final Answer: (A)

Answer: (A)

Q10.

Solution**Concept:** Percentage error in powers.**Formula:**

$$V \propto r^3$$

Solution: If

$$\frac{\Delta r}{r} = 2\%$$

then

$$\frac{\Delta V}{V} = 3 \frac{\Delta r}{r} = 3 \times 2\% = 6\%$$

Final Answer: (C)

Answer: (C)

Q11.

Solution**Concept:** Velocity is integral of acceleration.**Formula:**

$$v = \int a \, dt$$

Solution: Given,

$$a = 4t + 3$$

Starting from rest means

$$v(0) = 0$$

Therefore,

$$v = \int_0^2 (4t + 3) \, dt$$

$$v = \left[2t^2 + 3t \right]_0^2 = 2(4) + 6 = 14 \text{ m/s}$$

Final Answer: (A)

Answer: (A)

Q12.

Solution**Concept:** On combination of soap bubbles, volume of air is conserved.**Formula:**

$$\frac{4}{3}\pi c^3 = \frac{4}{3}\pi a^3 + \frac{4}{3}\pi b^3$$

Solution: Cancelling common factor,

$$c^3 = a^3 + b^3$$

Final Answer: (C)

Answer: (C)

Q13.

Solution**Concept:** Magnetic field at center of circular coil.**Formula:**

$$B = \frac{\mu_0 n I}{2r}$$

Solution: Suppose original wire length is

$$L = 2\pi R$$

For one turn,

$$B = \frac{\mu_0 I}{2R}$$

If same wire is bent into n turns, then each turn has radius

$$r = \frac{R}{n}$$

Hence new field,

$$B' = \frac{\mu_0 n I}{2(R/n)} = \frac{\mu_0 n^2 I}{2R} = n^2 B$$

Final Answer: (B)

Answer: (B)

Q14.

Solution**Concept:** At resonance in series LCR circuit, inductive and capacitive reactances cancel.**Solution:** At resonance,

$$X_L = X_C$$

Therefore net reactance becomes zero and impedance is minimum:

$$Z = R$$

Hence current and voltage are in phase.

Final Answer: (C)

Answer: (C)

Q15.

Solution**Concept:** Interference maxima and minima in terms of amplitudes.**Formula:**

$$I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2, \quad I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$$

Solution: Given

$$I_1 : I_2 = 1 : 4$$

So amplitudes are in ratio

$$1 : 2$$

Thus,

$$I_{\max} = (1 + 2)^2 = 9$$

$$I_{\min} = (2 - 1)^2 = 1$$

Hence,

$$I_{\max} : I_{\min} = 9 : 1$$

Final Answer: (A)

Answer: (A)

Q16.

Solution**Concept:** Escape velocity.**Formula:**

$$v_e = \sqrt{\frac{2GM}{R}}$$

Solution: If mass and radius both become double, then

$$v'_e = \sqrt{\frac{2G(2M)}{2R}} = \sqrt{\frac{2GM}{R}} = v_e$$

Final Answer: (A)

Answer: (A)

Q17.

Solution**Concept:** Voltage gain of CE amplifier.**Formula:**

$$A_v = \beta \frac{R_L}{R_{in}}$$

Solution: Given,

$$\beta = 100, \quad R_L = 20\,000 \, \Omega, \quad R_{in} = 200 \, \Omega$$

So,

$$A_v = 100 \times \frac{20000}{200} = 100 \times 100 = 10000$$

Final Answer: (C)

Answer: (C)

Q18.

Solution**Concept:** Maximum kinetic energy of pendulum equals loss in gravitational potential energy from extreme position to mean position.**Formula:**

$$K_{\max} = mgL(1 - \cos \theta)$$

Solution: At extreme position potential energy with respect to mean is

$$mgL(1 - \cos \theta)$$

At mean position this becomes maximum kinetic energy.

Final Answer: (A)

Answer: (A)

Q19.

Solution**Concept:** Internal energy of ideal gas depends only on temperature.**Solution:** For an ideal gas,

$$U = nC_V T$$

Hence for 1 mole ideal gas, internal energy depends only on temperature.

Final Answer: (C)

Answer: (C)

Q20.

Solution**Concept:** Induced emf in rotating rod.**Formula:**

$$\mathcal{E} = \frac{1}{2}B\omega l^2$$

Solution: Given,

$$B = 0.2 \text{ T}, \quad \omega = 5 \text{ rad/s}, \quad l = 1 \text{ m}$$

So,

$$\mathcal{E} = \frac{1}{2} \times 0.2 \times 5 \times 1^2 = 0.5 \text{ V}$$

Final Answer: (A)

Answer: (A)

Q21.

Solution**Concept:** Electrical power relation.**Formula:**

$$P = \frac{V^2}{R}$$

Solution: Given,

$$P = 100 \text{ W}, \quad V = 220 \text{ V}$$

So,

$$R = \frac{V^2}{P} = \frac{220^2}{100} = \frac{48400}{100} = 484 \Omega$$

Final Answer: $R = 484 \Omega$ **Answer: (484)**

Q22.

Solution**Concept:** Time period of spring-mass system.**Formula:**

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Solution: Given,

$$m = 1 \text{ kg}, \quad k = 100 \text{ N/m}$$

Then

$$T = 2\pi\sqrt{\frac{1}{100}} = 2\pi \cdot \frac{1}{10} = \frac{\pi}{5} \text{ s}$$

Comparing with

$$T = \frac{X\pi}{5}$$

we get

$$X = 1$$

Final Answer: $X = 1$ **Answer: (1)**

Q23.

Solution**Concept:** Einstein photoelectric equation.**Formula:**

$$K_{\max} = hf - \phi$$

Solution: Given,

$$f = 8 \times 10^{14} \text{ Hz}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

So photon energy is

$$hf = 6.626 \times 10^{-34} \times 8 \times 10^{14} = 5.3008 \times 10^{-19} \text{ J}$$

Work function

$$\phi = 2.0 \text{ eV} = 2.0 \times 1.6 \times 10^{-19} = 3.2 \times 10^{-19} \text{ J}$$

Therefore

$$K_{\max} = 5.3008 \times 10^{-19} - 3.2 \times 10^{-19} = 2.1008 \times 10^{-19} \text{ J}$$

Hence

$$X \approx 2.1$$

Final Answer: $K_{\max} = 2.1 \times 10^{-19} \text{ J}$ **Answer: (2.1 × 10⁻¹⁹)**

Q24.

Solution**Concept:** Radius of Bohr orbit.**Formula:**

$$r_n = n^2 r_1$$

Solution: For second orbit,

$$n = 2$$

Hence

$$r_2 = 2^2 r_1 = 4r_1 = 4 \times 0.53 \text{ \AA} = 2.12 \text{ \AA}$$

Now

$$1 \text{ \AA} = 10^{-10} \text{ m}$$

So

$$r_2 = 2.12 \times 10^{-10} \text{ m}$$

Therefore

$$X = 2.12$$

Final Answer: $r_2 = 2.12 \times 10^{-10} \text{ m}$ **Answer: (2.12)**

Q25.

Solution**Concept:** Work done by constant force is dot product of force and displacement.**Formula:**

$$W = \vec{F} \cdot \vec{s}$$

Solution: Given

$$\vec{F} = 2\hat{i} + 3\hat{j} + 4\hat{k}$$

and displacement

$$\vec{s} = 1\hat{i} + 1\hat{j} + 1\hat{k}$$

Therefore

$$W = \vec{F} \cdot \vec{s} = 2(1) + 3(1) + 4(1) = 9 \text{ J}$$

Final Answer: $W = 9 \text{ J}$ **Answer: (9)**

Answer Key — Section A

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

Answer Key — Section B

Q	Ans	Q	Ans
21	484	22	1
23	2.1×10^{-19}	24	2.12
25	9		

