

JEE Main 29 January 2024 Shift 1 Answer Key

Physics

Q.1: A body of mass 100 kg travelled 10 m before coming to rest. If $\mu = 0.4$, then find the work done against friction. Assume that the motion is happening on a horizontal surface and $g = 10 \text{ m/s}^2$.

A.1: 4000 J

Q.2: If an object has the same weight at the same distance above and below the surface of the earth. Find its distance from the surface of the earth.

A.2: $\frac{(\sqrt{5}-1)R}{2}$

Q.3: A solid sphere of radius $4a$ units is placed with its centre at the origin. Two charges $-2q$ at $(-5a, 0)$ and $5q$ at $(3a, 0)$ are placed. If the flux through the sphere is xq/ϵ_0 , then find x .

A.3: $x = 5$

Q.4: Consider the two statements (Assume the density of water to be constant):

Statement 1: A capillary tube is first dipped in hot water and then dipped in cold water. The rise is higher in hot water.

Statement 2: The capillary tube is first dipped in cold water and then in hot water. The rise is higher in cold water.

- i. Statement 1 is true and Statement 2 is false.
- ii. Statement 1 is false, and Statement 2 is true.
- iii. Both statements are true.
- iv. Both statements are false.

A.4: Statement 1 is false, and Statement 2 is true.

Q.5: A stationary hydrogen atom deexcites from the first excited state to the ground state. Find the recoil speed of the hydrogen atom up to the nearest integer value. (Take mass of hydrogen atom = 1.8×10^{-27} *kg)

A.5: 3

Q.6: If a particle starting from rest having constant acceleration covers distance S_1 in the first (P - 1) seconds & S_2 in the first P seconds, then determine the time for which displacement is $S_1 + S_2$.

A.6: $\sqrt{2P^2 + 1 - 2P}$

Q.7: If the ratio of the centripetal acceleration of two particles moving on the same circular path is 3: 4, then find the ratio of their speed.

A.7: $\sqrt{3}:2$

Q.8: If the De-Broglie wavelength of a proton and an electron is the same, then find the ratio of the kinetic energy of the electron to that of the proton.

A.8: 1835

Q.9: A capacitor having a capacitance of $100\mu\text{F}$ is charged with a potential difference of 12 V and is connected to an inductor of inductance 10 mH. Find the maximum current through the inductor.

A.9: 1.2 A

Q.10: A gas undergoes a cyclic process ABCA as shown in the P vs V graph. (The points correspond to A: $P_A = 900 \text{ N/m}^2$, $V_A = 3 \text{ m}^3$, B: $P_B = 300 \text{ N/m}^2$, $V_B = 7 \text{ m}^3$, and C: $P_C = 300 \text{ N/m}^2$, $V_C = 3 \text{ m}^3$). Find the work done by the gas from $A \rightarrow B \rightarrow C$.

A.10: 1200 J

Q.11: If an electric current passing through a conductor varies with time as $i = I_0 + \beta t$, where $I_0 = 20 \text{ A}$ and $\beta = 3 \text{ A/s}$, then find the charge flow through the conductor in the first 10 seconds.

A.11: 350 C

A.18: - 15 cm

Q.19: In a given voltage regulator circuit, the reverse breakdown voltage of the Zener diode is 3V. Find the current through the Zener diode. (Circuit diagram was given.)

A.19: 5.5mA

Q.20: In a given circuit, the galvanometer resistance is 10Ω and the current through the galvanometer is 3 mA. Find the resistance of the shunt. (Circuit diagram was given.)

A.20: $3.75 \times 10^{-3}\Omega$

Q.21: If a particle is executing simple harmonic motion along the x-axis with amplitude A about the origin, then the ratio of the Kinetic energy and total energy at $x = A/3$ is?

A.21: $\frac{8}{9}$

Q.22: The voltage and resistance for a resistor are measured as $V = 200 \pm 5V$ & $R = 20 \pm 0.2 \Omega$. Find the percentage error in the current $I = V/R$.

A.22: 3.5%

Q.23: A solid cylinder is placed gently over an inclined plane of inclination 60° . The acceleration of the cylinder when it starts rolling without slipping is g/\sqrt{x} where μ is the coefficient of friction. [take $g = 10\text{m/s}^2$]

A.23: 3.00