

JEE Mains 29 January 2024 Shift 1 Answer Key

Physics

Q. A series of steps has 0.5 m tread and 0.5 m riser. If a ball is thrown from a point on the ground beside the first step, then find the minimum speed required by the ball to directly jump to the 5th step.

Answer: $5(\sqrt{2} + 1) \text{ m/s}$

Q. An electron is moving with the speed of 1 m/s at a distance of 1 m, from a large sheet of charge with density $\sigma \text{ C/m}^2$. Find the maximum value of σ such that the electron hits the sheet after 1 sec. Take the mass of electron = $9 \times 10^{-31} \text{ kg}$ and the permittivity of free space = $9 \times 10^{-12} \text{ C}^2/\text{Nm}^2$.

Answer: $4.5 \times 10^{-22} \text{ C/m}^2$

Q. In a convex mirror having a radius of curvature of 30 cm, the height of the image is half of the height of the object. What will be the distance of the object from the mirror in cm?

Answer: - 15 cm

Q. 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.)

Answer: 5.5mA

Q. 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.)

Answer: $3.75 \times 10^{-3}\Omega$

Q. 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 $g = 10 \text{ m/s}^2$.

Answer: $4000 J$

Q.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.

Answer: $(\sqrt{5}-1)R$

Q.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 $S_1 + S_2$.

Answer: $\sqrt{2P^2 + 1} - 2P$

Q. 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.

Answer: $\sqrt{3}: 2$

Q. 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.

Answer: 1835

Q. A capacitor having a capacitance of $100\mu F$ 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.

Answer: 1.2 A

Q. 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 $A \rightarrow B \rightarrow C$.

Answer: 1200 J

Q. 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 .

Answer: $x = 5$

Q. 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.

Answer: Statement 1 is false, and Statement 2 is true.

Q. 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)

Answer: 3

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

Answer. 350 C

Q. A square loop of resistance 16Ω is connected with a battery of 9 V and an internal resistance of 12Ω in a steady state. Find the energy stored in the capacitor of capacity $C = 4 \mu\text{F}$ as per its position shown in the diagram. (The capacitor is connected diagonally in a separate loop attached to the circuit.)

Answer: $25.92 \mu\text{J}$

Q. If a biconvex lens of a material of refractive index 1.5 has a focal length of 20 cm in the air, then what will be its focal length when it is submerged in a medium of refractive index 1.6?

Answer: - 160 cm

Q. In a container, 1 g of hydrogen and 1 g of oxygen are taken. Find the ratio of hydrogen pressure to oxygen pressure inside the container.

Answer: 16

Q. The potential energy function corresponding to conservative force is given as $U(x, y, z) = 3x^2/2 + 5y + 6z$, then the force at $x = 6$ is pN. The value of p. (Round off to the nearest integer.)

Answer: 20

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

Answer: 3.5%

Q. 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 $g = 10\text{m/s}^2$]

Answer: 3.00

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Q. 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?

Answer: 8/9

Chemistry

Q.1: Which of the following pairs will be formed by the decomposition of KMnO_4 ?

- i. MnO_4^- , MnO_2
- ii. K_2MnO_4 , MnO_2
- iii. KMnO_4 , MnO_2
- iv. MnO_2 , H_2O

A.1: K_2MnO_4 , MnO_2

Q.2: Calculate the Molarity of a solution having a density of 1.5 g/ml, percentage of (w/w) of solute as 36%, and molecular weight of solute 36 g/mol.

A.2: 15

Q.3: What is the energy difference between the actual structure and its most stable resonating structure having the least energy is called as?

- 1) Electromeric Effect 2) Resonance Energy 3) Inductive Effect 4) Hyperconjugation

A.3: Resonance Energy

Q.4: If alkaline KMnO_4 is oxidised iodide to give a particular product (A), then determine the oxidation state of iodine in the compound (A).

A.4: +5 Q.5: What is the effect that occurs between lone pair and pi bond?

A.5: Resonance Effect

Q.6: Statement 1: Electronegativity of group 14 elements decreases from Si to Pb.

Statement 2: Group 14 has metals, metalloids, and non-metals

Both statement 1 and 2 are correct

Both statement 1 and 2 are incorrect

Statement 1 is correct and Statement 2 is incorrect

Statement 1 is incorrect and statement 2 is correct

A.6: Statement is incorrect and statement 2 is correct

Q.7: Hydrolysis of protein gives which type of amino acids

A.7: α - amino acid

Mathematics

Q. What is the rank of the word GTWENTY in the dictionary?

Answer: 553

Q. If a die is rolled until 2 is obtained, then what is the probability that 2 is obtained on an even-numbered toss?

Answer: $\frac{5}{11}$

Q. A GP has 64 terms such that $(S_n)_{\text{total}} = 7(S_n)_{\text{odd}}$. Find the common ratio r.

Answer: $R = 6$

Q. $(C_1^{11}/2) + (C_2^{11}/3) + \dots + (C_9^{11}/10) = m/n$. Find $m + n$.

Answer: 2041

Evaluate: $\lim_{x \rightarrow \frac{\pi}{2}^-} \frac{\int_{x^3}^{\left(\frac{\pi}{2}\right)^3} \cos t^{\frac{1}{3}} dt}{\left(x - \frac{\pi}{2}\right)^2}$

Q.

Answer: $(3\pi^2)/8$