

JEE Main 30 January 2024 Shift 1 Answer Key

Physics

Q.1: If two rings of equal radius R are arranged perpendicular to each other with a common centre at C and the rings carry an equal current I , then find the magnetic field at C .

A.1: $\frac{\mu_0 I}{\sqrt{2}R}$

Q.2: What is the acceleration of a 2 kg block on a fixed inclined surface at 37° with the horizontal? The block is tied with a rope that passes over two pulleys (represented through a diagram) such that pulley 1 rests at the top of the inclined surface and pulley 2 carries a weight of 4 kg. Neglect friction.

A.2: $4g/15$

Q.3: A particle of mass m is projected from the ground with a speed u at an angle of 30° with the horizontal. Find out the angular momentum about the point of projection when it reaches its ultimate height.

A.3: $\frac{\sqrt{3}mv^3}{16g}$

Q.4: What will be the ratio of the kinetic energy and the potential energy in the 5th excited state of a hydrogen atom?

A.4: $-\frac{1}{2}$

Q.5: Find the potential difference V_0 across the $700\ \Omega$ resistance. A diagram was given in which three resistances $3.5\ \text{k}\Omega$, $200\ \Omega$, and $700\ \Omega$ are connected in series across a 7 V battery.

A.5: 1.1V

Q.6: A ball is released from a height of 1 m on a fixed smooth hemispherical surface. Find its velocity when it is at a height of 0.5 m from the ground. ($g = 10\ \text{m/s}^2$.)

A.6: $\sqrt{10} \text{ m/s}$

Q.7: The electric potential due to the short electric dipole on the axial position at distance r from the dipole is proportional to? (Assume: $r \gg$ length of the dipole)

A.7: $1/r^2$

Q.8: A block of mass 2 kg is placed on a disc rotating at a constant angular velocity of 4 rad/sec. What is the friction force in (N) between the block and disc if the block is not sliding?

A.8: 32

Q.9: If the distance between the virtual image, which is twice the size of the object placed in front of the mirror, and the object is 45 cm, find the magnitude of the focal length of the mirror?

A.9: 15 cm

Q.10: A particle is undergoing uniform acceleration. If its displacement from the t^{th} to $(t + 1)^{\text{th}}$ second is 120 m and the change in velocity is 50 m/s. What will be its displacement in metre in the $(t + 2)^{\text{th}}$ second.

A.10: 170 m

Q.11: A uniform disc of mass 5 kg and radius 2 m is rotating with an angular velocity of 10 rad/s. Another identical disc is gently placed on the first disc. Because of the friction, both discs acquire a common angular velocity. What is the loss of kinetic energy in the process?

A.11: 250 J

Q.12: What is the maximum wavelength of the light source such that photoelectrons can be ejected from the material of work-function 3 eV?

A.12: 4133.3 \AA .

Q.13: A long wire carrying current $\sqrt{2}A$ is placed in the uniform magnetic field of $3 \times 10^{-5} \text{ T}$. If the magnetic field is perpendicular to the wire, find the magnetic force on a unit length of wire.

A.13: $3\sqrt{2} \times 10^{-5} \text{ N}$

Q.14: The electric field in an electromagnetic wave is moving in a free space given as $E = E_0 \sin(\omega t - kz) \hat{i}$. What will be the corresponding magnetic field?

A.14: $\frac{E_0}{c} \sin(\omega t - kz) \hat{j}$

Q.15: If the area of a cross-section is halved and the length of a wire having Young's modulus Y is doubled, then what will be its new Young's modulus?

A.15: Y

Q.16: In an electric transformer, 220 V is applied on the primary coil having 100 turns. A secondary coil with 10 turns is placed next to it having resistances 2Ω and 3Ω . Find out the output current through the 3Ω resistance.

A.16: 4.4 A

Q.17: Find the temperature of H_2 gas at which its RMS speed is equal to that of O_2 at 47°C .

A.17: -253°C

Q.18: In an AC circuit with source voltage $E = 20 \sin(1000t)$ is connected to a series L - R circuit whose power factor is $1/\sqrt{2}$. If $E = 25 \sin(2000t)$, find the new power factor.

A.18: $1/\sqrt{5}$

Q.19: At P, a point away from a planet of radius of 6400 km, the gravitational potential and field are $-6.4 \times 10^7 \text{ SI units}$ and 6.4 SI units , respectively. Find the height of that point above the surface of the planet.

A.19: 3600 km

Q.20: A wire has a resistance of 60Ω at a temperature of 27°C . When it is connected to a 220 V DC supply, a current 2.75 A flows through it at a certain temperature. Find the value of the temperature, if the coefficient of thermal resistance is $2 \times 10^{-4}/^\circ\text{C}$.

A.20: 1694

Q.21: Match the following:

Column I: i. Surface Tension, ii. Viscosity, iii. Angular Momentum, iv. Rotational Kinetic Energy

Column II: a. $[ML^2T^{-2}]$, b. $[ML^2T^{-1}]$, c. $[ML^{-1}T^{-1}]$, d. $[ML^0T^{-2}]$

A.21: P-4, Q-3, R-2, S-1