

PAPER : JNU 2019
PHYSICS-PH

OBJECTIVE QUESTIONS

1. A thermocouple is a device to measure
(a) Pressure (b) Volume (c) Density (d) Temperature
2. Longitudinal waves are
(a) Plane polarized (b) Circularly polarized
(c) Elliptically polarized (d) Unpolarized
3. One nanometer is equal to
(a) 0.1 \AA (b) 10 \AA (c) 100 \AA (d) 1000 \AA
4. An X-ray beam consists of
(a) Electrons (b) Protons (c) Neutrons (d) Photons
5. According to the Dulong-Petit law, the atomic heat which is a product of atomic weight and specific heat, of most of the elements in solid state
(a) Is constant (b) Increases with atomic number
(c) Decreases with atomic number (d) Does not depend on atomic weight
6. A burst of 10^{14} electrons uniformly accelerated to an energy of 15 MeV is stopped by a copper target block of mass 100g. Assuming the block is thermally insulated, what is the rise in its temperature? (Specific heat of copper is 0.09 cal/g.K)
(a) 6.3 K (b) 0.4 K (c) 1.7 K (d) 5.1 K
7. For a hydrogen atom the spacing between successive energy levels is given by $\Delta_n = E_{n+1} - E_n$, where n is the quantum number. Which of the following statements is true?
(a) Δ_n is constant (b) Δ_n increases as n increases
(c) Δ_n decreases as n increases (d) Δ_n increases and then decreases with n .
8. Resistance R_1 and R_2 are connected in parallel and I is the total current flowing in the circuit. I_1 is the current flowing through R_1 . Which of the following conditions will produce minimum joule heating in the circuit?
(a) $I_1 = I \left(\frac{R_2}{R_1 + R_2} \right)$ (b) $I_1 = I_2 \left(\frac{R_2}{R_1 + R_2} \right)$ (c) $I_1 = I_2 \left(\frac{R_2}{R_1} \right)$ (d) $I_1 = I_2 \left(\frac{R_1}{R_2} \right)$
9. The function $y = ax^2 - bx + c$, where a , b and c are positive and constants, has a minima at $x =$
(a) $\frac{b}{2a}$ (b) $\frac{a}{2b}$ (c) $\frac{b}{a}$ (d) $\frac{a}{b}$
10. The adiabatic compressibility of an ideal gas is equal to (P is pressure and V is volume)
(a) $1/P$ (b) P/V (c) P (d) V/P
11. The black body radiation emitted from a cavity of volume V at temperature T has chemical potential equal to (N is the number of photons emitted)
(a) N (b) 0 (c) $1/T$ (d) V/T



12. The equation of motion of a particle of mass m in one dimension is

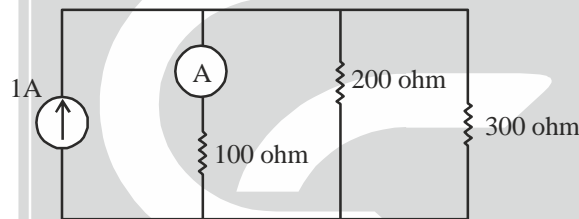
$$m \frac{d^2x}{dt^2} = -ax - 3bx^2 - 4cx^3$$

where a , b and c are constants of appropriate dimension. The quantity that remains constant during its motion is

- (a) $\frac{1}{2}m\dot{x}^2 + \frac{1}{2}ax^2 + bx^3 + cx^4$ (b) $\frac{1}{2}m\dot{x}^2 + ax^2 + bx^3 + cx^4$
- (c) $\frac{1}{2}m\dot{x}^2 + \frac{1}{2}ax^2 + \frac{1}{3}bx^3 + cx^4$ (d) $\frac{1}{2}m\dot{x}^2 + ax^2 + \frac{1}{3}bx^3 + \frac{1}{4}cx^4$
13. Consider a momentum conservation experiment, where two masses m_1 and m_2 are collided head-on with velocities V_1 and V_2 , respectively, the measured values are $m_1 = 200 \pm 2g$, $V_1 = 5.5 \pm 0.1 m/s$ and $V_2 = 10 \pm 0.4 m/s$. What is the fractional error associated with mass m_2 of the other body?
- (a) ± 7.7 (b) ± 0.77 (c) ± 10.1 (d) ± 0.07
14. A particle of mass m moves in a circle of radius r with uniform angular speed ω . The work done by the centripetal force in half of a complete rotation is
- (a) 0 (b) $2\pi m\omega^2 r^2$ (c) $\pi m\omega^2 r^2 / 2$ (d) $2\pi m\omega^2$
15. At time $t = 0$, a series RC circuit is connected to an emf of 9 V. How long will it take for the capacitor to reach 8 V?
- (a) RC (b) 1/RC (c) RC ln 9 (d) ln 9
16. An ideal gas undergoes isothermal expansion at temperature T from volume V_1 to V_2 . The entropy change per mole is
- (a) $R \ln \left(\frac{V_2}{V_1} \right)$ (b) $R \ln \left(\frac{V_1}{V_2} \right)$ (c) $R \ln \left(\frac{V_2}{V_1} \right)$ (d) $R \ln \left(\frac{V_1}{V_2} \right)$
17. Consider a two-dimensional quantum harmonic oscillator with frequency ω . How many energy levels are there with energy $11 \hbar\omega$?
- (a) 5 (b) 8 (c) 11 (d) 21
18. Consider a planet of mass, m_2 in circular motion with angular momentum, L . The planet orbits a star of mass, M and the orbit radius is r . If the radius of the orbit is changed from r to $r/2$, what would be the new value of angular momentum?
- (a) L (b) $L/2$ (c) $L/\sqrt{2}$ (d) $\sqrt{2} L$
19. If \hbar is the reduced Planck's constant, c is the speed of light, and G is the universal gravitational constant, which of the following has the dimension of length?
- (a) $\frac{\hbar G}{c^2}$ (b) $\sqrt{\frac{\hbar c}{8\pi G}}$ (c) $\sqrt{\frac{\hbar G}{c^5}}$ (d) $\sqrt{\frac{\hbar G}{c^3}}$
20. Which of the following quantities has the same physical dimension as that of $\frac{h}{e^2}$, where h is Planck's constant and e is the electronic charge?
- (a) Magnetic flux (b) Electrical resistance (c) Magnetic field (d) Electrical resistivity

21. A 100 W electric bulb has an efficiency of 2.5%. Assuming it is a point source, the intensity at a distance of 3m will be
 (a) 2.5 W/m² (b) 25 W/m² (c) 0.025 W/m² (d) 0.022 W/m²
22. An electron has a speed of 300 m/s, accurate to 0.01%. With what accuracy can we determine the position of the electron? (mass of electron = 9.1×10^{-31} kg, Planck's constant = 6.6×10^{-34} J.s)
 (a) 2.4 nm (b) 2.4 μ m (c) 2.4 mm (d) 2.4 cm
23. The crystal structure of CsCl is a simple cubic lattice. Each unit cell of CsCl will contain
 (a) 1 atom (b) 2 atoms (c) 3 atoms (d) 4 atoms
24. During radioactive decay a nucleus emits a gamma ray with energy of of 1.35 MeV. What is the wavelength of this photon?
 (a) 920 fm (b) 920 nm (c) 920 pm (d) 920 Å
25. Which of the following is responsible for the existence of the Fermi surface in metals?
 (a) Nuclear force (b) Coulomb repulsion between electrons
 (c) Bose-Einstein condensation (d) Pauli exclusion principle

26. The reading in the Ammeter A is



- (a) 0.5454 A (b) 5.5450 A (c) 5.4555 A (d) 1.5455 A
27. A 2 mW laser light is emitted at a frequency of 6×10^{14} Hz. How many photons on average are emitted by this source per second? (Planck's constant = 6.6×10^{-34} J.s)
 (a) 1×10^{15} (b) 2×10^{15} (c) 3×10^{15} (d) 5×10^{15}
28. In a two-level atom the energy gap is E . The probability of finding the atom in the excited state at temperature T will be

(a) $\exp\left(-\frac{E}{k_B T}\right)$ (b) $\frac{1}{1 + \exp\left(-\frac{E}{k_B T}\right)}$ (c) $\frac{\exp\left(\frac{E}{k_B T}\right)}{1 + \exp\left(-\frac{E}{k_B T}\right)}$ (d) $\frac{\exp\left(-\frac{E}{k_B T}\right)}{1 + \exp\left(-\frac{E}{k_B T}\right)}$

29. What would be the frequency of the photon produced when an electron of energy 20 keV is brought to rest in a collision with a heavy nucleus?
 (a) 4.84×10^{18} Hz (b) 5×10^{18} Hz (c) 4.23×10^{18} Hz (d) 3.84×10^{18} Hz
30. The angle between the vectors $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ is
 (a) 0° (b) 45° (c) $\cos^{-1}\left(\frac{1}{3}\right)$ (d) $\cos^{-1}\left(\sqrt{\frac{2}{3}}\right)$

31. What is the entropy change when 1 kg of ice at 0°C melts reversibly to water at the same temperature? (Latent heat of melting of ice = 79.6 cal/g)
(a) 122 kJ.K^{-1} (b) 12.2 kJ.K^{-1} (c) 1.22 kJ.K^{-1} (d) 0.122 kJ.K^{-1}
32. If $z = x + iy$, then the value of $|\sin z|^2$ is
(a) $\sin^2 x + \sin^2 y$ (b) $\sin^2 x + \cos^2 y$ (c) $\sin^2 x + \sinh^2 y$ (d) $\sin^2 x + \cosh^2 y$
33. A sodium vapour lamp emits yellow light corresponding to two wavelength 589 and 589.59 nm. What is the minimum number of rulings must a diffraction grating have to resolve these two lines in the first order?
(a) 589 (b) 700 (c) 900 (d) 1000
34. A sinusoidal wave moving along a string in the x-direction is described by
 $y(x, t) = 0.002 \sin(10x - 120t)$
What is the propagation speed of the wave?
(a) 12 m/s (b) 10 m/s (c) 120 m/s (d) 1200 m/s
35. If a signal passing through a gate is inhibited by sending a LOW into one of the inputs, and the output is HIGH, the gate is
(a) an AND gate (b) a NAND gate (c) a NOR gate (d) an OR gate

