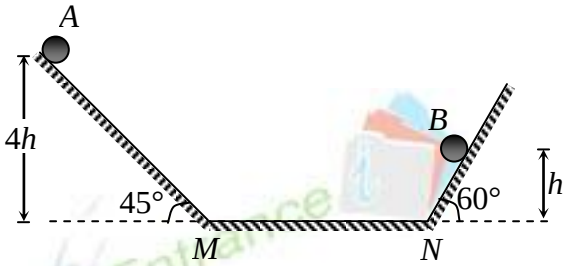
PHYSICS

1. The potential difference and current flowing through an instrument in an a.c. circuit are given by $V = 5\cos\omega t$ volt, $I = -2\sin\omega t$ ampere. The power dissipated in the circuit is

(a) 5 W (b) 2 W (c) 10 W (d) none of these

2. Two identical balls *A* and *B* are released from the positions shown in the figure. They collide elastically on horizontal portion *MN*. The ratio of the maximum height attained by *A* and *B* after collision will be (neglect friction)



(a) 1 : 4 (b)2 : 1

(c) 4 : 13 (d)2 : 5

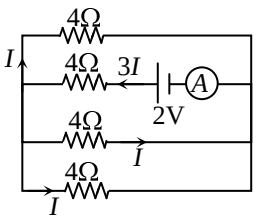
3. In a uniform electric field a charge of 3C experiences a force of 3000 N. The potential difference between two points 1 cm apart along the electric line of force will be

(a) 10 V (b) 100 V (c) 30 V (d) 300 V

4. When a β^+-particle is emitted from a nucleus, then its neutron-proton ratio

(a) increases (b) decreases (c) remains same (d) first (a) and then (b)

5. Four resistors of 4 Ω each are connected to a 2V battery as shown in the figure. The ammeter reads a current of



(a) $\frac{1}{8}$ A (b) $\frac{3}{8}$ A

(c) $\frac{1}{2}$ A (d) 2A

6. Thermocouple is an arrangement of two different metal to

(a) convert heat energy into electrical energy

(b) produce more heat

(c) convert heat energy into chemical energy

(d) convert electrical energy into heat energy

7. In a pure inductor circuit, the angle between potential and current is

(a) 0 (b) π (c) π/2 (d) 2π

8. Two longitudinal waves of wavelength 100 cm and 90 cm, each of velocity 396 m/s interfere with each other. The number of beats in one second is

(a) 41 (b) 42 (c) 34 (d) 44

9. What will be the temperature when the rms speed of gas is double of that at 300 K

(a) 300 K (b) 600 K (c) 900 K (d) 1200 K

10. According to Bohr's model of hydrogen atom, the radius of stationary orbits characterized by the principal quantum number is proportional to

(a) n^{-1} (b) n^{-2} (c) n (d) n^2

11. Refractive index depends upon

(a) angle of prism (b) wavelength of light

(c) intensity of light (d) frequency of light

12. A potential barrier of 0.50 V exists across a *p-n* junction. If the depletion region is 5.0×10^{-7} m wide, the intensity of the electric field in this region is

(a) 1.0×10^6 V/m (b) 1.0×10^5 V/m (c) 2.0×10^5 V/m (d) 2.0×10^6 V/m

13. A capacitor of capacitance C has charge Q. It is connected to an identical capacitor through a resistance. The heat produced in the resistance is

(a) $\frac{Q^2}{2C}$ (b) $\frac{Q^2}{4C}$

(c) $\frac{Q^2}{8C}$ (d) dependent on the value of the resistance

14. The electric potential V at any point x, y, z (all in metres) in space is given by $V = 4x^2$ volts. The electric field (in V/m) at the point (1 m, 0, 2 m) is

(a) $-8\hat{i}$ (b) $8\hat{i}$ (c) $-16\hat{i}$ (d) $8\sqrt{5}\ \hat{i}$

15. If a particle is projected from origin and it follows the trajectory $y = x - \frac{1}{2}x^2$, then the time of flight is (g = acceleration due to gravity)

(a) $\frac{1}{\sqrt{g}}$ (b) $\frac{2}{\sqrt{g}}$ (c) $\frac{3}{\sqrt{g}}$ (d) $\frac{4}{\sqrt{g}}$

16. An air bubble of radius r in water is at a depth h below the water surface at some instant. If P is atmospheric pressure, d and T are density and surface tension of water respectively, the pressure inside the bubble will be

(a) $P + hdg - \frac{4T}{r}$ (b) $P + hdg + \frac{2T}{r}$ (c) $P + hdg - \frac{2T}{r}$ (d) $P + hdg + \frac{4T}{r}$

17. When a metal wire is elongated by hanging a load Mg on it, the gravitational potential energy of mass M decreases by Mgl. The energy appears

(a) as elastic potential energy completely

(b) as thermal energy completely

(c) half as elastic potential energy and half as thermal energy

(d) as kinetic energy of the load completely

18. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius 1.01 R. The time period of the second satellite is larger than that of the first one by approximately.

(a) 0.5 % (b) 1.5 % (c) 1 % (d) 3.0 %

19. If a man at the equator weight $(3/5)^{th}$ of his actual weigh, the angular speed of the earth is

(a) $\sqrt{\frac{2}{5}\frac{g}{R}}$ (b) $\sqrt{\frac{g}{R}}$ (c) $\sqrt{\frac{R}{g}}$ (d) $\sqrt{\frac{2}{5}\frac{R}{g}}$

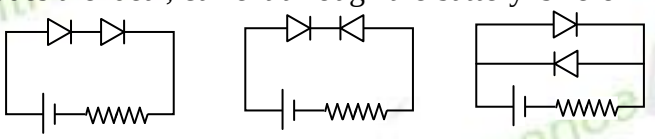
20. A uniform rod AB of mass m and length $2a$ is falling freely without rotation under gravity with AB horizontal. Suddenly the end A is fixed when the speed of the rod is v. The angular speed with which the rod begins to rotate is

(a) $\frac{v}{2a}$ (b) $\frac{4v}{3a}$ (c) $\frac{v}{3a}$ (d) $\frac{3v}{4a}$

21. Two particles of mass m_1 and m_2 are connected by a rigid massless rod of length r to constitute a dumb-bell which is free to move in the plane. The moment of inertia of the dumb-bell about an axis perpendicular to the plane passing through the centre of mass is

(a) $\frac{m_1 m_2 r^2}{m_1 + m_2}$ (b) $(m_1 + m_2)r^2$ (c) $\frac{m_1 m_2 r^2}{m_1 - m_2}$ (d) $(m_1 - m_2)r^2$

22. Assuming the diodes are ideal, current through the battery is zero



(i) (ii) (ii)

(a) in (i) and (iii) (b) in (ii) and (iii) (c) in only (ii) (d) in only (iii)

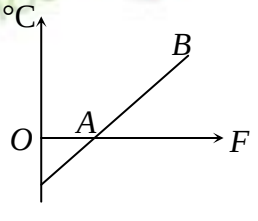
23. A particle is projected with a velocity v, so that its range on a horizontal plane is twice the greatest height attained. If g is acceleration due to gravity, then its range is

(a) $\frac{4v^2}{5g}$ (b) $\frac{4g}{5v^2}$ (c) $\frac{4v^3}{5g^2}$ (d) $\frac{4v}{5g^2}$

24. A graph AB shown in figure is a plot of the temperature of a body in degree Celsius and degree Fahrenheit. The slope of line AB is

(a) 9/5 (b) 5/9

(c) 1/9 (d) 3/9



25. Which of the following statements is correct?

(a) Whenever heat is supplied to a gas, its internal energy increases

(b) Internal energy of a gas must increase when its temperature is decreased

(c) Internal energy of a gas may be increased even if heat is not supplied to the gas

(d) Internal energy of a gas is proportional to square of the velocity of the vessel in which the gas is contained.

26. According to second law of thermodynamics

(a) all heat can be converted into work

(b) the efficiency of a heat engine is always greater than unity

(c) it is not possible to transfer heat from lower to higher temperature by itself

(d) when heat changes to other forms, energy is conserved

27. A hollow and a solid sphere of same martial and identical outer surfaces are heated to the same temperature

(a) in the beginning both will emit equal amount of radiation per unit time

(b) in the beginning both will absorb unequal amount of radiation per unit time

(c) both spheres will have same rate of fall of temperature (dT/dt)

(d) both spheres will have equal temperatures at any moment

28. Two identical beakers are filled with water to the same level at 4°C. If *A* is heated while *B* is cooled, then:

(a) water level in *A* will rise (b) water level in *B* will remain constant

(c) water level in *A* will fall (d) water level in *B* will fall

29. A source of sound is moving with a velocity of 10 m/s towards an observer moving with a velocity of 10 m/s away from the source along the same straight line. If the frequency emitted by the source is 1000 Hz, the frequency received by observer will be, (velocity of sound in air = 332 m/s)

(a) 2000 Hz (b) 1500 Hz (c) 1000 Hz (d) 500 Hz

30. A mechanical wave propagates in a medium along the *x*-axis. The particles of the medium

(a) may move on the *x*-axis (b) does not move

(c) must move on the *y*-axis (d) must move on the *x*-axis

31. To prepare a print with 40 watt. lamp at 25 cm, it requires 3 seconds. If the distance is increased to 50 cm, how much time will be required to prepare the print?

(a) 6 s (b) 9 s (c) 12 s (d) 1 s

32. Two thin lenses are in contact and the foal length of the combination is 80 cm. If the focal length of one of the lenses is 20 cm, the power of the other lens is

(a) 1.66 D (b) 4.00 D (c) –1.00 D (d) –3.75 D

33. A beam of light is converging towards a point I on a screen. A plane parallel plate of glass whose thickness in the direction of beam = t, refractive index = μ, is introduced in the path of the beam. The convergence point shifted by

(a) $t\left(1-\frac{1}{\mu}\right)$ away (b) $t\left(1+\frac{1}{\mu}\right)$ away (c) $t\left(1-\frac{1}{\mu}\right)$ nearer (d) $t\left(1+\frac{1}{\mu}\right)$ nearer

34. A balloon of mass M is descending at a constant acceleration α. When a mass m is released from the balloon it starts rising with the same acceleration α. Assuming that its volume does not change, what is the value of m?

(a) $\frac{\alpha}{\alpha+g}M$ (b) $\frac{2\alpha}{\alpha+g}M$ (c) $\frac{\alpha+g}{\alpha}M$ (d) $\frac{\alpha+g}{2\alpha}M$

35. Equation $a=-\omega^2 y$ states the SHM of a body. Which of the following statement is correct?

(a) The acceleration is maximum at the extreme position

(b) Periodic time $T=2\pi\sqrt{\omega}$

(c) At $y = 0$, the potential energy is maximum

(d) At $y = 0$, the kinetic energy is minimum

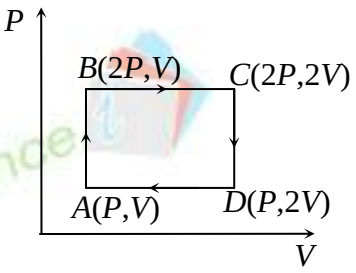
36. In Young's double slit experiment, the 7th maximum with wavelength λ_1 is at a distance d_1 and that with wavelength λ_2 is at a distance d_2. Then d_1/d_2 is

(a) λ_1/λ_2 (b) λ_2/λ_1 (c) λ_1^2/λ_2^2 (d) λ_2^2/λ_1^2

37. An ideal monatomic gas is taken round the cycle $ABCDA$ as shown in figure. The work done by the gas during the cycle is

(a) PV (b) $2PV$

(c) $\frac{1}{2}PV$ (d) Zero



38. If $Q=\frac{X^n}{Y^m}$ and ΔX is maximum possible error in the measurement of X, ΔY is maximum possible error in the measurement of Y, then maximum possible error ΔQ in Q is

(a) $\Delta Q=\pm\left(n\frac{\Delta X}{X}+m\frac{\Delta Y}{Y}\right)$ (b) $\Delta Q=\pm\left(n\frac{\Delta X}{X}+m\frac{\Delta Y}{Y}\right)Q$

(c) $\Delta Q=\pm\left(n\frac{\Delta X}{X}-m\frac{\Delta Y}{Y}\right)Q$ (d) $\Delta Q=\pm\left(n\frac{\Delta X}{X}-m\frac{\Delta Y}{Y}\right)$

39. A monkey is climbing up a tree at a speed of 3 m/s. A dog runs towards the tree with a speed of 4 m/s. What is the magnitude of relative velocity of the dog as seen by the monkey?

(a) > 7 m/s (b) Between 5 m/s and 7 m/s
(c) 5 m/s (d) < 5 m/s

40. Two bodies *A* and *B* initially at rest are attracted towards each other due to gravitation. Given that *A* is much heavier than *B*, which of the following correctly describes the motion of the centre of mass of the bodies?

(a) It moves towards *A* (b) It remains at rest

(c) It moves towards *B*

(d) it moves perpendicular to the line joining the particles.

41. If an electron is moving in a circle of radius *r*, with a frequency *n*, then magnitude of magnetic field at the centre is given by

(a) $\frac{\mu_0 ne}{2\pi r}$ (b) $\frac{\mu_0 ne}{2r}$ (c) $\frac{\mu_0 n^2 e}{2r}$ (d) none of these

42. The number of turns in the primary and secondary coils of a transformer are 1000 and 3000 respectively. If 80 volt AC is applied to the primary coil of the transformer, then the potential difference of the secondary coil would be

(a) 240 volt (b) 2400 volt (c) 24 volt (d) 0.08 volt

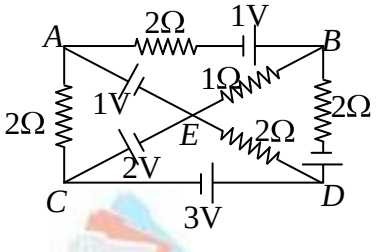
43. The unit of magnetic susceptibility is

(a) Henry (b) ampere/meter (c) weber/meter (d) none of these

44. In the circuit shown $V_D - V_A$ is

(a) 4 V (b) 2 V

(c) 3 V (d) none of these



45. If the potential difference *V* applied to the Coolidge tube is doubled, then the cut-off wavelength of *x*-rays

(a) becomes double (b) becomes half

(c) remains unchanged (d) becomes quadruple

46. A radioactive element *A* with a half-life period of 2 hours decays giving a stable element *Y*. After a time *t* the ratio of *X* to *Y* atoms is 1 : 7. Then *t* is

(a) 6 hours (b) 4 hours

(c) between 4 and 6 hours (d) 14 hours

47. A particle of mass 10^{-31} kg is moving with a velocity equal to 10^5 m/s. The wavelength of the particle is equal to ($h = 6.63 \times 10^{-34}$)

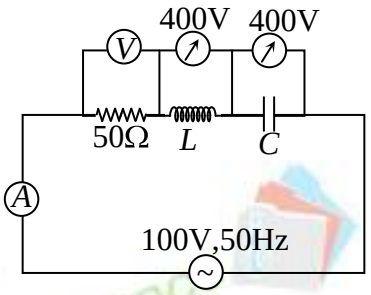
(a) 0 (b) 6.6×10^{-8} m (c) 0.66 m (d) 1.5×10^7 m

48. The intensity of incident light falling on a photosensitive metal plate is doubled, the KE of the emitted photoelectrons is

(a) double the earlier value (b) unchanged

(c) more than doubled (d) less than doubled

49. In the series LCR circuit, the voltmeter and ammeter reading are



(a) V = 100 volt, I = 2 amp

(b) V = 100 volt, I = 5 amp

(c) V = 1000 volt, I = 2 amp

(d) V = 300 volt, I = 1 amp

50. Two circular coils of radii R_1 and R_2, turns N_1 and N_2 are placed concentrically in the same plane. If $R_2 << R_1$, then the mutual inductance between them is equal to

(a) $\frac{\mu_0 \pi R_2^2}{2R_1}$ (b) $\frac{\mu_0 \pi R_2^2 N_1 N_2}{2R_1}$ (c) $\frac{\mu_0 \pi R_2 N_1 N_2}{2R_1}$ (d) $\frac{\mu_0 \pi R_1 N_1 N_2}{2R_2}$