PHYSICS

1. A point moves in a straight line so that its displacement x metre at time t sec is given by $x^2 = 1 + t^2$. Its acceleration in m/s^2 at time t sec is

(a) $\frac{1}{x^3}$ (b) $\frac{1}{x} - \frac{1}{x^2}$ (c) $\frac{1}{x} - \frac{t^2}{x^3}$ (d) $\frac{-t}{x^2}$

2. A projectile is thrown with an initial velocity of $(x\hat{i} + y\hat{j})$ m/s. If the range of the projectile is double the maximum height reached by it then

(a) $x = 2y$ (b) $y = 2x$ (c) $x = y$ (d) $y = 4x$

3. A heavy uniform chain lies on horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25 then the maximum fraction of length of chain that can overhang on edge of table is

(a) 20 % (b) 35 % (c) 25 % (d) 15 %

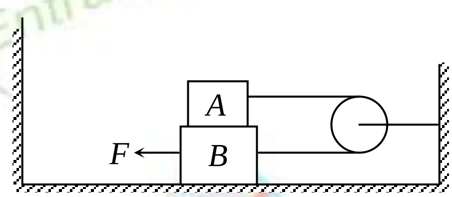
4. A body of mass M is situated in a potential field $u(x) = u_0(1 - \cos\alpha x)$, where u_0 and α are constants. The time period of small oscillations of body will be

(a) $2\pi\sqrt{\frac{M}{u_0\alpha^2}}$ (b) $2\pi\sqrt{\frac{u_0}{M\alpha^2}}$ (c) $2\pi\sqrt{\frac{u_0\alpha^2}{M}}$ (d) $2\pi\sqrt{Mu_0\alpha^2}$

5. 1000 drops of a liquid of surface tension σ and radius r join together to form a big single drop. The energy released raises the temperature of the drop. If ρ be the density of the liquid and S be the specific heat, the rise in temperature of the drop would be (J = Joule's equivalent of heat)

(a) $\frac{\sigma}{JrS\rho}$ (b) $\frac{10\sigma}{JrS\rho}$ (c) $\frac{100\sigma}{JrS\rho}$ (d) $\frac{27\sigma}{10JrS\rho}$

6. The masses of the blocks A and B are 0.5 kg and 1 kg respectively. These are arranged as shown in the figure and are connected by a massless string. The coefficient of friction between all contact surfaces is 0.4. The force needed to move the block B with constant velocity will be (g = 10 m/s^2)



(a) 5 N (b) 10 N (c) 15 N (d) 20 N

7. A pendulum consists of a wooden bob of mass m and length l. A bullet of mass m_1 is fired towards the pendulum with a speed v_1. The bullet emerges out of the bob with a speed $v_1/3$ and the bob just completes motion along a vertical circle. Then v_1 is

(a) $\left(\frac{m}{m_1}\right)\sqrt{5gl}$ (b) $\frac{3}{2}\left(\frac{m}{m_1}\right)\sqrt{5gl}$ (c) $\frac{2}{3}\left(\frac{m_1}{m}\right)\sqrt{5gl}$ (d) $\left(\frac{m_1}{m}\right)\sqrt{gl}$

8. A metal wire of length L and radius r is clamped rigidly at one end. A force F is applied at another end so that its length increases by L. The increase in length of another metal wire of length $2L$ and radius $2r$, when stretched by a force $2F$, will be

(a) $2L$ (b) L (c) $L/2$ (d) $L/4$

9. An incompressible liquid is continuously flowing through a cylindrical pipe whose radius is $2R$ at point A. The radius at point B, in the direction of flow, is R. If the velocity of liquid at point A is v then its velocity at point B will be

(a) v (b) $4v$ (c) $2v$ (d) $v/2$

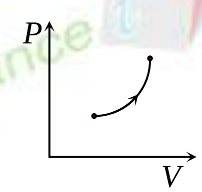
10. A sphere of density ρ, specific heat capacity c and radius r, is hung by a thermally insulated thread in an enclosure which is kept constant at a lower temperature than the sphere. The temperature of the sphere starts to drop at a rate which depends upon the temperature difference between the sphere and the enclosure and the nature of the surface of the sphere, and is proportional to

(a) $\frac{c}{r^3\rho}$ (b) $\frac{1}{r^3\rho c}$ (c) $3r^3\rho c$ (d) $\frac{1}{r\rho c}$

11. A steel tape gives correct measurement at 20°C. A piece of wood is being measured with the steel tape at 0°C. The reading is 25 cm on the tape. The real length of the given piece of wood must be

(a) 25 cm (b) less than 25cm (c) more than 25 cm (d) none of these

12. The figure shows a process on a gas in which pressure and volume both changes. The molar heat capacity for this process is C. Then



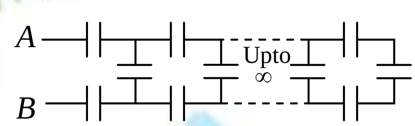
(a) $C = 0$ (b) $C = C_V$

(c) $C > C_V$ (d) $C < C_V$

13. Heat required to melt 1 gm of ice is 80 cal. A man melts 60 gms of ice by chewing it in 1 minute. His power is

(a) 4800 W (b) 336 W (c) 80 W (d) 0.75 W

14. The equivalent capacitance of the network (with all capacitors having the same capacitance C) is



(a) ∞ (b) zero

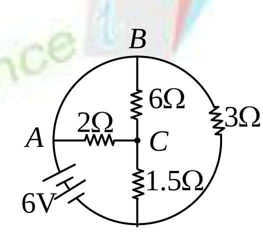
(c) $C\left(\frac{\sqrt{3}-1}{2}\right)$ (d) $C\left(\frac{\sqrt{3}+1}{2}\right)$

15. There is a current of 1.344 amp in a copper wire whose area of cross-section normal to the length of the wire is 1 mm^2. If the number of free electrons per cm^3 is 8.4×10^{22}, then the drift velocity of electrons will be

(a) 1.0 mm per sec (b) 1.0 meter per sec

(c) 0.1 mm per sec (d) 0.01 mm per sec

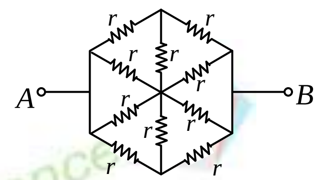
16. In the circuit shown, the total current supplied by the battery is



(a) 2 A (b) 4 A

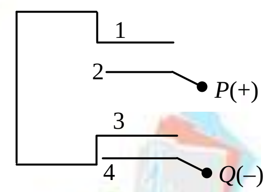
(c) 1 A (d) 6 A

17. The resistance of hexagon circuit between A and B represented in figure is



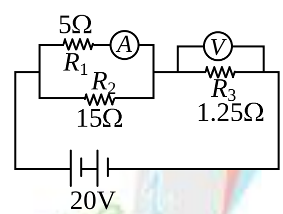
(a) r (b) $0.5\,r$
(c) $2r$ (d) $3r$

18. Four metallic plates, each with surface area of one side A, are placed at a distance d from each other. The plates are connected as shown in figure. Then the capacitance of the system between P and Q is



(a) $\frac{3\varepsilon_0 A}{d}$ (b) $\frac{2\varepsilon_0 A}{d}$ (c) $\frac{2\varepsilon_0 A}{3d}$ (d) $\frac{3\varepsilon_0 A}{2d}$

19. An ideal ammeter and an ideal voltmeter are connected as shown. The ammeter and voltmeter reading for $R_1 = 5\Omega$, $R_2 = 15\Omega$, $R_3 = 1.25\Omega$ and $E = 20$V are given as



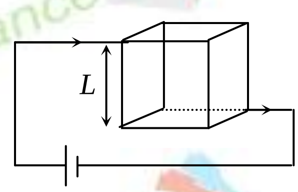
(a) 6.25 A, 3.75 V (b) 3.00 A, 5 V
(c) 3.75 A, 3.75 V (d) 3.75 A; 6.25 V

20. A point charge + q is fixed at point B. Another point charge + q at A of mass m vertically above B at height h is dropped from rest. Choose the correct statement

(a) It will collide with B
(b) It will execute S.H.M
(c) It will go down only if $\frac{q^2}{4\pi\varepsilon_0} < mgh^2$
(d) go down up to a point and then come up.

21. The temperature of cold junction of a thermocouple is –20°C and the temperature of inversion is 560°C. The neutral temperature is
(a) 270°C (b) 560°C (c) 1120°C (d) 290°C

22. A cube made of wires of equal length is connected to a battery as shown in figure. The side of cube is L. The magnetic field at the centre of cube will be



(a) $\frac{12}{\sqrt{2}}\frac{\mu_0 I}{\pi L}$ (b) $\frac{6}{\sqrt{2}}\frac{\mu_0 I}{\pi L}$ (c) $6\frac{\mu_0 I}{\pi L}$ (d) zero

23. Two straight long conductors AOB and COD are perpendicular to each other and carry currents I_1 and I_2 respectively. The magnitude of the magnetic induction at a point P at a distance a from the point O in a direction perpendicular to the plane $ABCD$ is

(a) $\frac{\mu_0}{2\pi a}(I_1+I_2)$ (b) $\frac{\mu_0}{2\pi a}(I_1-I_2)$ (c) $\frac{\mu_0}{2\pi a}(I_1^2+I_2^2)^{1/2}$ (d) $\frac{\mu_0}{2\pi a}\left(\frac{I_1 I_2}{I_1+I_2}\right)$

24. An e.m.f. of 15 V is applied in a circuit containing 5 H inductance and 10 ohm resistance. The ratio of the currents at time $t = \infty$ and $t = 1$ second is

(a) $\frac{\sqrt{e}}{(\sqrt{e}-1)}$ (b) $\frac{e^2}{(e^2-1)}$ (c) $1-e$ (d) e^{-1}

25. Earth's magnetic induction at a certain point is 7×10^{-5} Wb/m^2. This field is to be annulled by the magnetic induction at the centre of a circular conducing loop 5.0 cm in radius. The required current is

(a) 0.056 A (b) 6.5A (c) 5.6 A (d) 12.8 A

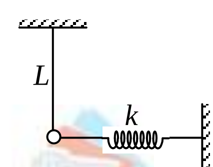
26. The intensity of sound after passing through a slab decreases by 20%. On passing through two such slabs, the intensity will decrease by

(a) 50 % (b) 40 % (c) 36 % (d) 30%

27. The electric field intensity at a point at a distance 2 m from a charge q is E. The amount of work done in bringing a charge of 2 coulomb from infinity to this point will be

(a) $2E$ joules (b) $4E$ joules (c) $\frac{E}{2}$ joules (d) $\frac{E}{4}$ joules

28. The bob of a pendulum, is attached to a horizontal spring of spring constant k. The pendulum will undergo simple harmonic motion with period (T)



(a) $2\pi\sqrt{\frac{L}{g}}$ (b) $2\pi\sqrt{\frac{m}{k}}$

(c) $2\pi\left(\frac{1}{\sqrt{(g/L)+(k/m)}}\right)$ (d) $\frac{1}{2}2\pi\sqrt{\left(\frac{L}{g}\right)+\frac{2\pi}{\sqrt{m/k}}}$

29. Transverse waves are generated in two uniform wires A and B of the same material by attaching their free ends to a vibrating source of frequency 200 Hz. The cross-section of A is half that of B while the tension on A is twice that on B. The ratio of wavelengths of the transverse waves in A and B is

(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$ (c) 1 : 2 (d) 2 : 1

30. A thin sheet of glass (μ=1.5) of thickness 6 microns introduced in the path of one of interfering beams of a double slit experiment shifts the central fringes to a position previously occupied by fifth bright fringe. Then the wavelength of the light used is

(a) 6000 Å (b) 3000 Å (c) 4500 Å (d) 7500 Å

31. A concave lens of focal length F produces an image equal to $1/n$ of size of object, the distance of the image, from the lens is

(a) $(n+1)F$ (b) $(n-1)F$ (c) $\left(\frac{n+1}{n}\right)F$ (d) $\left(\frac{n-1}{n}\right)F$

32. A convex lens *A* of focal length 20 cm and a concave lens *B* of focal length 5 cm are kept along the same axis with a distance *d* between them. If a parallel beam of light falling on *A* leaves *B* as a parallel beam, then the distance *d* in cm will be

(a) 25 (b) 15 (c) 30 (d) 50

33. The magnifying power of an astronomical telescope in normal adjustment is 8 and the distance between the two lenses is 54 cm. The focal length of eye lens and objective lens will be respectively.

(a) 6 cm and 48 cm (b) 48 cm and 6 cm (c) 8 cm and 64 cm (d) 64 cm and 8 cm

34. Two electrons of kinetic energy 2.5 eV fall on a metal plate, which has work function of 4.0 eV. Number of electrons ejected from the metal surface is

(a) one (b) two (c) zero (d) more than two

35. The binding energies of the atoms of elements *A* and *B* are E_a and E_b respectively. Three atoms of the element *B* fuse to give one atom of element *A*. This fusion process is accompanied by release of energy *e*. Then E_a, E_b and *e* are related to each other as

(a) $E_a + e = 3E_b$ (b) $E_a = 3E_b$ (c) $E_a - e = 3E_b$ (d) $E_a + 3E_b + e = 0$

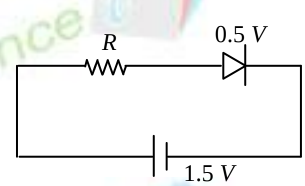
36. What is the ratio of the circumference of the first Bohr orbit for the electron in the hydrogen atom to the de-Broglie wavelength of electrons having the same velocity as the electron in the first Bohr orbit of the hydrogen atom?

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

37. In the X-ray tube before striking the target we accelerate the electrons through a potential difference of *V* volt. For which of the following value of *V*, we will have *X*-rays of largest wavelength?

(a) 10 kV (b) 20 kV (c) 30 kV (d) 40 kV

38. A diode used in the circuit shown has constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milli-watts. What should be the value of the resistor *R*, connected in series with the diode to obtain maximum current ?

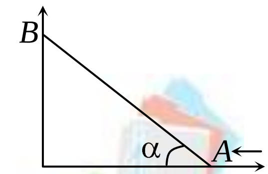


(a) 5 Ω (b) 5.6 Ω (c) 6.76 Ω (d) 20 Ω

39. The dimensional formula of magnetic flux is

(a) $[ML^2T^{-2}A^{-1}]$ (b) $[ML^0T^{-2}A^{-2}]$ (c) $[M^0L^{-2}T^{-2}A^{-2}]$ (d) $[ML^2T^{-1}A^3]$

40. Two particles A and B are connected by a rigid rod AB. The rod slides along perpendicular rails as shown here. The velocity of A to the left is 10 m/s. What is the velocity of B when angle $\alpha = 30°$?

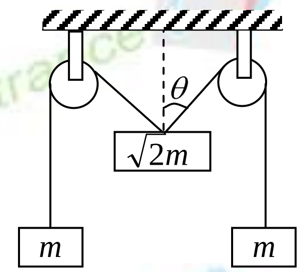


(a) 9.8 m/s (b) 10 m/s (c) 5.8 m/s (d) 17.3 m/s

41. If the thrust acting on a rocket moving with a velocity of 300 m/s is 210 N, then the rate of combustion of fuel is

(a) 0.7 kg/s (b) 1.4 kg/s (c) 0.07 kg/s (d) 10.7 kg/s.

42. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be

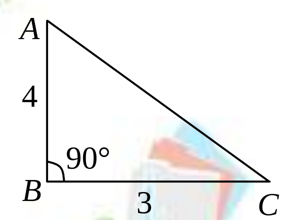


(a) 0° (b) 30°
(c) 45° (d) 60°

43. If a sphere is rolling, the ratio of the translational energy to total kinetic energy is given by

(a) 7 : 10 (b) 2 : 5 (c) 10 : 7 (d) 5 : 7

44. There is a flat uniform triangular plate ABC such that $AB = 4$ cm, $BC = 3$ cm and $\angle ABC = 90°$, figure. The moment of inertia of the plate about AB, BC and CA as axis is respectively I_1, I_2 and I_3. The incorrect statement is



(a) $I_3 < I_2$ (b) $I_2 > I_1$
(c) $I_3 < I_1$ (d) $I_3 > I_2$

45. The period of revolution of planet A around the sun is 8 times that of B. The distance of A from the sun is how many times greater than that of B from the sun?

(a) 2 (b) 3 (c) 4 (d) 5

46. The escape velocity on the surface of the earth is 11.2 km/s. What would be the escape velocity on the surface of another planet of the same mass but 1/4 times the radius of the earth?

(a) 44.8 km/s (b) 22.4 km/s (c) 5.6 km/s (d) 11.2 km/s

47. When a 4 kg mass is hung vertically on a light spring that obeys Hook's law, the spring stretches by 2 cm. The work required to be done by an external agent in stretching this spring further 5 cm will be ($g = 9.8$ m/s^2)

(a) 0.245 J (b) 4.410 J (c) 2.450 J (d) 4.900 J.

48. A soap bubble in vacuum has a radius of 3 cm and another soap bubble in vacuum has a radius of 4 cm. If two bubbles coalesce under isothermal conditions then the radius of the new bubble is

(a) 2.3 cm (b) 4.5 cm (c) 5 cm (d) 7 cm

49. A simple pendulum of length *l* has a bob of mass *m*, with a charge *q* on it. A vertical sheet of charge, with surface charge density σ passes through the point of suspension. At equilibrium, the string makes an angle θ with the vertical, then

(a) $\tan\theta = \frac{\sigma q}{2\varepsilon_0 mg}$ (b) $\tan\theta = \frac{\sigma q}{\varepsilon_0 mg}$ (c) $\cot\theta = \frac{\sigma q}{2\varepsilon_0 mg}$ (d) $\cot\theta = \frac{\sigma q}{\varepsilon_0 mg}$

50. The length of a sonometer wire *AB* is 110 cm. Where should the two bridges be placed from *A* to divide the wire in three segments whose fundamental frequencies are in the ratio of 1 : 2 : 3 ?

(a) 30 cm, 90 cm (b) 60 cm, 90 cm (c) 40 cm, 70 cm (d) None of these