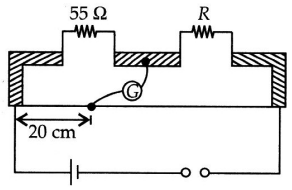
1. A tennis racket can be idealized as a uniform ring of mass M and radius R, attached to a uniform rod also of mass M and length L. The rod and the ring are coplanar, and the line of the rod passes through the centre of the ring. The moment of inertia of the racket about an axis through the centre of the ring and perpendicular to its plane is

(a) $\frac{1}{12}M(6R^2+L^2)$ (b) $\frac{1}{12}M(18R^2+L^2)$

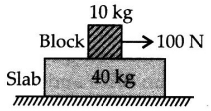
(c) $\frac{1}{3}M(6R^2+L^2+3LR)$ (d) $\frac{1}{12}M(R^2+L^2+6LR)$

2. Shown in the figure below is a meter-bridge set up with null deflection in the galvanometer. The value of the unknown resistance R is



(a) 55 Ω (b) 13.75 Ω
(c) 220 Ω (d) 110 Ω

3. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on the top of the slab as shown in the figure. The coefficients of static and kinetic friction are 0.60 and 0.40 respectively. The 10 kg block is pulled by a horizontal force of 100 N. The resulting acceleration of the slab is

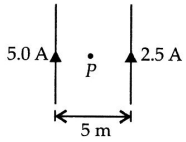


(a) 1 m s^{-2} (b) 2 m s^{-2}
(c) 4 m s^{-2} (d) 6 m s^{-2}

4. In a common base amplifier the phase difference between the input signal voltage and the output voltage is

(a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) π

5. The magnetic field at centre, P will be

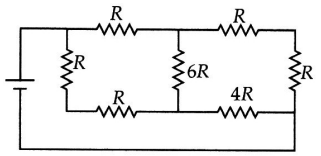


(a) $\frac{\mu_0}{4\pi}$ (b) $\frac{\mu_0}{\pi}$ (c) $\frac{\mu_0}{2\pi}$ (d) $4\mu_0\pi$

6. In a Young's double slit experiment, the intensity at a point where the path difference is $\frac{\lambda}{6}$ (λ being the wavelength of light used) is I. If I_0 denotes the maximum intensity, $\frac{I}{I_0}$ is equal to

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

7. A battery of internal resistance 4 Ω is connected to the network of resistances as shown in the figure. In order that the maximum power can be delivered to the network, the value of R should be



(a) 2 Ω (b) 4 Ω
(c) 6 Ω (d) 10 Ω

8. A certain vector in the xy plane has an x-component of 12 m and a y-component of 8 m. It is then rotated in the xy plane so that its x-component is halved. Then its new y-component is approximately

(a) 14 m (b) 13.11 m
(c) 10 m (d) 2.0 m

9. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by

$$V(x)=\frac{20}{(x^2-4)} \text{ volt}$$

The electric field E at x = 4 μm is given by

(a) (10/9) volt/μm and in the +ve x direction
(b) (5/3) volt/μm and in the –ve x direction
(c) (5/3) volt/μm and in the +ve x direction
(d) (10/9) volt/μm in the –ve x direction

10. A 40.0 kg boy is standing on a plank of mass 160 kg. The plank originally at rest, is free to slide on a smooth frozen lake. The boy walks along the plank at a constant speed of 2 m s^{-1} relative to the plank. The speed of the boy relative to the ice surface is

(a) $\frac{8}{5}$ m s^{-1} (b) $\frac{5}{8}$ m s^{-1}
(c) $\frac{2}{5}$ m s^{-1} (d) $\frac{5}{2}$ m s^{-1}

11. The displacement of an object attached to a spring and executing simple harmonic motion is given by $x = 2 \times 10^{-2}\cos\pi t$ metre. The time at which the maximum speed first occurs is
(a) 0.25 s (b) 0.5 s (c) 0.75 s (d) 0.125 s

12. In a room where the temperature is 30°C, a body cools from 61°C to 59°C in 4 minutes. What time will the body take to cool from 51°C to 49°C in the same room?
(a) 2 minutes (b) 6 minutes
(c) 4 minutes (d) 8 minutes

13. The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time ($t = 1$) is
(a) $v_0 + \frac{g}{2} + f$ (b) $v_0 + 2g + 3f$
(c) $v_0 + \frac{g}{2} + \frac{f}{3}$ (d) $v_0 + g + f$

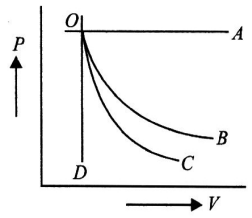
14. The physical quantity that has a ratio of 10^3 between its SI unit and CGS unit is
(a) Young's modulus
(b) Boltzmann constant
(c) Planck's constant
(d) Universal gravitational constant

15. A cylindrical tube open at both the ends has a fundamental frequency of 390 Hz in air. If $\left(\frac{1}{4}\right)^{\text{th}}$ of the tube is immersed vertically in water the fundamental frequency of air column is
(a) 260 Hz (b) 130 Hz
(c) 390 Hz (d) 520 Hz

16. Infrared radiation is detected by
(a) spectrometer (b) pyrometer
(c) nanometer (d) photometer

17. Earth is flattened at the poles and bulges at the equator. This is due to the fact that
(a) the earth revolves around the sun in an elliptical orbit.
(b) the angular velocity of spinning about its axis is more at the equator.
(c) the centrifugal force is more at the equator than at poles.
(d) none of these.

18. A graph of pressure versus volume for an ideal gas for different processes is as shown. In the graph curve *OC* represents



(a) isochoric process (b) isothermal process
(c) isobaric process (d) adiabatic process

19. One end of a string of length l is tied to the ceiling of a lift accelerating upwards with an acceleration $g/2$. The linear mass density of the string is $\mu(x) = \mu_0 x^{1/2}$ where, x is measured from the bottom. The time taken by a pulse to reach from bottom to top is
(a) $\sqrt{\frac{3l}{g}}$ (b) $2\sqrt{\frac{l}{g}}$ (c) $\sqrt{\frac{l}{g}}$ (d) $\sqrt{\frac{l}{3g}}$

20. Ferromagnetic materials used in a transformer must have
(a) low permeability and high hysteresis loss
(b) high permeability and low hysteresis loss
(c) high permeability and high hysteresis loss
(d) low permeability and low hysteresis loss

21. A bomb moving with velocity $(40\hat{i} + 50\hat{j} - 25\hat{k})$ m s^{-1} explode into two pieces of mass ratio 1 : 4. After explosion the smaller piece moves away with velocity $(200\hat{i} + 70\hat{j} + 15\hat{k})$ m s^{-1}. The velocity of larger piece after explosion is
(a) $45\hat{j} - 35\hat{k}$ (b) $45\hat{i} - 35\hat{j}$
(c) $45\hat{k} - 35\hat{j}$ (d) $-35\hat{i} + 45\hat{k}$

22. Young's double slit experiment gives interference fringes of width 0.3 mm. A thin glass plate made of material of refractive index 1.5 is kept in the path of light from one of the slits, then the fringe width becomes
(a) zero (b) 0.3 mm
(c) 0.45 mm (d) 0.15 mm

23. The number of turns in the primary and the secondary coils of a transformer are 1000 and 3000 respectively. If the primary of the coil is connected to 80 V ac, the potential difference per turn of the secondary coil is
(a) 240 V (b) 24 V
(c) 0.24 V (d) 0.08 V

24. Acceleration of a charged particle of charge 'q' and 'm' moving in a uniform electric field of strength 'E' is
(a) $\frac{qE}{m}$ (b) $\frac{m}{qE}$ (c) mqE (d) $\frac{q}{mE}$

25. According to Bohr's model, relation between the radius of an orbit and principal quantum number is
(a) $r \propto \frac{1}{n}$ (b) $r \propto \frac{1}{n^2}$
(c) $r \propto n$ (d) $r \propto n^2$

26. Steel wire of length L at 40°C is suspended from the ceiling and then a mass m is hung from its free end. The wire is cooled down from 40°C to 30°C to regain its original length L. The coefficient of linear thermal expansion of the steel is 10^{-5}°C^{-1}, Young's modulus of steel is 10^{11} N m^{-2} and radius of the wire is 1 mm. Assume that $L >>$ diameter of the wire. Then the value of m is nearly
(a) 1 kg (b) 2 kg (c) 3 kg (d) 4 kg

27. An iron block of sides 50 cm × 8 cm × 15 cm has to be pushed along the floor. The force required will be minimum when the surface in contact with ground is
(a) 8 cm × 15 cm surface (b) 5 cm × 15 cm surface
(c) 8 cm × 5 cm surface
(d) force is same for all surfaces

28. A steady current I goes through a wire loop PQR having shape of a right angle triangle with $PQ = 3x$, $PR = 4x$ and $QR = 5x$. The magnitude of the magnetic field at P due to this loop is

(a) $\frac{7\mu_0 I}{48\pi x}$ (b) $\frac{48\mu_0 I}{7\pi x}$ (c) $\frac{\mu_0 I}{\pi x}$ (d) $\frac{9\mu_0 I}{\pi x}$

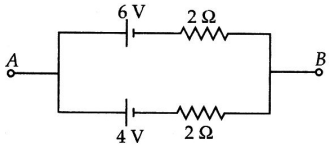
29. A ball moves on a frictionless inclined table without slipping. The work done by the table surface on the ball is

(a) positive (b) negative
(c) zero (d) none of these

30. A diatomic ideal gas is used in a Carnot engine as the working substance. If during the adiabatic expansion part of the cycle, the volume of the gas increases from V to $32V$, the efficiency of the engine is

(a) 0.75 (b) 0.99
(c) 0.25 (d) 0.5

31. Two batteries of different emfs and different internal resistances are connected as shown in the figure. The voltage across AB is



(a) 3 V (b) 4 V
(c) 5 V (d) 6 V

32. The position x of a particle varies with time t as $x = 6 + 12t - 2t^2$ where x is in metre and t in seconds. The distance travelled by the particle in first five seconds is

(a) 16 m (b) 26 m
(c) 10 m (d) 36 m

33. The input resistance of a CE amplifier is 333 Ω and the load resistance is 5 kΩ. A change of base current by 15 μA results in the change of collector current by 1 mA. The voltage gain of the amplifier is

(a) 550 (b) 51
(c) 101 (d) 1001

34. There is a point charge q located at the centre of a cube. What is the electric flux of this point charge, through a face of the cube?

(a) $\frac{q}{\varepsilon_0}$ (b) $\frac{q}{6\varepsilon_0}$
(c) $\frac{q}{3\varepsilon_0}$
(d) It will depend upon the size of the cube.

35. Which of the following quantities remain constant in a planetary motion (consider elliptical orbits) as seen from the Sun?

(a) Speed (b) Angular speed
(c) Kinetic energy (d) Angular momentum

36. A convex lens is made of glass of refractive index 1.5. If radius of curvature of each of is two surface is 20 cm, the ratio of the power of the lens, when placed in air to its power when immersed inside a liquid of refractive index 1.25 is

(a) $\frac{2}{5}$ (b) $\frac{5}{2}$ (c) $\frac{5}{1}$ (d) $\frac{5}{1}$

37. A brick of mass m, tied to a rope, is being whirled in a vertical circle, with a uniform speed. The tension in the rope is

(a) the same throughout
(b) largest when the brick is at the highest point of the circular path and smallest when it is at the lowest point.
(c) largest when the rope is horizontal and smallest when it is vertical
(d) largest when the brick is at the lowest point and smallest when it is at the highest point.

38. Two persons A and B standing 54 m apart on a long moving belt. Person A rolls a ball towards person B with a speed of 9 m s^{-1} with respect to the belt. If the belt is moving with a speed of 4 m s^{-1} in the direction from A to B, what is the speed of the ball with respect to an observer on a stationary platform?

(a) 13 m s^{-1} (b) 9 m s^{-1}
(c) 5 m s^{-1} (d) 4 m s^{-1}

39. What is the ratio of the angular speeds of the minute's hand and second's hand of a clock?

(a) 1 : 12 (b) 12 : 1 (c) 1 : 60 (d) 60 : 1

40. Two moles of monoatomic gas is mixed with three moles of a diatomic gas. The molar specific heat of the mixture at constant volume is

(a) $1.55R$ (b) $2.1R$ (c) $1.63R$ (d) $2.2R$

41. A bar magnet is placed upright on a floor (so that the axis of the magnet is vertical). A copper ring is held above the magnet, with its plane horizontal, and released. The copper ring falls in such a manner that its axis always coincides with that of the magnet. What will be the acceleration with which the ring will fall? Acceleration due to gravity is 10 m s^{-2}.

(a) 10 m s^{-2}
(b) less than 10 m s^{-2}
(c) more than 10 m s^{-2}
(d) the answer will depend upon which pole of the magnet is up.

42. A uniform solid cylinder has a radius R and length L. If the moment of inertia of this cylinder about an axis passing through its centre and normal to its circular face is equal to the moment of inertia of the same cylinder about an axis passing through its centre and perpendicular to its length, then

(a) $L = R$ (b) $L = \sqrt{3}R$
(c) $L = \frac{R}{\sqrt{3}}$ (d) $L = \sqrt{\frac{3}{2}}R$

43. A circular coil carrying a certain current produces a magnetic field B_0 at its centre. The coil is now rewound so as to have 3 turns and the same current is passed through it. The new magnetic field at the centre is

(a) $B_0/9$ (b) $9B_0$ (c) $B_0/3$ (d) $3B_0$

44. Tanks A and B open at the top contain two different liquids upto certain height in them. A hole is made to the wall of each tank at a depth h from the surface of the liquid. The area of the hole in B is twice that of in A. If the liquid mass flux through each hole is equal, then the ratio of the densities of the liquids respectively, is

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

45. The half-life of ^{60}Co is approximately 5.25 years. In a sample containing 1 g of freshly prepared ^{60}Co, how much of the isotope will be left after 21 years?

(a) 125 mg (b) 62.5 mg
(c) 31.25 mg (d) nothing will be left