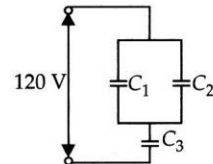


- If a charged spherical conductor of radius 10 cm has potential V at a point distant 5 cm from its centre, then the potential at a point distant 15 cm from the centre will be
 (a) $\frac{V}{3}$ (b) $\frac{2}{3}V$ (c) $\frac{3}{2}V$ (d) $3V$
- A particle of mass 0.01 kg is projected with velocity $v = 2\hat{i} \text{ m s}^{-1}$ from point $(x = 0, y = 20)$. After 2 seconds, its position coordinates are
 (a) (4, 0) (b) (20, 4)
 (c) (0, 4) (d) (4, 20)
- The angle subtended by vector $\vec{A} = 4\hat{i} + 3\hat{j} + 12\hat{k}$ with the x -axis is
 (a) $\sin^{-1}\left(\frac{3}{13}\right)$ (b) $\sin^{-1}\left(\frac{4}{13}\right)$
 (c) $\cos^{-1}\left(\frac{4}{13}\right)$ (d) $\cos^{-1}\left(\frac{3}{13}\right)$
- In vernier callipers, m divisions of main scale coincide with $(m + 1)$ divisions of vernier scale. If each division of main scale is d units, the least count of the instrument is
 (a) $\frac{d}{(m-1)}$ (b) $\frac{d}{(m+1)}$ (c) $\frac{d}{m}$ (d) $\frac{md}{(m+1)}$
- The magnetic field at the centre of a current carrying circular coil of radius 10 cm is $5\sqrt{5}$ times the magnetic field at a point on its axis. The distance of the point from the centre of the coil in cm is
 (a) 5 (b) 10
 (c) 20 (d) 35
- Electromagnetic waves travel in a medium which has relative permeability 1.3 and relative permittivity 2.14. Speed of electromagnetic waves in this medium will be
 (a) $13.6 \times 10^6 \text{ m s}^{-1}$ (b) $1.8 \times 10^6 \text{ m s}^{-1}$
 (c) $3.6 \times 10^8 \text{ m s}^{-1}$ (d) $1.8 \times 10^8 \text{ m s}^{-1}$
- If G , c and h are the fundamental constant of Physics, then the unit of time is expressed as
 (a) $\sqrt{\left(\frac{hc}{G}\right)}$ (b) $\sqrt{\left(\frac{hG}{c^5}\right)}$
 (c) $\left(\frac{hc}{G}\right)$ (d) hGc^3
- The time period of a geostationary satellite is
 (a) 1.5 hours (b) 6 hours
 (c) 12 hours (d) 24 hours

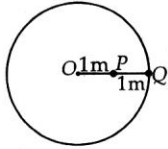
- There are two radioactive substances A and B . Decay constant of B is two times that of A . Initially, both have equal number of nuclei. After n half lives of A , rate of disintegration of both are equal. The value of n is
 (a) 1 (b) 4 (c) 2 (d) 8
- A magnet of magnetic moment M is rotated through an angle from 0° to 360° in a uniform magnetic field B , the work done will be
 (a) MB (b) $2MB$ (c) $2\pi MB$ (d) zero
- What is the relationship between time of flight T and horizontal range R ?
 (where θ is angle of projection with the horizontal)
 (a) $R = \frac{gT}{\tan\theta}$ (b) $R = \frac{gT^2}{2\tan\theta}$
 (c) $R = \frac{gT^2}{\tan\theta}$ (d) $R = \frac{gT}{2\tan\theta}$
- The position of a particle moving on x -axis is given by, $x = At^3 + Bt^2 + Ct + D$. The numerical value of A , B , C , D are 1, 4, -2 and 5 respectively and SI units are used. What is the velocity of the particle at $t = 4$?
 (a) 78 m s^{-1} (b) 87 m s^{-1}
 (c) 68 m s^{-1} (d) 97 m s^{-1}
- Two alternating currents are given by $I_1 = I_0 \sin\omega t$ and $I_2 = I_0 \cos(\omega t + \phi)$
 The ratio of rms values is
 (a) 1 : 1 (b) 1 : ϕ
 (c) 1 : 2 (d) none of these
- In figure $C_1 = 10 \mu\text{F}$, $C_2 = 20 \mu\text{F}$ and $C_3 = 15 \mu\text{F}$. The potential difference across C_3 is
 (a) 25 V (b) 80 V
 (c) 35 V (d) 40 V



- When a pentavalent impurity is added in Ge crystal then, what type of semiconductor is obtained?
 (a) A p -type (b) An n -type
 (c) Intrinsic (d) None of these
- The mass is pulled down by 2.5 cm and let it go. The mass will oscillate with an amplitude of
 (a) 2.5 cm (b) 2 cm
 (c) 3 cm (d) 2.75 cm



17. Two spheres of equal masses are attached to a string of length 2 m as shown in figure. The string and the spheres are then whirled in a horizontal circle about O at a constant rate.

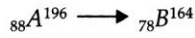


What is the value of the ratio

$$\left(\frac{\text{Tension in the string between P and Q}}{\text{Tension in the string between P and O}} \right)?$$

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

18. The number of α -particles and β -particles respectively emitted in the reaction



- (a) 8 and 8 (b) 8 and 6
(c) 6 and 8 (d) 8 and 4

19. Which of the following quantity remains constant in an ideal transformer?

- (a) Current (b) Voltage
(c) Power (d) All of these

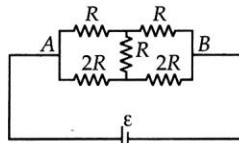
20. Two bars A and B of circular cross-section and of same volume and made of the same material are subjected to tension. If the diameter of A is half that of B and if the force applied to both the rods is the same and it is in the elastic limit, the ratio of extension of A to that of B will be

- (a) 16 (b) 8
(c) 4 (d) 2

21. 8 identical cells, each of emf ϵ and internal resistance r , are connected in series. If polarity of two cells is reversed then the total internal resistance in the circuit will be

- (a) $8r$ (b) $6r$
(c) $4r$ (d) $2r$

22. Consider the following statements regarding the network shown in the figure.

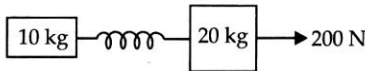


- (i) The equivalent resistance of the network between A and B is independent of the value of R' .
(ii) The equivalent resistance of the network between points A and B is $4R/3$.
(iii) The current flowing through R' is zero.

Which of the above statements is/are correct?

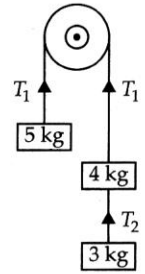
- (a) (i) alone (b) (ii) alone
(c) (ii) and (iii) (d) (i), (ii) and (iii)

23. Two masses of 10 kg and 20 kg respectively are connected by a massless spring. A force of 200 N is applied on the 20 kg mass as shown in the figure. At the instant shown, the 10 kg mass has acceleration 12 m s^{-2} . What is the acceleration of 20 kg mass?



- (a) 2 m s^{-2} (b) 8 m s^{-2}
(c) 6 m s^{-2} (d) 4 m s^{-2}

24. With reference to the figure showing a light inextensible string passing over a fixed frictionless pulley, the tension T_2 is



- (a) 24.5 N
(b) 29.4 N
(c) 18.6 N
(d) 68.6 N

25. Two soap bubbles of radii $2r$ and $3r$ are in contact with each other. The radius of curvature of the interface between the bubbles is

- (a) $2r$ (b) $6r$
(c) $3r$ (d) r

26. The sides of a rectangular block are 2 cm, 3 cm and 4 cm. The ratio of maximum to minimum resistance between its parallel faces is

- (a) 4 : 1 (b) 3 : 1
(c) 2 : 1 (d) 1 : 1

27. An object of mass m is allowed to fall from rest along a rough inclined plane. The speed of the object reaching the bottom of the plane is proportional to

- (a) m (b) m^2
(c) m^{-1} (d) m^0

28. The angle between vectors $(\hat{i} + \hat{j})$ and $(\hat{j} + \hat{k})$ is

- (a) 30° (b) 45°
(c) 60° (d) 90°

29. Two identical blocks A and B , each of mass m resting on smooth floor are connected by a light spring of natural length L and spring constant k . A third identical block of mass m moving with a speed v along the line joining A and B collides with A . The maximum compression in the spring is

- (a) $v\sqrt{\frac{m}{2k}}$ (b) $m\sqrt{\frac{v}{2k}}$
(c) $\sqrt{\frac{mk}{v}}$ (d) $\sqrt{\frac{mv}{2k}}$

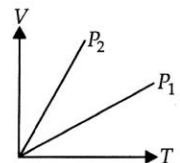
30. In a double-slit experiment, the angular width of a fringe is found to be 0.2° on a screen placed 1 m away. The wavelength of light used is 600 nm. What will be the angular width of the fringe if the entire experimental apparatus is immersed in water? Take refractive index of water to be $\frac{4}{3}$.

- (a) 0.15° (b) 0.3°
(c) 0.35° (d) 0.4°

31. The figure shows the volume V versus temperature T graphs for a certain mass of a perfect gas at two constant pressures of P_1 and P_2 .

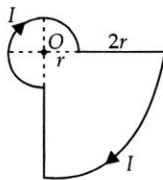
What inference can you draw from the graphs?

- (a) $P_1 > P_2$
(b) $P_1 < P_2$
(c) $P_1 = P_2$
(d) no inference can be drawn due to insufficient information.



32. A current I flowing through the loop as shown in figure. The magnetic field at the centre O is

- (a) $\frac{7\mu_0 I}{12r}$ acting downwards
 (b) $\frac{5\mu_0 I}{12r}$ acting downwards
 (c) $\frac{7\mu_0 I}{12r}$ acting upwards
 (d) $\frac{5\mu_0 I}{12r}$ acting upwards



33. An α particle moves in a circular path of radius 0.83 cm in the presence of a magnetic field of 0.25 Wb m^{-2} . The De Broglie wavelength associated with the particle will be ($h = 6.63 \times 10^{-34} \text{ J s}$; $e = 1.6 \times 10^{-19} \text{ C}$)

- (a) 0.1 \AA (b) 0.01 \AA
 (c) 1 \AA (d) 10 \AA

34. Two rings of radius R and nR made up of same material have the ratio of moment of inertia about an axis passing through centre as $1 : 8$. The value of n is

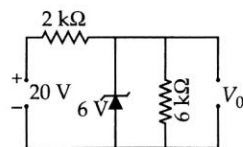
- (a) 2 (b) $2\sqrt{2}$
 (c) 4 (d) $\frac{1}{2}$

35. The ratio of specific heat of a gas at constant pressure to that at constant volume is γ . The change in internal energy of one mole of gas when volume changes from V to $2V$ at constant pressure P is

- (a) $\frac{R}{(\gamma - 1)}$ (b) PV
 (c) $\frac{PV}{(\gamma - 1)}$ (d) $\frac{\gamma PV}{\gamma - 1}$

36. What is the value of output voltage V_0 in the circuit as shown in figure?

- (a) 42 V
 (b) 14 V
 (c) 7 V
 (d) 6 V



37. Two particles P and Q describes SHM of same amplitude A and frequency ν along the same straight line. The maximum distance between two particles is $\sqrt{2}A$. The initial phase difference between the particles is

- (a) zero (b) $\frac{\pi}{2}$
 (c) $\frac{\pi}{6}$ (d) $\frac{\pi}{3}$

38. A vessel of height $2d$ is half-filled with a liquid of refractive index $\sqrt{2}$ and the other half with a liquid of refractive index μ . (The given liquids are immiscible). Then the apparent depth of the inner surface of the bottom of the vessel (neglecting the thickness of the bottom of the vessel) will be

- (a) $\frac{\mu}{d(\mu + \sqrt{2})}$ (b) $\frac{d(\mu + \sqrt{2})}{\mu\sqrt{2}}$
 (c) $\frac{\sqrt{2}\mu}{d(\mu + \sqrt{2})}$ (d) $\frac{\mu d}{d + \sqrt{2}\mu}$

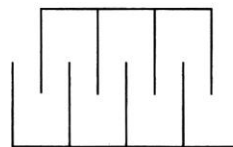
39. The maximum wavelength of a beam of light that can be used to produce photoelectric effect on a metal is 250 nm. The energy of the electrons in joule emitted from the surface of the metal when a beam of light of wavelength 200 nm is used

- (a) 89.61×10^{-22} (b) 69.81×10^{-22}
 (c) 18.96×10^{-20} (d) 19.89×10^{-20}

40. Mass of the earth has been determined through

- (a) use of Kepler's $\frac{T^2}{R^3}$ constancy law and Moon's period
 (b) sampling the density of earth's crust and using earth's radius
 (c) Cavendish's determination of G and using earth's radius and g at its surface
 (d) use of periods of satellites at different heights above earth's surface and known radius of earth.

41. A gang capacitor is formed by inter locking a number of plates as shown in the figure. The distance between the consecutive plates is 0.885 cm and the overlapping area of the plates is 5 cm^2 . The capacity of the unit is



- (a) 1.06 pF (b) 4 pF
 (c) 6.36 pF (d) 12.72 pF

42. If the temperature of the ideal gas contained in a closed vessel increased by 0.5%, the increase in temperature is 2 K. The initial temperature of the gas is

- (a) 27°C (b) 127°C (c) 300°C (d) 400°C

43. If the range of a gun which fires a shell with muzzle speed v is R , then the angle of elevation of the gun is

- (a) $\cos^{-1}\left[\frac{v^2}{gR}\right]$ (b) $\cos^{-1}\left[\frac{gR}{v^2}\right]$
 (c) $\frac{1}{2}\left[\frac{v^2}{gR}\right]$ (d) $\frac{1}{2}\sin^{-1}\left(\frac{gR}{v^2}\right)$

44. An engine running at speed $\frac{v}{10}$ sounds a whistle of frequency 600 Hz. A passenger in a train coming from the opposite side at speed $\frac{v}{15}$ experiences this whistle to be of frequency ν . If v is speed of sound in air and there is no wind, ν is nearest to

- (a) 710 Hz (b) 630 Hz
 (c) 580 Hz (d) 510 Hz

45. A beaker contains 200 g of water. The heat capacity of the beaker is equal to that of 20 g of water. The initial temperature of water in the beaker is 20°C . If 440 g of hot water at 92°C is poured in it, the final temperature, neglecting radiation loss, will be nearest to

- (a) 58°C (b) 68°C
 (c) 73°C (d) 78°C