Questions

Physics

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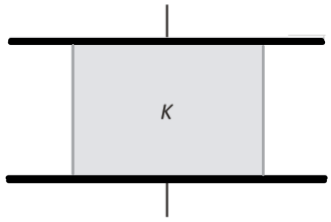
1. If the charge on a capacitor is doubled, the value of its capacitance C will be :

   a) Doubled
   b) Halved
   c) Remains Unchanged
   d) None of these

2. The maximum electric field that a dielectric medium of a capacitor can withstand without breakdown (of its insulating property) is called its :

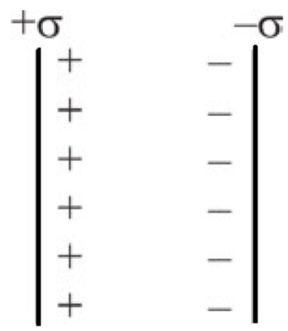
   a) *Polarization*
   b) *Capacitance*
   c) *Dielectric strength*
   d) *Dielectric constant*

3. Consider a parallel plate capacitor of 10 μF (microfarad) with air filled in the gap between the plates. Now, exactly one-half of the space between the plates is filled with a dielectric of dielectric constant 4, as shown in the figure.The capacity of the capacitor changes to :



   a) 25 μF
   b) 20 μF
   c) 40 μF
   d) 5 μF

4. Two large metal plates are placed parallel to each other. The inner surfaces of plates are charged by $+\sigma$ and $-\sigma$ C/m^2. The electric field between the plates and outside the plates :



   a) $\sigma/2\varepsilon_o$, σ/ε_o
   b) σ/ε_o , 0
   c) $\sigma/2\varepsilon_o$, 0
   d) $2\sigma/\varepsilon_o$, σ/ε_o

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5. Two identical capacitors C_1 and C_2 (equal in value) are connected in series with a battery of $e.m.f\ V_o$. They are fully charged. Now, a dielectric slab is inserted between the plates of C_2. The potential diff. across C_1 will :

a) Increase
b) Decrease
c) Remains Same
d) Depends on internal resistance of the cell

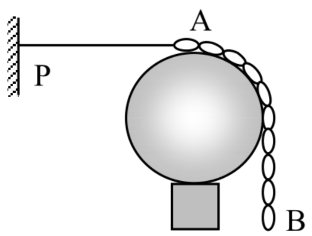
6. A smooth parabolic wire track lies in the vertical plane ($x - y\ plane$). The shape of track is defined by the equation $y = x^2/a$ (where a is constant). A bead of mass m which can slide freely on the wire track, is placed at the position $A(a, a)$. The track is rotated with constant angular speed ω about $y - axis$, such that there is no relative slipping between the ring and the track. Then ω is equal to :

a) $\sqrt{g/a}$
b) $\sqrt{2g/a}$
c) $\sqrt{g/2a}$
d) $\sqrt{\sqrt{2}g/a}$

7. A uniform circular ring of mass per unit length λ and radius R is rotating with angular velocity ω about its own axis in a gravity free space. Tension in the ring is :

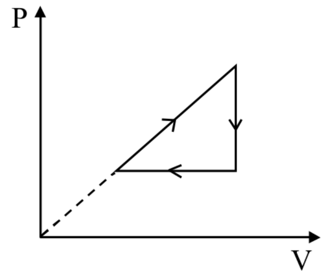
a) $Zero$
b) $\lambda\,\omega^2 R^2/2$
c) $\lambda\,\omega^2 R^2$
d) $2\lambda\,\omega^2 R^2$

8. A chain of mass per unit length λ and length $1.5\ m$ rests on a fixed smooth sphere of radius $R = (2/\pi)\ m$ such that end A of chain is at the top of sphere while the other end is hanging freely as shown. The chain is held stationary by a horizontal thread PA. The tension in this thread is :



a) $\lambda g\left(\frac{1}{2} + \frac{2}{\pi}\right)$
b) $\lambda g\left(\frac{\pi}{2} + \frac{2}{\pi}\right)$
c) $\lambda g\left(\frac{2}{\pi}\right)$
d) $None\ of\ These$

9. An ideal gas with adiabatic exponent $\gamma = 2$ goes through a cycle as shown in figure, in which absolute temperature varies $\tau = 4$ times. Find efficiency of this cycle :



a) $\frac{1}{9}$
b) $\frac{1}{8}$
c) $\frac{1}{6}$
d) $\frac{1}{5}$

10. The potential energy of a 4 kg particle free to move along the $x - axis$ is given by $U(x) = \frac{x^3}{3} - \frac{5x^2}{2} + 6x + 3$. Total mechanical energy of the particle is $17J$. Then the maximum kinetic energy is :

a) 10 J
b) 2 J
c) 9.5 J
d) 0.5 J

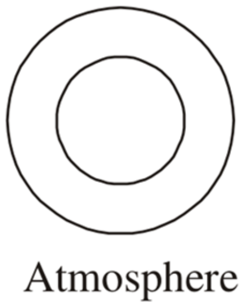
11. If a mercury droplet of radius R and surface tension S is broken into 8 smaller droplets of equal size. Then the work done by the external agency is :

a) $\frac{4}{3}\pi R^3 S$
b) $\pi R^2 S$
c) $8\pi R^2 S$
d) $4\pi R^2 S$

12. If n drops of a liquid, each with surface energy E, join to form a single drop then :

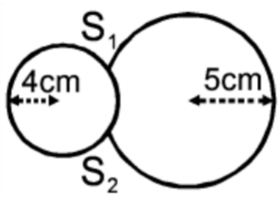
a) energy released in the process will be $E(n - n^{1/3})$
b) energy absorbed in the process will be $E(n - n^{1/3})$
c) energy released in the process will be $E(n - n^{2/3})$
d) energy absorbed in the process will be $E(n - n^{2/3})$

13. A soap bubble of radius R is surrounded by another soap bubble of radius $2R$, as shown. If surface tension $= S$, then the pressure inside the smaller soap bubble, in excess of the atmospheric pressure, will be :



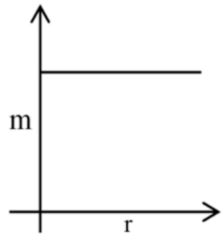
a) $4S/R$
b) $3S/R$
c) $6S/R$
d) *None of these*

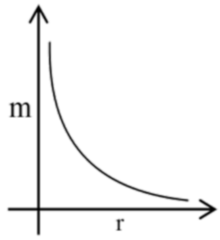
14. Two soap bubbles of radii R_1 and R_2 equal to 4 cm and 5 cm are touching each other over a common surface S_1S_2 (shown in figure). Radius of the common surface will be :

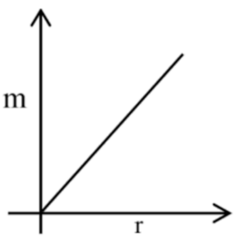


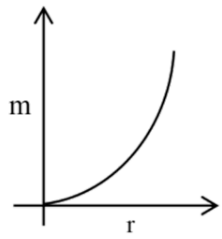
a) 4 cm
b) 20 cm
c) 5 cm
d) 4.5 cm

15. Graph between the mass of liquid inside the capillary and the radius of capillary :

a) 

b) 

c) 

d) 

16. A particle of mass 2 kg moves in a straight line. If v is the velocity at a distance x from a fixed point on the line and $v^2 = 3 - 4x^2$, then :

a) The motion continues along $+x$-direction only
b) The graph of v versus x would be a straight line
c) The angular frequency of oscillation is 4 rad/s
d) The total energy of oscillation is 3 J

17. A particle moves along the $z - axis$ according to the equation $z = 5 + 12\, cos\left(2\pi t + \frac{\pi}{2}\right)$, where z is in cm and t is in seconds. Select the correct alternative :

a) The motion of the particle is SHM with mean position at $z = 12\ cm$
b) The motion of the particle is SHM with one extreme position as $-7\ cm$
c) The motion of the particle is Oscillatory but not SHM
d) Amplitude of SHM is 17 cm

18. The amplitude of a particle in SHM is 5 cm and its time period is π. At a displacement of 3 cm from its mean position the velocity in cm/sec will be :

a) 8
b) 12
c) 2
d) 16

19. At a particular position the velocity of a particle in SHM with amplitude A is $\sqrt{3}/2$ of that at its mean position. In this position, its displacement is :

a) $A/2$
b) $\sqrt{3}A/2$
c) $A/\sqrt{2}$
d) $\sqrt{2}A$

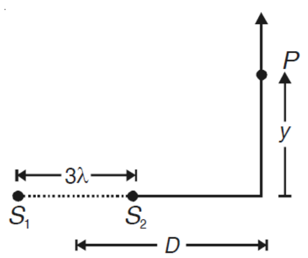
20. If the maximum velocity of a particle in SHM is v_o, then its velocity at half the amplitude from position of rest will be :

a) $v_o/2$
b) v_o
c) $v_o\sqrt{3/2}$
d) $v_o\sqrt{3}/2$

21. The velocities of a particle executing S.H.M. are 30 cm/s and 16 cm/s when its displacements are 8 cm and 15 cm from the equilibrium position. Then its amplitude of oscillation in cm is :

a) 25
b) 21
c) 17
d) 13

22. The figure shows two coherent microwave sources S_1 and S_2 emitting waves of wavelength λ and separated by a distance 3λ . The minimum non-zero value of y for point P to be an intensity maximum is $(D >> \lambda)$:



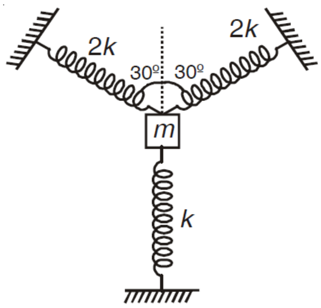
a) D

b) $\sqrt{3}D$

c) $\sqrt{5}D/2$

d) $2\sqrt{2}D$

23. A block of mass m is connected to three springs as shown in the figure. The block is displaced down slightly, from its mean position. The time period of oscillation is :



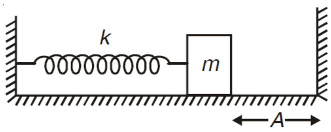
a) $2\pi\sqrt{\frac{m}{k}}$

b) $\pi\sqrt{\frac{m}{k}}$

c) $2\pi\sqrt{\frac{m}{2k}}$

d) $4\pi\sqrt{\frac{m}{k}}$

24. In the figure shown, a spring fixed to wall is initially undeformed. Now it is compressed by $\sqrt{2}A$. Consider the collision of the block with the wall to be perfectly elastic. The time period of oscillation is :



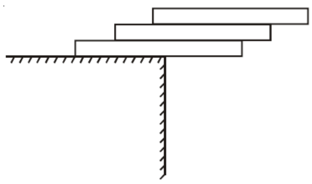
a) $2\pi\sqrt{\frac{m}{k}}$

b) $4\pi\sqrt{\frac{m}{k}}$

c) $\frac{3\pi}{2}\sqrt{\frac{m}{k}}$

d) $\frac{5\pi}{2}\sqrt{\frac{m}{k}}$

25. Three identical rods of mass M and length L are placed on one another on the table so as to produce the maximum overhang as shown in figure. The maximum possible overhang will be :



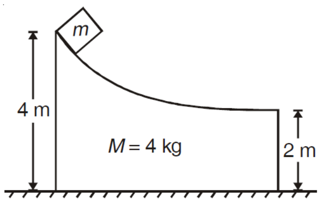
a) $\frac{2L}{3}$

b) $\frac{11L}{12}$

c) $\frac{L}{3}$

d) $\frac{13L}{12}$

26. As shown in figure a small block of mass $m = 1\ kg$ is placed over a wedge of mass $M = 4\ kg$. All surfaces are smooth. Mass m is released from rest from top position of wedge. Find the velocity of block at the instant, it is leaving the wedge :



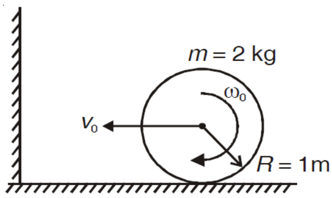
a) $\sqrt{2}$

b) 4

c) $4\sqrt{2}$

d) 2

27. A solid sphere of mass 2 kg and radius 1 m is moving on a smooth ground with linear velocity $v_o = 4\ m/s$ and angular velocity $\omega_o = 9\ rad/s$ as shown in figure. It collides elastically with a rough wall of coefficient of friction μ and after collision with the wall rolls without slipping in opposite direction. Find the coefficient of friction μ :



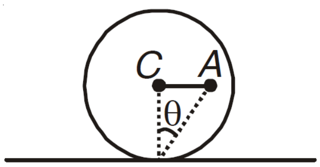
a) $\frac{3}{4}$

b) $\frac{3}{5}$

c) $\frac{1}{4}$

d) $\frac{1}{2}$

28. The disc rolls without slipping on a smooth horizontal surface as shown. The speed of the centre C is v. The speed of point A on the disc at the instant shown is :



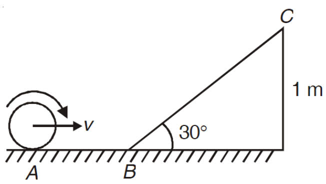
a) v

b) $v\cos\theta$

c) $\sqrt{2}v$

d) $v\sec\theta$

29. A small sphere of mass 1 kg is rolling without slipping with linear speed $v = \sqrt{\frac{200}{7}}$ m/s. It leaves the inclined plane at point C. Find the kinetic energy at the top just before leaving the inclined plane, neglecting any impact at B and assuming no slipping anywhere :



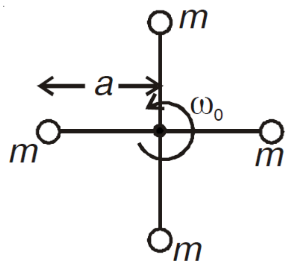
a) 20 J

b) 100/7 J

c) 10 J

d) 15 J

30. Initial angular velocity of the system shown is ω_o and frame length is a . System is rotating about the vertical axle and frame has negligible mass compared to the four point masses each of mass m. Due to an internal mechanism the spokes in the frame lengthen to $2a$. Find new angular velocity of the system :



a) ω_0

b) $\frac{3\omega_0}{4}$

c) $\frac{\omega_0}{2}$

d) $\frac{\omega_0}{4}$

31. A current in circuit is given by $i = 3 + 4 \sin \omega t$. Then the effective value of current is :

a) 5

b) $\sqrt{7}$

c) $\sqrt{17}$

d) $\sqrt{10}$

32. The incorrect statement is :

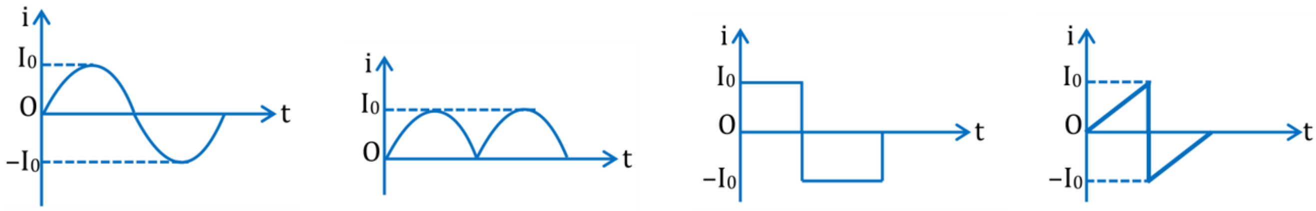
a) A.C. meters can be used to measure D.C

b) D.C meters cannot be used to measure A.C

c) A.C. and D.C. meters are based on the heating effect of current

d) A.C. meter reads rms value of current

33. If I_1, I_2, I_3 and I_4 are the respective r.m.s. values of the time-varying currents as shown in the four cases I, II, III, and IV. Then identify the correct relations :



a) $I_1 = I_2 = I_3 = I_4$

b) $I_3 > I_1 = I_2 > I_4$

c) $I_3 > I_4 > I_2 = I_1$

d) $I_3 > I_2 > I_1 > I_4$

34. The effective value of current $i = 2 \sin 100\pi t + 2 \sin(100\pi t + 30°)$ is :

a) $\sqrt{2}$ A

b) $2\sqrt{2} + \sqrt{3}$ A

c) 4 A

d) None

35. If $I = 2\sqrt{t}$ ampere then calculate rms values over $t = 2$ to 4 s :

a) $\frac{\sqrt{3}}{2}$

b) $2\sqrt{3}$

c) $\sqrt{3}$

d) $4\sqrt{3}$

36. In an AC circuit an alternating voltage $\varepsilon = 200\sqrt{2} \sin 100t$ volts is connected to a capacitor of capacity $1\mu F$. The r.m.s. value of the current in the circuit is :

a) 10 mA

b) 100 mA

c) 200 mA

d) 20 mA

37. In an AC circuit containing a pure capacitor, across which an AC emf $\varepsilon = 100\sin(1000t)$ volt is applied. If the peak value of the current is 200 mA, then the value of the capacitor is :

a) 2 μF

b) 20 μF

c) 5 μF

d) 500 μF

38. A student connects a long air cored – coil of manganin wire to a 100 V D.C. supply and records a current of 25 amp. When the same coil is connected across 100 V, 50 Hz a.c. the current reduces to 20 A. The reactance of the coil is :

a) 4 Ω

b) 3 Ω

c) 5 Ω

d) None

39. In a purely inductive circuit, the applied voltage $V = 50\sqrt{2}\sin(100\ \pi t)$ volt and ammeter reading is 2A then calculate value of L :

a) $\frac{1}{2\pi}\ H$

b) $\frac{1}{4\pi}\ H$

c) $\frac{1}{\pi}\ H$

d) None

40. If the power factor of an R-L series circuit is $\frac{1}{2}$ when applied voltage is $V = 100\sin(100\pi t)$ volt and resistance of circuit is 200 Ω, then calculate the inductance of the circuit :

a) $2\sqrt{3}\pi\ H$

b) $\frac{2\sqrt{3}}{\pi}\ H$

c) $\frac{\pi}{2\sqrt{3}}\ H$

d) $\frac{\sqrt{3}}{2\pi}\ H$

Answer Key

1. C	2. C	3. A	4. B
5. A	6. B	7. C	8. A
9. A	10. C	11. D	12. C
13. C	14. B	15. C	16. D
17. B	18. A	19. A	20. D
21. C	22. C	23. B	24. C
25. B	26. C	27. C	28. D
29. C	30. D	31. C	32. C
33. B	34. A	35. B	36. D
37. A	38. B	39. B	40. B