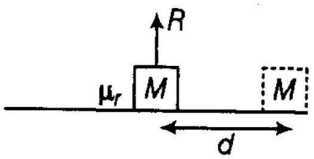
1. The velocity of a transverse wave in a string is directly proportional to $\sqrt{T}$ and inversely proportional to $\sqrt{u}$. In a measurement, the mass applied at the end of string is 3.0 g, length of string is 1 m and mass of string is 5 g. If possible error in measuring mass is 0.1 g and that of length is 1mm, the percentage error in measurement of velocity is
(a) 4.5%
(b) 2.7%
(c) 2.1%
(d) 3.7%

Correct: b

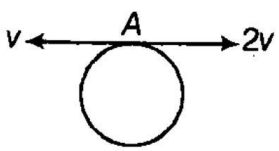
2. If reaction is R and coefficient of friction μ_r, what is the work done against friction in moving a body by distance d?



(a) $\frac{\mu_r Rd}{4}$
(b) $2\mu_r, Rd$
(c) $\mu_r Rd$
(d) $\frac{\mu_r Rd}{2}$

Correct: c

3. Two small particles of equal masses start moving in opposite directions from a point A in a horizontal circular orbit. Their tangential velocities are v and 2v respectively, as shown in the figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, these two particles will again reach the point A?



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

Correct: c

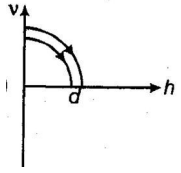
4. The displacement of a body is given by $x = 4t + 5t^3$ where x is in metre and t is in second. The difference between the average velocity of the body in the time-interval t =1 s to t= 2 s and its instantaneous- velocity at t=1s is
(a) 20.0 m/s
(b) 22.5 m/s
(c) 27.0 m/s
(d) 39.0 m/s

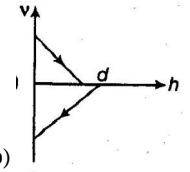
Correct: a

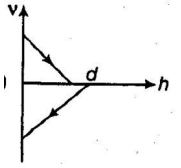
5. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward followed again by 5 steps forward and 3 steps backward and so on. Each step is 1m long and requires 1s. Determine how long the drunkard takes to fall in a pit 13 m away from the starting point?
(a) 37 s
(b) 13 s
(c) 49
(d) 18 s

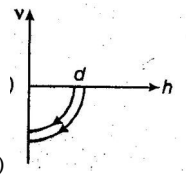
Correct: a

6. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as

(a)


(b)


(c)


(d)


Correct: b

7. Two seconds after projection, a projectile is moving at 30° above the horizontal, after one more second, it is moving horizontally. The initial speed of the projectile is (Take $g = 10\text{ms}^{-2}$)
(a) 10 m/s
(b) 10/3 m/s
(c) 20 m/s
(d) 2013 m/s

Correct: d

8. A thin circular ring of mass M and radius r is rotating about its axis at angular velocity ω. Two particles, each of mass m are attached gently to the ring at points which are at opposite ends of diameter of the ring. New angular velocity of the ring is
(a) $\frac{M\omega}{M+2m}$
(b) $\frac{\omega(M+2m)}{M}$
(c) ω
(d) $\frac{\omega m}{(M+2m)}$

Correct: a

9. A particle of mass m is moving with a constant velocity along a line parallel to the positive direction of X-axis. The magnitude of its angular momentum with respect to the origin
(a) is zero.
(b) goes on increasing as x increases.
(c) goes on decreasing as x increases.
(d) remains constant for all positions of the particle.

Correct: d

10. A satellite of mass M is revolving in circular orbit of radius r around the earth. Time of revolution of the satellite is

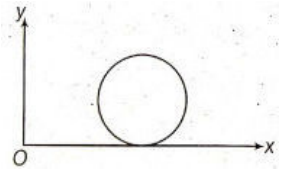
(a) $T \propto r^{\frac{1}{2}}$
(b) $T \propto r^{\frac{3}{2}}$
(c) $T \propto r^{\frac{-1}{2}}$
(d) $T \propto r^{\frac{-3}{2}}$

Correct: b

11. One end of massless spring of spring constant 100 N/m and natural length 0.49 m is fixed and other end is connected to a body of mass 0.5 kg lying on a frictionless horizontal table. The spring remains horizontal. If the body is made to rotate at an angular velocity of 2 rad/s, then the elongation of the spring will be
(a) 2 cm
(b) 1 cm
(c) 0.5 cm
(d) 0.25 cm

Correct: b

12. A disc of mass M and radius R is rolling with angular speed ω on a horizontal surface as shown in figure. The magnitude of angular momentum of the disc about the origin O is (here v is the linear velocity of the disc)



(a) $\frac{3}{2}MR^2\omega^2$
(b) $MR^2\omega$
(c) MRv
(d) $\frac{3}{2}MRv$

Correct: d

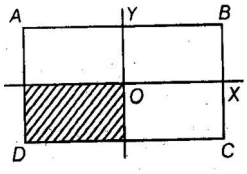
13. The only force acting on a 2 kg body that is moving in xy-plane has a magnitude of 5 N. The body initially has a velocity of 4 m/s in the positive x-direction. Some time later, the body has a velocity of 6 m/s in the positive y-direction. The work done on the body by the 5 N force during this time is
(a) 20 J
(b) 40 J
(c) 52 J
(d) 72 J

Correct: a

14. A simple pendulum has time period T_1. The point of suspension is now moved upward according to the relation $y = kt^2$, $\left(k = 1\text{m/s}^2\right)$ where y is the vertical displacement. The time period now becomes T_2.
The ratio of $\frac{T_1^2}{T_2^2}$ $\left(g = 10\text{m/s}^2\right)$ is
(a) 5/6
(b) 6/5
(c) 1
(d) ⅘

Correct: b

15. Figure shows a rectangular copper plate with is centre of mass at the origin O and side AB = 2BC = 2 m. If a quarter part of the plate (shown as shaded) is removed, the centre of mass of the remaining plate would lie at



(a) $\frac{1}{12}m, \frac{1}{6}m$
(b) $\frac{1}{6}m, \frac{1}{12}m$
(c) $\frac{1}{3}m, \frac{1}{6}m$
(d) $\frac{1}{3}m, \frac{1}{2}m$

Correct: b

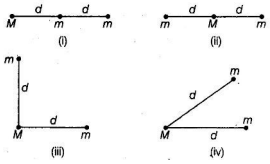
16. Two long conductors, separated by a distance d carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of force between them is
(a) - 2F
(b) F/3
(c) -2F/3
(d) -F/3

Correct: c

17. Two identical cells are first connected in series and then in parallel. The ratio of power consumed by them is
(a) 1:1
(b) 1:2
(c) 1:3
(d) 1:4

Correct: a

18. Three particles, two with masses m and one with mass M, might be arranged in any of the four configurations shown below. Rank the configurations according to the magnitude of the gravitational force on M, least to greatest



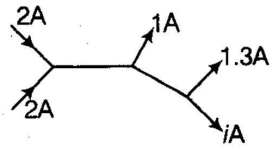
(a) (i), (i), (iii), (iv)
(b) (ii), (i), (iii), (iv)
(c) (ii), (i), (iv), (iii)
(d) (ii), (iii), (iv), (i)

Correct: b

19. A cylinder of radius R made of a material of thermal conductivity K_1, is surrounded by a cylindrical shell of inner radius R and outer radius 2R and made of a material of thermal conductivity K_2. The two ends of the combined system are maintained at two different temperatures. There is no loss of heat across the cylindrical surface and the system is in steady state. The effective thermal conductivity of the system is
(a) $\frac{3K_1+K_2}{4}$
(b) $\frac{K_1+3K_2}{4}$
(c) $K_1 + K_2$
(d) $\frac{K_1K_2}{K_1+K_2}$

Correct: b

20. The strength of current i in the given figure is



(a) 1.7 A
(b) 1.3 A
(c) 3.7 A
(d) 1.0 A

Correct: a

21. Two solid spheres of the same metal but of mass M and 8 M fall simultaneously in a viscous liquid. If their terminal velocities are v and nv, then the value of n will be
(a) 16
(b) 8
(c) 4

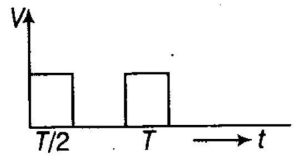
(d) 2

Correct: c

22. 1A current flows through an infinitely long straight wire. The magnetic field produced at a point 1 m away from it is
(a) $2 \times 10^{-3}\mathrm{T}$
(b) $\frac{2}{10}\mathrm{T}$
(c) $2 \times 10^{-7}\mathrm{T}$
(d) $2\pi \times 10^{-6}\mathrm{T}$

Correct: c

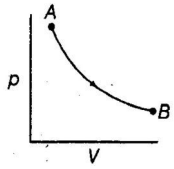
23. The rms value of potential difference V_0 shown in figure is



(a) V_0
(b) $\frac{V_0}{\sqrt{2}}$
(c) $\frac{V_0}{2}$
(d) $\frac{V_0}{\sqrt{3}}$

Correct: b

24. A sample of an ideal gas undergoes an isothermal process as shown by the curve AB in the pV diagram. If $\Delta Q, \Delta U$ and ΔW represent the amount of heat absorbed the change in internal energy and the work done respectively, then which of the following statement is correct?



(a) $\Delta Q = +$ ve, $\Delta U = 0, \Delta W = -ve$
(b) $\Delta Q = +v\theta, \Delta U = 0, \Delta W = +ve$
(c) $\Delta Q = +v\theta, \Delta U = 0, \Delta W = 0$
(d) $\Delta Q = +ve, \Delta U = +ve, \Delta W = +ve$

Correct: b

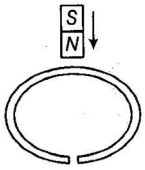
25. An electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then, the potential difference $V_A - V_o$, where Vo is the potential at the origin and V_A is the potential at x=2 m, is given by
(a) $-80\hat{j}$
(b) $120\hat{j}$
(c) $-120\hat{j}$
(d) $80\hat{j}$

Correct: a

26. A rocket is moving at a speed of 200 m/s towards a stationary target. While moving it emits a wave of frequency 1000 Hz. Some of the sound reaching the target gets reflected back to the rocket as an echo. The frequency of the echo as detected by the rocket is (velocity of sound = 330 m/s)
(a) 1000 Hz
(b) 1580 Hz
(c) 2540 Hz
(d) 4080 Hz

Correct: d

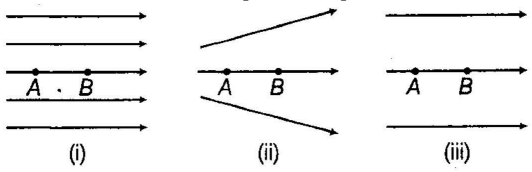
27. A copper ring having a cut such that it does not form a complete loop is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. Then acceleration of the falling magnet is



(a) g
(b) less than g
(c) more than g
(d) zero

Correct: a

28. Figure shows three arrangements of electric field lines. In each arrangement, a proton is released from rest at point A and then i accelerated through point B by the electric field. Points A and B have equal separations in the three arrangements. If p_1, p_2 and p_3 are linear momentum of the proton at point B in the three arrangement respectively, then



(a) $p_1 > p_3 > p_2$
(b) $p_1 > p_2 > p_3$
(c) $p_2 > p_1 > p_3$
(d) $p_1 = p_2 = p_3$

Correct: b

29. The electromagnetic wave used in LASIK eye surgery is
(a) ultraviolet ray
(b) X-ray
(c) microwave
(d) radio wave

Correct: a

30. Two bulbs consume the same power when operated at 200 V and 300 V, respectively. When these bulbs are connected in series across a DC source of 500 V, then the ratio of potential difference across them is
(a) 2/3
(b) 4/9
(c) 6/27
(d) 8/24

Correct: b

31. Two identical conducting spheres A and B carry equal charge. They are initially separated by a distance much larger than their diameters and the force between them is F. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to C and removed. As a result, the force between A and B now is
(a) F/16
(b) F/4
(c) 3F/8
(d) F/2

Correct: c

32. The bending of beam of light around corners of obstacles is called
(a) reflection
(b) refraction
(c) diffraction
(d) interference

Correct: c

33. An inverter battery operated on 24 V and has negligible internal resistance. It is rated at 140 ampere-hour. What external resistance would have to be connected to the battery, if it were to be discharged in 14 hours.
(a) 1.6Ω

(b) 2.4Ω
(c) 5.9Ω
(d) 10.0Ω-

Correct: b

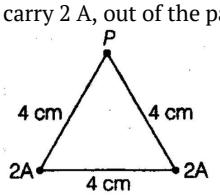
34. Light travels in a straight line because
(a) it is not absorbed by atmosphere
(b) its velocity is very high
(c) diffraction effect is negligible
(d) None of the above

Correct: c

35. Mirage is a phenomenon due to
(a) reflection of light
(b) refraction of light
(c) total internal reflection of light
(d) diffraction of light

Correct: c

36. Two long straight wires vertically pierced the plane of the paper at vertices of an equilateral triangle as shown in figure. They each carry 2 A, out of the paper. The magnetic field at the third vertex P has magnitude.



(a) $10^{-5}T$
(b) $14 \times 10^{-5}\mathrm{T}$
(c) $17 \times 10^{-5}\mathrm{T}$
(d) $0.85 \times 10^{-5}\mathrm{T}$

Correct: c

37. There are four lenses L_1, L_2, L_3 and L_4 of focal lengths, 2, 4, 6 and 8 cm respectively. Two of these lenses form a telescope of length 10 cm and magnifying power 4. The objective and eye lenses are
(a) L_2, L_3
(b) L_1, L_4
(c) L_3, L_2
(d) L_4, L_1

Correct: d

38. A magnetic field cannot
(a) change the velocity of a charged particle.
(b) change the momentum of a charged particle.
(c) change the kinetic energy of a charged particle.
(d) change the trajectory of a charged particle.

Correct: c

39. The de-Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 m/s is Given: Planck's constant =6.63x 10 34 J s
(a) $10^{-16}\mathrm{m}$
(b) $10^{-25}\mathrm{m}$
(c) $10^{-31}\mathrm{m}$
(d) $10^{-33}\mathrm{m}$

Correct: d

40. What will be the ratio of de-Broglie wavelengths of proton and a-particle of the same energy?
(a) 2:1
(b) 1:2
(c) 4:1

(d) 1:4

Correct: a

41. An alternating voltage $V = 200\sqrt{2}\sin(100n)$ volt is connected to a $\mathbf{1}\mu\mathrm{F}$ capacitor through an AC ammeter. The reading of the ammeter
(a) 40 mA
(b) $20\sqrt{2}\mathrm{mA}$
(c) 20 mA
(d) $10\sqrt{2}\mathrm{mA}$

Correct: c

42. In Young's double slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where the path difference is λ, is k units. The intensity of the light at a point, where path difference is λ/3 is
(a) k/2
(b) k/3
(c) k/4
(d) 2k/3

Correct: c

43. The mass-defect in a nuclear fusion reaction is 0.3 per cent. The amount of energy released in one kg of fusion reaction is
(a) $2.7 \times 10^{23}\mathrm{J}$
(b) $2.7 \times 10^{19}\mathrm{J}$
(c) $2.7 \times 10^{16}\mathrm{J}$
(d) $2.7 \times 10^{14}\mathrm{J}$

Correct: d

44. In a stack of three polarising sheets, the first and the third are crossed while the middle one has its axis at 45° to the axes of the other two. The fraction of intensity of an incident unpolarised beam of light that is transmitted by the stack is
(a) ½
(b) ⅓
(c) ¼
(d) ⅛

Correct: d

45. A proton (p) and an α-particle are accelerated through the same potential difference V volt. The de-Broglie wavelengths associated with the proton and the α -particle, λ_p and λ_α respectively are in the ratio
(a) 2:1
(b) $2\sqrt{2} : 1$
(c) 4:1
(d) $\sqrt{2} : 1$

Correct: b

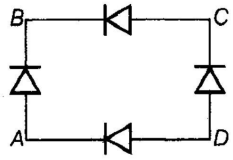
46. The wave nature of electron was first experimentally verified by
(a) Louis Victor de-Broglie
(b) James Frank and Gustav Hertz
(c) C.J. Davisson and L.H. Germer
(d) Hans Geiger and Ernst Marsden

Correct: a

47. In a semiconductor crystal if the current flows due to breakage of crystal bonds, then the semiconductor is called
(a) donor
(b) acceptor
(c) intrinsic semiconductor
(d) extrinsic semiconductor

Correct: c

48. In adjoining figure, the input (A.C.) is across the terminals A and C and the output is across B and D. Then output is



(a) zero
(b) the same as input
(c) half wave rectified
(d) full wave rectified

Correct: d

49. Consider the following
(i) Submarine communications
(ii) A.M. radio
(iii) Shortwave ratio
(iv) Radar
Arrange the above in increasing frequency of the waves associated with them (a) (iv), (iii), (ii), (i)
(b) (i), (ii), (iii), (iv)
(c) (ii), (i), (iv), (iii)
(d) (ii), (iii), (iv), (i)

Correct: b

50. For a CE transistor amplifier the audio signal voltage across the collector resistance of $2k\Omega$ is 2 V. The current amplification factor of the transistor is 100. If the base resistance is $1k\Omega$, the input signal voltage and base current are respectively
(a) 0.01 V, 10 μA
(b) 0.04 V, 10 μA
(c) 0.01 V, 10 μA
(d) 0.04 V, 10 μA

Correct: a