01 Which of the following represents uniformly accelerated motion?

(a) $x = \sqrt{\frac{t+a}{b}}$ (b) $x = \frac{t+a}{b}$

(c) $t = \sqrt{\frac{x+a}{b}}$ (d) $x = \sqrt{t+a}$

02 A particle moves along a straight line. Its position at any instant is given by $x = 32t - \frac{8t^3}{4}$, where x is in metre and t is in second. Find the acceleration of the particle at the instant when particle is at rest.

(a) $-16\,ms^{-2}$ (b) $-27.6\,ms^{-2}$

(c) $32\,ms^{-2}$ (d) $16\,ms^{-2}$

03 The ratios of the distance traversed, in successive intervals of time by a body, falling from rest, are

(a) 1 : 3 : 5 : 7 : 9 :...

(b) 2 : 4 : 6 : 8 : 10 :...

(c) 1 : 4 : 7 : 10 : 13 :...

(d) None of the above

04 Velocity and acceleration of a particle at some instant of time are $\mathbf{v} = (3\hat{i} + 4\hat{j})\,ms^{-1}$ and $\mathbf{a} = -(6\hat{i} + 8\hat{j})\,ms^{-2}$ respectively. At the same instant particle is at origin. Maximum x-coordinate of particle will be

(a) 1.5 m (b) 0.75 m

(c) 2.25 m (d) 4 m

05 A particle moves in the XY-plane according to the law $x = kt$, $y = kt(1 - \alpha t)$, where k and α are positive constants and t is time. The trajectory of the particle is

(a) $y = kx$ (b) $y = x - \frac{\alpha x^2}{k}$

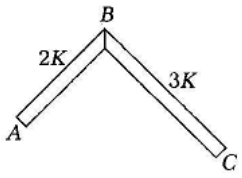
(c) $y = -\frac{ax^2}{k}$ (d) $y = \alpha x$

06 The equation of projectile is $y = \sqrt{3}x - \frac{g}{2}x^2$, the angle of its projection is

(a) 90° (b) zero

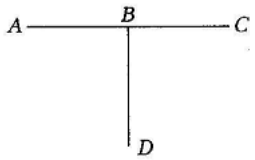
(c) 60° (d) 30°

07 In the figure ABC is a conducting rod whose lateral surfaces are insulated. The length of the section AB is one-half of that of BC, and the respective thermal conductivities of the two sections are as given in the figure. If the ends A and C are maintained at 0°C and 70°C respectively, the temperature of junction B in the steady state is



(a) 30°C (b) 40°C (c) 50°C (d) 60°C

08 Three conducting rods of same material and cross-section are shown in figure. Temperatures of A, D and C are maintained at 20°C, 90°C and 0°C. The ratio of lengths BD and BC if there is no heat flow in AB is



(a) 2/7 (b) 7/2 (c) 9/2 (d) 2/9

09 Work done in converting one gram of ice at $-10°C$ into steam at 100°C is

(a) 3045 J (b) 6056 J (c) 721 J (d) 616 J

10 A particle starts travelling on a circle with constant tangential acceleration. The angle between velocity vector and acceleration vector, at the moment when particle complete half the circular track, is

(a) $\tan^{-1}(2\pi)$ (b) $\tan^{-1}(\pi)$ (c) $\tan^{-1}(3\pi)$ (d) zero

11 Three identical particles are joined together by a thread as shown in figure. All the three particles are moving in a horizontal plane. If the velocity of the outermost particle is v_0, then the ratio of tensions in the three sections of the string is $(T_{BC} : T_{AB} : T_{DA})$

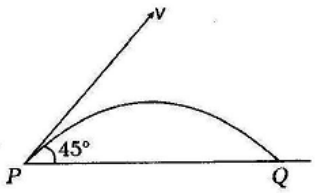
(a) 3 : 5 : 7 (b) 3 : 4 : 5

(c) 7 : 11 : 6 (d) 3 : 5 : 6

12 A metal ball falls from a height of 32 m on a steel plate. If the coefficient of restitution is 0.5, to what height will the ball rise after second bounce?

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

13 A projectile of mass m is fired with velocity v from a point P, as shown. Neglecting air resistance, the magnitude of the change in momentum between the points P and arriving at Q is



(a) zero (b) $\frac{mv}{\sqrt{2}}$
(c) $mv\sqrt{2}$ (d) $2mv$

14 A bullet of mass 20 g and moving with 600 ms^{-1} collides with a block of mass 4 kg hanging with the string of length 0.4 m. What is velocity of bullet when it comes out of block, if block rises to height 0.2 m after collision?

(a) 200 ms^{-1} (b) 150 ms^{-1} (c) 400 ms^{-1} (d) 300 ms^{-1}

15 The bulk modulus of water is 2.1×10^9 Nm^{-2}. The pressure required to increase the density of water by 0.1% is

(a) 2.1×10^3 Nm^{-2} (b) 2.1×10^6 Nm^{-2}
(c) 2.1×10^5 Nm^{-2} (d) 2.1×10^7 Nm^{-2}

16 An elastic material with Young's modulus Y is subjected to a tensile stress S, elastic energy stored per unit volume of the material is

(a) $\frac{YS}{2}$ (b) $\frac{S^2}{Y}$ (c) $\frac{S^2}{2Y}$ (d) $\frac{S}{2Y}$

17 A 5 m long wire is fixed to the ceiling. A weight of 10 kg is hang at the lower end and is 1 m above the floor. The wire was elongated by 1 mm. The energy stored in the wire due to stretching is

(a) 0.01 J (b) 0.05 J (c) 0.02 J (d) 0.04 J

18 If two soap bubble of different radii are in communication with each other

(a) air flows from larger bubble into the smaller one
(b) the size of the bubbles remains the same
(c) air flows from the smaller bubble into the large one and the larger bubble grows at the expense of the smaller one
(d) None of the above

19 A tank is filled to a height H. The range of water coming out of a hole which is a depth $H/4$ from the surface of water level is

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

20 A boat having a length 3 m and breadth 2 m is floating on a lake. The boat sinks by 1 cm when a man gets on it. The mass of the man is

(a) 60 kg (b) 72 kg (c) 52 kg (d) 65 kg

21 A stone of relative density K is released from rest on the surface of a lake. If viscous effects are ignored, the stone sinks in water with an acceleration of

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

22 Which of the following quantities does not depend upon the orbital radius of a satellite?

(a) $\frac{T}{R}$ (b) $\frac{T^2}{R}$ (c) $\frac{T^2}{R^2}$ (d) $\frac{T^2}{R^3}$

(where, R = radius of orbit)

23 For a satellite orbiting very close to earth's surface, total energy is

(a) zero (b) $\frac{GMm}{R}$ (c) $-\frac{GMm}{R}$ (d) $-\frac{GMm}{2R}$

24 A body which is initially at rest at a height R above the surface of the earth of radius R, falls freely towards the earth, then its velocity on reaching the surface of the earth is

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

25 Two particles of equal mass m go round a circle of radius R under the action of their mutual gravitational attraction. The speed of each particle is

(a) $v=\sqrt{\frac{Gm}{R}}$ (b) $v=\sqrt{\frac{Gm}{2R}}$ (c) $v=\frac{1}{2}\sqrt{\frac{Gm}{R}}$ (d) $v=\sqrt{\frac{4Gm}{R}}$

26 The molar heat capacity in a process of a diatomic gas if it does a work of $Q/4$ when a heat of Q is supplied to it is

(a) $\frac{2}{5}R$ (b) $\frac{5}{2}R$ (c) $\frac{10}{3}R$ (d) $\frac{6}{7}R$

27 A gas mixture consists of 4 moles of oxygen and 6 moles argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

(a) $4RT$ (b) $14RT$ (c) $8RT$ (d) $19RT$

28 A constant torque of 1000 N-m turns a wheel of moment of inertia 200 kg-m^2 about an axis through its centre. Its angular velocity after 3 s is

(a) 1 rad s^{-1} (b) 5 rad s^{-1}
(c) 10 rad s^{-1} (d) 15 rad s^{-1}

29 A flywheel having a radius of gyration of 2 m and mass 10 kg rotates at an angular speed of 5 rad s^{-1} about an axis perpendicular to it through its centre. The kinetic energy of rotation is

(a) 500 J (b) 2000 J (c) 1000 J (d) 250 J

30 A rod is placed along the line, $y = 2x$ with its centre at origin. The moment of inertia of the rod is maximum about

(a) X-axis (b) Y-axis
(c) Z-axis (d) Data insufficient

31 A second pendulum is moved to moon where acceleration due to gravity is 1/6 times that of the earth, the length of the second pendulum on moon would be

(a) 6 times (b) 12 times
(c) $\frac{1}{6}$ times (d) $\frac{1}{12}$ times

32 A particle executing SHM has a maximum speed of 30 cm s^{-1} and a maximum acceleration of 60 cm s^{-2}. The period of oscillation is

(a) π s (b) $\frac{\pi}{2}$ s
(c) 2π s (d) NOT

33 A disc of radius R and mass M is pivoted at the rim and is set for small oscillations about an axis perpendicular to plane of disc. If a simple pendulum has to have the same time period as that of the disc, the length of the pendulum should be

(a) $\frac{5}{4}R$ (b) $\frac{2}{3}R$
(c) $\frac{3}{4}R$ (d) $\frac{3}{2}R$

34 The absolute zero temperature in Fahrenheit scale is
(a) $-273°F$ (b) $-32°F$
(c) $-460°F$ (d) $-132°F$

35 Coefficient of real expansion of mercury is $0.18 \times 10^{-3}/°C$. If the density of mercury at 0°C is 13.6 g/cc, its density at 173 K is
(a) 13.11 g/cc (b) 26.22 g/cc
(c) 52.11 g/cc (d) None of these

36 If $\mathbf{P} + \mathbf{Q} = \mathbf{R}$ and $|\mathbf{P}| = |\mathbf{Q}| = \sqrt{3}$ and $|\mathbf{R}| = 3$, then the angle between $\mathbf{P}$ and $\mathbf{Q}$ is
(a) $\pi/4$ (b) $\pi/6$
(c) $\pi/3$ (d) $\pi/2$

37 A vector perpendicular to both the vectors $2\hat{\mathbf{i}} - \hat{\mathbf{j}} + 5\hat{\mathbf{k}}$ and X-axis is
(a) $\hat{\mathbf{j}} + 5\hat{\mathbf{j}}$ (b) $\hat{\mathbf{j}} - 5\hat{\mathbf{k}}$ (c) $5\hat{\mathbf{j}} + \hat{\mathbf{k}}$ (d) $\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}$

38 If $\mathbf{A} = 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$ and $\mathbf{B} = 7\hat{\mathbf{i}} + 24\hat{\mathbf{j}}$, the vector having the same magnitude as $\mathbf{B}$ and parallel to $\mathbf{A}$ is
(a) $5\hat{\mathbf{i}} + 20\hat{\mathbf{j}}$ (b) $15\hat{\mathbf{i}} + 10\hat{\mathbf{j}}$
(c) $20\hat{\mathbf{i}} + 15\hat{\mathbf{j}}$ (d) $15\hat{\mathbf{i}} + 20\hat{\mathbf{j}}$

39 If a particle is travelling with a speed of 0.9 of the speed of sound and is emitting radiations of frequency 1 kHz and moving towards the observer, what is its apparent frequency (in kHz)?
(a) 1.1 (b) 2.0 (c) 0.1 (d) 10

40 Two strings of copper are stretched to the same tension. If their cross-section area are in the ratio 1 : 4, then the respective wave velocities will be in the ratio
(a) 4 : 1 (b) 2 : 1
(c) 1 : 2 (d) 1 : 4

41 The displacement, y of a particle on a straight line is given by $y = f(x, t)$, as a function of time. Which of the following functions does not represent wave motion?
(a) $y = A \sin(kx - \omega t)$ (b) $y = A \sin^2(kx - \omega t)$
(c) $y = A \sin(k^2x^2 - \omega^2t^2)$ (d) $y = A \sin\left(kx + \omega t + \frac{\pi}{10}\right)$

42 If you set up the seventh harmonic on a string fixed at both ends, how many nodes and antinodes are set up in it?
(a) 8, 7 (b) 7, 7 (c) 8, 9 (d) 9, 8

43 A car moving with a speed of 40 kmh^{-1} can be stopped by applying brakes in 2 m. If the car is moving with a speed of 80 kmh^{-1} the minimum stopping distance under similar brake
(a) 8 m (b) 2 m
(c) 4 m (d) 6 m

44 A stone of mass 2 kg is projected upwards with KE of 98 J. The height at which the KE of the body becomes half its original value, is given by (take, $g = 9.8ms^{-2}$)
(a) 5 m (b) 2.5 m (c) 1.5 m (d) 0.5 m

Given that the displacement of the body in metre is a function of time as follows

$$x = 2t^4 + 5$$

45 The mass of the body is 2 kg. What is the increase in its kinetic energy one second after the start of motion?
(a) 8 J (b) 16 J
(c) 32 J (d) 64 J