QAD Series

Mechanics-II

1. **Given that P is a point on a wheel rolling on a horizontal road. The radius of the wheel is R. Initially the point P is in contact with ground. The wheel rolls through half the revolution. What is the displacement of point P?**
   a) πR b) $2\pi R$
   c) $\sqrt{(\pi^2 + 1)}\,R$ d) $\sqrt{(\pi^2 + 4)}\,R$
2. **A bucket filled with water is revolved in a vertical circle of radius 4m. If $g = 10ms^{-2}$ the maximum period of revolution will be nearest to:**
   a) 10 s b) 8 s
   c) 5 s d) 4 s
3. **A spirit level is placed with its centre at the axis of a turn table. The air bubble will be:**
   a) at the centre
   b) at outer edge
   c) at inner edge
   d) will oscillate about the centre
4. **An object is tied to string and rotated in a vertical circle of radius r. Constant speed is maintained along the trajectory. If $T_{max}/T_{min} = 2$, then v^2/rg is:**
   a) 1 b) 2
   c) 3 d) 4
5. **A mass 'M' is broken into two parts one of which has mass '*m*'. To have maximum gravitational force of attraction between the broken masses:**
   a) $m = 2M$ b) $m = \frac{M}{2}$
   c) $m = \frac{M}{4}$ d) $m = \frac{M}{6}$
6. **A body of mass *m* is moved to a height *h* equal to the radius of the earth. The increase in potential energy is:**
   a) 2mg R b) mgR
   c) $\frac{1}{2}$ mgR d) $\frac{1}{4}$ mgR
7. **A body is projected vertically upwards from the surface of a planet of radius R with a velocity equal to half the escape velocity for that planet. The maximum height attained by the body is:**
   a) $\frac{R}{2}$ b) $\frac{R}{3}$
   c) $\frac{R}{4}$ d) $\frac{R}{5}$
8. **Two sphere made of same material and having same radius 'R' are just in contact with each other. The gravitational force of attraction 'F' between them is:**
   a) $F \propto R^2$ b) $F \propto \frac{1}{R^2}$
   c) $F \propto \frac{1}{R^4}$ d) $F \propto R^4$
9. **If the change in the value of *g* at a height *h* above the surface of the earth is the same as at a depth *x* below it. When both *x* and *h* are much smaller than the radius of the earth then:**
   a) x = h b) x = 2h
   c) x = h/2 d) $x = h^2$
10. **A body is projected with a velocity twice the escape velocity of earth, then its velocity in free space is:**
    a) v_e b) $2v_e$
    c) $\sqrt{2}\,v_e$ d) $\sqrt{3}\,v_e$
11. **A particle moves in a circular orbit under the action of central attractive force, which is inversely proportional to the distance *r* . The speed of the particle is proportional to:**
    a) r^2 b) r^0
    c) r d) r^{-1}
12. **If R is the radius of earth, ω its angular velocity and gp is the value of *g* at poles. The effective value of *g* at latitude $\lambda = 60°$ will be equal to:**
    a) $gp - \frac{1}{4} R\omega^2$ b) $gp - \frac{3}{4} R\omega^2$
    c) $gp - R\omega^2$ d) $gp + \frac{1}{4} R\omega^2$
13. **The period of satellite in a circular orbit near to a planet is independent of:**
    a) the mass of the planet b) the radius of the satellite
    c) the radius of the planet d) all of the above
14. **A satellite with K.E. 'E' is revolving close to earth in circular orbit. By what percentage should it K.E. be increased so that it just escape to outer space?**
    a) 100% b) 200%
    c) 50% d) 41.4%
15. **In a missile launched with velocity less than escape velocity, the sum of its KE and PE is always:**
    a) positive b) zero
    c) negative d) arbitrary
16. **The escape velocity on earth (radius R, mass M) is 11.2 km/s. The escape velocity on another planet of mass M/4 and radius R/2 in km/s is around:**
    a) 11.2 b) 22.4
    c) 15.8 d) 8
17. **A particle is vibrating in a SHM with amplitude A. At what distance from equilibrium position is its energy half potential and half kinetic?**
    a) A b) $\frac{A}{\sqrt{2}}$
    c) $\frac{\sqrt{3}\,A}{2}$ d) $\frac{\sqrt{3}\,A}{4}$
18. **Time taken to reach a displacement equal to half the amplitude from extreme position is:**
    a) $\frac{T}{4}$ b) $\frac{T}{8}$
    c) $\frac{T}{6}$ d) $\frac{T}{12}$
19. **A spring of force constant *k* is cut into two pieces in the ratio 1:2. What is the spring constant of the longer piece?**
    a) k b) $\frac{k}{3}$
    c) $\frac{2k}{3}$ d) $\frac{3}{2}$k
20. **A simple pendulum has a bob made of solid sphere of steel. If we replace it with a hollow sphere of same mass and same material, the time period will:**
    a) increase b) decrease
    c) remains same d) becomes infinite
21. **The time period of two individually oscillating springs are 3 seconds and *x* seconds. If they are joined in series, the resulting time period is 5 seconds. If they are joined in parallel, the resulting time period is *y* seconds. Find *x* and *y*.**
    a) 4, 2, 4 b) 4, 5, 6
    c) 2, 4, 4 d) 6, 8, 2

22. A simple pendulum with a mass *m* swings with an angular amplitude of 40°. When the angular displacement is 20°, then the tension in the string is:

a) = mg sin 20° b) = mg cos20°

c) > mg cos20° d) < mg cos20°

23. A simple pendulum has a time period T on the surface of earth of radius R. When taken to a height H = R above the earth surface, its time period is T_2. Then the ratio T_2/T_1 is:

a) $\frac{1}{\sqrt{2}}$ b) $\sqrt{2}$

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

24. The mass and diameter of a planet are two times those of earth. If a seconds pendulum is taken to it, the time period of the pendulum in second is:

a) $\frac{1}{\sqrt{2}}$ b) $\frac{1}{2}$

c) 2 d) $2\sqrt{2}$

25. The time period of a simple pendulum is T. If it is taken in a communication satellite, its time period would become e/remain:

a) 24 hours b) zero

c) infinite d) T

26. The time period of a mass-spring system is T. If it is taken in a communication satellite, its time period would become/remain:

a) 24 hours b) zero

c) infinite d) T

27. A hollow sphere and a solid sphere of same mass and same size are allowed to roll down an inclined plane from same height simultaneously. Which will reach the bottom first?

a) hollow sphere b) solid sphere

c) both together d) none of above

28. Two particles A and B initially at rest move towards each other under a mutual force of attraction. At the instant when velocity of A is v and that of B is 2v, the velocity of centre of mass of the system is:

a) v b) 2v

c) 3v d) zero

29. A particle performing uniform circular motion has angular momentum L. If its angular frequency is doubled and its KE is halved, then the new angular momentum is:

a) $\frac{L}{4}$ b) $\frac{L}{2}$

c) 4L d) 2L

30. The least coefficient of friction for an inclined plane of inclination α with the horizontal, in order that solid cylinder will roll down it without slipping is:

a) $\frac{2}{3}\tan\alpha$ b) $\frac{2}{5}\tan\alpha$

c) $\frac{1}{3}\tan\alpha$ d) $\frac{4}{3}\tan\alpha$

31. A body rolls down an inclined plane. If its KE of rotational motion is 40% of its translatory motion, the body is:

a) ring b) cylinder

c) spherical shell d) solid sphere

32. A circular disc is rotating with angular velocity ω. If a man standing on the edge of the disc walks towards the centre, then the angular velocity of the disc will:

a) decrease b) increase

c) be halved d) not change

33. If the polar ice caps melt and spread uniformly, the length of day would:

a) increase b) decrease

c) remain unchanged d) be halved

34. Two solid spheres are made of same material and having the radii in the ratio 1:2. The ratio of their moments of inertia is:

a) 1:2 b) 1:4

c) 1:16 d) 1:32

35. A shell at rest explodes into fragments. The centre of mass of the fragments:

a) moves along a straight path

b) moves along a parabolic path

c) moves along an elliptical path

d) remains at rest

36. A mass *m* is moving with constant velocity parallel to x-rays. Its angular momentum with respect to origin:

a) is zero b) remains constant

c) goes on increasing d) goes on decreasing

37. A shell is fired from a gun with muzzle velocity *u* m/s at an angle θ to the horizontal. At the top of the trajectory, the shell explodes into two fragments P and Q of equal mass. If the speed of P immediately after explosion is zero, where does the centre of mass of the fragments hit the ground?

a) $\frac{u^2\sin 2\theta}{g}$ b) $\frac{u^2\sin^2\theta}{g}$

c) $\frac{u^2\sin^2\theta}{2g}$ d) $\frac{u\sin\theta}{g}$

38. A long vertical pole of length *l* is standing vertically with one end hinged at the floor. If the pole is released and allowed to fall, then the velocity of free end when it hits the floor is:

a) $\sqrt{3g/}$ b) $\sqrt{3g}$

c) $\frac{l}{2}\sqrt{3g}$ d) $\sqrt{\frac{3l^2}{4g}}$

39. In case of a uniform circular motion, velocity and acceleration are:

a) perpendicular b) in same direction

c) in opposite direction d) not related to each other

40. If a person standing on a rotating disc stretches out his hands, the angular speed will

a) increase b) decrease

c) remain same d) none of these

41. Suppose the gravitational force varies inversely as the n^{th} power of distance. Then the time period of a planet in circular orbit of radius *r* around the sun will be proportional to

a) $r^{1/2(n+1)}$ b) $r^{1/2(n-1)}$ c) r^n d) $r^{1/2(n-2)}$

42. Suppose a vertical tunnel is along the diameter of earth, assumed to be a sphere of uniform mass density ρ. If a body of mass *m* is thrown in this tunnel, its acceleration at a distance *y* from the centre is given by

a) $\frac{4\pi}{3}G\rho ym$ b) $\frac{3}{4}\pi\rho y$

c) $\frac{4}{3}\pi\rho y$ d) $\frac{4}{3}\pi G\rho y$