Circular Motion

Questions on Circular Motion, Paper 3

1. A stone attached to a rope of length l = 80 cm is rotated with a speed of 240 r.p.m. At the moment when the velocity is directed vertically upwards, the rope breaks. To what height does the stone rise further?
   (a) 1.2 m
   (b) 41.2 m
   (c) 20.6 m
   (d) 24.9 m

2. A stone is tied to one end of a string. Holding the other end, the string is whirled in a horizontal plane with progressively increasing speed. It breaks at some speed because
   (a) gravitational forces of the earth is greater than the tension in string.
   (b) the required centripetal force is greater than the tension sustained by the string.
   (c) the required centripetal force is less than the tension in the string.
   (d) the centripetal force is greater than the weight of the stone.

3. A stone of mass 250 gram, attached at the end of a string of length 1.25 m is whirled in a horizontal circle at a speed of 5 m/s. What is the tension in the string?
   (a) 2.5 N
   (b) 5 N
   (c) 6 N
   (d) 8 N

4. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the outer end is
   (a) $\frac{ML\omega^2}{2}$ (b) $ML\omega^2$
   (c) $\frac{ML^2\omega^2}{2}$ (d) $\frac{ML\omega^2}{4}$

5. A van is moving with speed of 108 km/hr. on level road where coefficient of friction between tires and road 0.5. For the safe driving of van the minimum radius of curvature of the road will be (g = 10 m/s^2)
   (a) 80 m
   (b) 40 m
   (c) 180 m
   (d) 20 m

6. A weightless thread can bear tension upto 3.7 kg weight. A stone of mass 500 gram is tied at its one end and revolved in a vertical circular path of radius 4 m. If g = 10 m/s^2, then the maximum angular velocity of the stone is (radians/sec) will be
   (a) 3 (b) 4
   (c) 5 (d) 6

7. A wheel is subjected to uniform angular acceleration about its axis. Initially its angular velocity is zero. In the first two seconds, it rotates through θ_1 and in next two seconds, it rotates through θ_2. What is the ratio θ_2 / θ_1?
   (a) 1 (b) 2
   (c) 3 (d) 4

8. A wheel of diameter 20 cm is rotating at 600 rpm. The linear velocity of particle at its rim is
   (a) 6.28 cm/s (b) 62.8 cm/s
   (c) 0.628 cm/s (d) 628.4 cm/s

9. A wheel rotates with a constant angular velocity of 600 r.p.m. What is the angle through which the wheel rotates in one second?
   (a) 5π radian (b) 20π radian
   (c) 15π radian (d) 10π radian

10. An aeroplane is taking a turn in a horizontal plane
    (a) its remains horizontal
    (b) it inclines inward
    (c) it inclines outward
    (d) its wings becomes vertical

11. An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 r.p.m., then the acceleration of a point on the tip of the blade is (take π^2 = 10)
    (a) 1600 m/s^2 (b) 3200 m/s^2
    (c) 4800 m/s^2 (d) 6000 m/s^2

12. An electron revolve around the nucleolus the radius of the circular orbit is r to double the kinetic energy of electron its orbit radius of
    (a) $\sqrt{2}$ r (b) $-\sqrt{2}$ r
    (c) $\sqrt{3}$ r (d) $-\sqrt{3}$ r

13. Angle between Centripetal acceleration and radius vector is
    (a) 90° (b) 180°
    (c) 0° (d) 45°

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14. Angular velocity of an hour hand of a watch
(a) $\frac{\pi}{43200}$ rad/s
(b) $\frac{\pi}{21600}$ rad/s
(c) $\frac{\pi}{30}$ rad/s
(d) $\frac{\pi}{1800}$ rad/s

15. At a curved path of the road, the road bed is raised a little on the side away from the centre of the curved path. The slope of the road bed is given by
(a) $\tan\theta = \left(\frac{r}{gv^2}\right)$
(b) $\tan\theta = \left(\frac{rg}{v^2}\right)$
(c) $\tan\theta = \left(\frac{v^2g}{r}\right)$
(d) $\tan\theta = \left(\frac{v^2}{rg}\right)$

16. Centripetal force in vector form can be expressed as
(a) $\vec{F} = \frac{mv^2}{r}$
(b) $\vec{F} = \frac{mv^2}{r}\vec{r}$
(c) $\vec{F}m\omega^2\vec{r}$
(d) $\vec{F} = -\frac{mv^2}{\vec{r}}\vec{r}$

17. For a particle performing a U.C.M. the acceleration is
(a) constant in direction
(b) constant in magnitude but not in direction
(c) constant in magnitude and direction
(d) constant in neither magnitude nor in direction

18. If a cycle wheel of radius 0.4 m completes one revolution in one second, then acceleration of the cycle is
(a) 0.4 π m/s^2
(b) 0.8 π m/s^2
(c) 0.4 π^2 m/s^2
(d) 1.6 π^2 m/s^2

19. If a particle moves with uniform speed that its tangential acceleration will be
(a) zero (b) constant
(c) infinite (d) none of these

20. If a stone of mass m is rotated in a vertical circular path of radius 1 m, the critical velocity will be
(a) 6.32 m/s (b) 3.13 m/s
(c) 9.48 m/s (d) 12.64 m/s

21. If T_1 and T_2 are the periods of a simple pendulum and a conical pendulum respectively, of the same length, then
(a) $T_1 = T_2$ (b) $T_1 > T_2$
(c) $T_1 < T_2$ (d) $T_1 = \frac{T_2}{2}$

22. In a tension of a string is 6.4 N. Load at the lower end of a string is 0.1 kg the length of string is 6 m then find its angular velocity? (g = 10 m/sec^2)
(a) 4 rad/sec (b) 3 rad/sec
(c) 2 rad/sec (d) 1 rad/sec

23. In a vertical circle of radius r at what point in its path, a particle has a tension equal to zero?
(a) Highest point
(b) Lowest point
(c) Any point
(d) An horizontal point

24. In an atom two electrons move round the nucleus in circular orbits of radii R and 4R respectively, the ratio of time taken by them to complete one revolution is
(a) $\frac{1}{4}$ (b) $\frac{4}{1}$
(c) $\frac{8}{1}$ (d) $\frac{1}{8}$

25. In cycle wheel of radius 0.4 m completes one revolution in one second, then acceleration of the cycle is
(a) 0.4 πm/s^2
(b) 0.8 πm/s^2
(c) 0.4 π^2m/s^2
(d) 1.6 π^2m/s^2

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Answers to Circular Motion, Paper 3

1. Ans.: (c)
2. Ans.: (b)
3. Ans.: (b)
4. Ans.: (b)
5. Ans.: (c)
6. Ans.: (b)
7. Ans.: (c)
8. Ans.: (d)
9. Ans.: (b)
10. Ans.: (b)
11. Ans.: (c)
12. Ans.: (a)
13. Ans.: (b)
14. Ans.: (b)
15. Ans.: (d)
16. Ans.: (c)
17. Ans.: (b)
18. Ans.: (d)
19. Ans.: (a)
20. Ans.: (b)
21. Ans.: (b)
22. Ans.: (b)
23. Ans.: (a)
24. Ans.: (d)
25. Ans.: (d)