## Chapter Problems

**Period and Frequency:**

**Classwork**

1. An object is spun around in circular motion such that it completes 100 cycles in 25 s.
    a. What is the period of its rotation?
    b. What is the frequency of its rotation?

2. An object completes 2500 cycles in 25 s.
    a. What is the period of its rotation?
    b. What is the frequency of its rotation?

3. An object is spun around in circular motion such that its period is 12s.
    a. What is the frequency of its rotation?
    b. How much time will be required to complete 86 rotations?

**Homework**

4. An object completes 10 cycles in 50 s.
    a. What is the period of its rotation?
    b. What is the frequency of its rotation?

5. An object is spun around in circular motion such that its frequency is 12 Hz.
    a. What is the period of its rotation?
    b. How much time will be required to complete 86 rotations?

6. An object is spun around in circular motion such that its frequency is 500 Hz.
    a. What is the period of its rotation?
    b. How much time will be required to complete 7 rotations?

**Velocity and Acceleration**

**Classwork**

7. A 5.0 kg object is spun around in a circle of radius 1.0 m with a period of 4.0s.
    a. What is the frequency of its rotation?
    b. *What is its velocity?
    c. *What is its acceleration?

8. A 15.0 kg mass is spun in a circle of radius 5.0 m with a frequency of 25 Hz.
    a. What is the period of its rotation?
    b. *What is its velocity?
    c. *What is its acceleration?

**Homework**

9. A 0.5 kg object is spun around in a circle of radius 2.0 m with a period of 10.0s.
    a. What is the frequency of its rotation?
    b. *What is its velocity?
    c. *What is its acceleration?

 

10. A 500 kg mass is spun in a circle of radius 25 m with a velocity of 250 m/s.
    a. *What is the period of its rotation?
    b. *What is its frequency?
    c. What is its acceleration?

**Dynamics of UCM**

**Classwork**

11. What is the acceleration of an object that has a velocity of 25 m/s and is moving in a circle of radius 10m?

12. An object is experiencing an acceleration of 12 $m/s^2$ while traveling in a circle at a velocity of 3.1 m/s. What is the radius of its motion?

13. A 61 kg object is experiencing a net force of 25 N while traveling in a circle of radius 35 m. What is its velocity?

14. A 0.25 kg object is experiencing a net force of 15 N while traveling in a circle at a velocity of 21 m/s. What is the radius of its motion?

15. An object is experiencing a centripetal acceleration of 36 $m/s^2$ while traveling in a circle of radius 15 m. What is its velocity?

16. A 61 kg object is experiencing a net force of 250 N while traveling in a circle of radius 1.5 m. What is its velocity?

**Homework**

17. An object is experiencing an acceleration of 12 $m/s^2$ while traveling in a circle of radius 5.0 m. What is its velocity?

18. What is the net force acting on a 5.0 kg object that has a velocity of 15 m/s and is moving in a circle of radius 1.6m?

19. What is the acceleration of an object that has a velocity of 37 m/s and is moving in a circle of radius 45m?

20. An object is experiencing a centripetal acceleration of 2.0 $m/s^2$ while traveling in a circle at a velocity of 0.35 m/s. What is the radius of its motion?

21. What is the net force acting on a 52 kg object that has a velocity of 17 m/s and is moving in a circle of radius 1.6m?

22. A 6.8 kg object is experiencing a net force of 135 N while traveling in a circle at a velocity of 45 m/s. What is the radius of its motion?

 

**General Problems**

**Class Work**

23. A 0.65 kg ball is attached to the end of a string. It is swung in a vertical circle of radius 0.50 m. At the top of the circle its velocity is 2.8 m/s.

    a. Draw a free body diagram for the ball when it is at the top of the circle. Next to that diagram indicate the direction of its acceleration.

    b. Use that free body diagram to set up the equations needed to determine the Tension in the string.

    c. Solve those equations for the Tension in the string.

24. A 0.65 kg ball is attached to the end of a string. It is swung in a vertical circle of radius 0.50 m. At the bottom of the circle its velocity is 2.8 m/s.

    a. Draw a free body diagram for the ball when it is at the bottom of the circle. Next to that diagram indicate the direction of its acceleration.

    b. Use that free body diagram to set up the equations needed to determine the Tension in the string.

    c. Solve those equations for the Tension in the string.

**Homework**

25. A 0.25 kg ball is attached to the end of a string. It is swung in a vertical circle of radius 0.6 m. At the top of the circle its velocity is 3 m/s.

    a. Draw a free body diagram for the ball when it is at the top of the circle. Next to that diagram indicate the direction of its acceleration.

    b. Use that free body diagram to set up the equations needed to determine the Tension in the string.

    c. Solve those equations for the Tension in the string.

26. A 0.25 kg ball is attached to the end of a string. It is swung in a vertical circle of radius 0.6 m. At the bottom of the circle its velocity is 3 m/s.

    a. Draw a free body diagram for the ball when it is at the bottom of the circle. Next to that diagram indicate the direction of its acceleration.

    b. Use that free body diagram to set up the equations needed to determine the Tension in the string.

    c. Solve those equations for the Tension in the string.

 

**Class Work**

27. *A ball is attached to the end of a string. It is swung in a vertical circle of radius 1.5 m. What is the minimum velocity that the ball must have to make it around the circle?

28. *A ball is attached to the end of a string. It is swung in a vertical circle of radius 0.75 m. What is the minimum velocity that the ball must have to make it around the circle?

29. *A car is going over the top of a hill whose curvature approximates a circle of radius 200 m. At what velocity will the occupants of the car appear to weigh 20% less than their normal weight (or their normal weight times 0.8)?

30. *A car is going through a dip in the road whose curvature approximates a circle of radius 200 m. At what velocity will the occupants of the car appear to weigh 20% more than their normal weight (or their normal weight times 1.2)?

31. *The occupants of a car traveling at a speed of 30 m/s note that on a particular part of a road their apparent weight is 15% higher than their weight when driving on a flat road.
    a. Is that part of the road a hill or a dip?
    b. What is the vertical curvature of the road?

**Homework**

32. *A ball is attached to the end of a string. It is swung in a vertical circle of radius 0.33 m. What is the minimum velocity that the ball must have to make it around the circle?

33. *A ball is attached to the end of a string. It is swung in a vertical circle of radius 2.5 m. What is the minimum velocity that the ball must have to make it around the circle?

34. *A car is going over the top of a hill whose curvature approximates a circle of radius 350m. At what velocity will the occupants of the car appear to weigh 10% less than their normal weight?

35. *A car is going through a dip in the road whose curvature approximates a circle of radius 150m. At what velocity will the occupants of the car appear to weigh 15% more than their normal weight?

36. *The occupants of a car traveling at a speed of 40 m/s note that on a particular part of a road their apparent weight is 30% lower than their weight when driving on a flat road.
    c. Is that part of the road a hill or a dip?
    d. What is the vertical curvature of the road?

 

**Class Work**

37. **A car, traveling at a speed of 25 m/s, rounds a flat curve whose radius is 125 m.

    a. Draw a side view free body diagram for the car. Indicate the direction of acceleration.

    b. Use that free body diagram to set up the equations needed to determine the frictional force acting on the car.

    c. Solve those equations for the coefficient of friction between the tires and the road.

**Homework**

38. **A car, traveling at a speed of 32 m/s, rounds a flat curve whose radius is 250 m.

    a. Draw a side view free body diagram for the car. Indicate the direction of acceleration.

    b. Use that free body diagram to set up the equations needed to determine the frictional force acting on the car.

    c. Solve those equations for the coefficient of friction between the tires and the road.

 

**Answers**

1)
a)0.25 s
b)4 Hz

2)
a)0.01 s
b)100 Hz

3)
a)0.083 Hz
b)1032 s

4)
a) 5s
b) 0.2Hz

5)
a) 0.083s
b) 7.2s

6)
a) 0.002s
b) 0.014s

7)
a) 0.25Hz
b) 1.6m/s
c) 2.56 $m/s^2$

8)
a) 0.04s
b) 785m/s
c) 123,245$m/s^2$

9)
a)0.1 Hz
b)1.257 m/s
c)0.79 m/s2

10)
a)0.63 s
b)1.59 Hz
c)2,500 $m/s^2$

11) 62.5 $m/s^2$

12) 0.8 m

13) 3.8 m/s

14) 7.35 m

15) 23 m/s

16) 2.5 m/s

17) 7.7 m/s

18) 705 N

19) 30.4 $m/s^2$

20) 0.06 m

21) 9393 N

22) 102 m

**General Problems**

23) a)$F_T$, mg, and a down
b) $F_T+mg=mv^2/r$
c) 3.83 N

24) a)$F_T$ up, mg down, a up
b) $F_T-mg=mv^2/r$
c) 16.57 N

25) a)$F_T$, mg, and a down
b) $F_T+mg=mv^2/r$
c) 1.3 N

26) a)$F_T$ up, mg down, a up
b) $F_T-mg=mv^2/r$
c) 6.2 N

27) 3.83 m/s

28) 2.71 m/s

29) 19.8 m/s

30) 19.8 m/s

31) a) dip
b) 612 m

32) 1.80 m/s

33) 4.95 m/s

34) 18.52 m/s

35) 14.85 m/s

36) a) hill
b) 544 m

37) 0.51

38) 0.42

 