Name: _____
Hour: ____ Date: _____

Physics: *Circular Motion and Gravity HW*

Set 1: Angular Kinematics

1. A Ferris wheel cart moves through an arc of 12 m between stops. If the carts are 35 m from the axis of rotation, through what angular displacement does each cart move between stops?

   G:

   U: S:

   E: S:

2. A beetle sits at the top of a bicycle wheel with a diameter of 0.75 m. Through what arc length does the beetle travel before it is squashed under the wheel?

   G:

   U: S:

   E: S:

3. A girl ties a toy plane to a string and swings it around. Find the plane's average angular speed if it undergoes an angular displacement of 3.3 rad in 1.5 s.

   G:

   U: S:

   E: S:

4. A car tire rotates counterclockwise 3.5 times in 0.75 s. What is the tire's average angular speed?

   G:

   U: S:

   E: S:

5. In rad/s, what is the angular speed of someone standing on the equator? Assume the Earth is a sphere.

6. A girl sits on a merry-go-round at a distance of 1.5 m from the center. If the girl moves through an arc length of 2.5 m, through what angular displacement does she move?

ANSWERS:
1. 0.34 rad
2. 1.2 m
3. 2.2 rad/s
4. 29 rad/s
5. 7.27×10^{-5} rad/s
6. 1.7 rad

7. What angular acceleration will increase the angular speed of a fan blade from 8.5 rad/s to 15.4 rad/s in 5.2 s?

G:

U: S:

E: S:

8. A figure skater begins spinning counterclockwise at 3.57 rad/s. While pulling her arms in over a 3.05 s period, her angular acceleration is 4.21 rad/s^2. What is her final angular speed?

G:

U: S:

E: S:

9. A fish with an initial angular speed of 1.5 rad/s gets caught in a whirlpool from a ship's propellers. If the fish speeds up to 6.7 rad/s in 4.5 s, find the angular displacement the fish goes through.

G:

U: S:

E: S:

10. A remote-controlled car's wheel accelerates at 22.4 rad/s^2. If the wheel has an initial angular speed of 10.8 rad/s, what is the wheel's angular speed after exactly three full turns?

G:

U: S:

E: S:

11. A spinning diver accelerates at 3.23 rad/s^2 for 3.12 s between leaving the board and landing in the water. If he left the board having zero initial angular speed, how many revolutions did he complete?

ANSWERS: 7. 1.3 rad/s^2 8. 16.4 rad/s 9. 18 rad 10. 31.0 rad/s 11. 2.50 rev

Set 2: Tangential Speed and Acceleration

12. A revolving door turns at an angular speed of 1.8 rad/s. If a woman passes through the door at a distance of 0.86 m from the center of the door, what is the woman's linear speed?

G:

U: S:

E: S:

13. A softball pitcher winds up and swings the ball with a tangential speed of 23 m/s. If her arm is 0.66 m long, what is her arm's angular speed?

G:

U: S:

E: S:

14. A DVD of radius 6.00 cm accelerates at 35.2 rad/s^2 when a student pushes "play." Find the tangential acceleration of the edge of the DVD.

G:

U: S:

E: S:

15. A dog sits 3.28 m from the center of a merry-go-round. If the dog undergoes a 1.46 m/s^2 linear acceleration, what is the angular acceleration of the merry-go-round?

G:

U: S:

E: S:

16. A boy swings a yo-yo on a string of length r with an initial angular speed of ω_i. The yo-yo accelerates with linear acceleration a_t while undergoing an angular displacement of $\Delta\Theta$. In terms of r, ω_i, a_t, and $\Delta\Theta$, find the final angular speed, ω_f.

ANSWERS: 12. 1.5 m/s 13. 35 rad/s 14. 2.11 m/s^2 15. 0.445 rad/s^2

Set 3: Centripetal Acceleration and Force

17. A dog sits 2.80 m from the center of a spinning merry-go-round. The dog's tangential speed is 2.64 m/s. What is the dog's centripetal acceleration?

G:

U: S:

E: S:

18. A race car on a circular track has a centripetal acceleration of 15.4 m/s^2. If the car has a tangential speed of 30.0 m/s, what is the distance between the car and the center of the track?

G:

U: S:

E: S:

19. A rope attaches a tire to an overhanging tree limb. A girl swinging on the tire has a centripetal acceleration of 5.3 m/s^2. If the length of the rope is 2.85 m, what is the girl's tangential speed?

G:

U: S:

E: S:

20. A piece of clay sits 0.20 m from the center of a potter's wheel. If the potter spins the wheel at 4.50 rad/s, what is the magnitude of the centripetal acceleration of the clay?

G:

U: S:

E: S:

21. A piece of dust on a CD that is spinning at 7.40 rad/s has a centripetal acceleration of 2.07 m/s^2. How far is the dust particle from the center of the CD?

G:

U: S:

E: S:

ANSWERS: 17. 2.49 m/s^2 18. 58.4 m 19. 3.9 m/s 20. 4.0 m/s^2 21. 0.0378 m

22. It is measured that a person standing 3.60 m from the center of a large, rotating platform has a centripetal acceleration of 8.88×10^{-2} m/s^2. What is the angular speed of the platform?

G:

U: S:

E: S:

23. A toddler stands 1.50 m from the center of a merry-go-round and revolves at a tangential speed of 2.80 m/s. If the toddler's mass is 16.5 kg, what is the magnitude of the centripetal force on the toddler?

G:

U: S:

E: S:

24. A 40.0 kg child rides on a Ferris wheel rotating at 0.50 rad/s. Find the centripetal force on the child if he is 18.0 m from the center of the wheel.

G:

U: S:

E: S:

25. A bicyclist is riding at a speed of 13.2 m/s around a circular track. The magnitude of the centripetal force is 389 N, and the combined mass of the bicycle and rider is 86.5 kg. What is the track's radius?

G:

U: S:

E: S:

26. A 905 kg car travels around a circular track that has a circumference of 3.25 km. If the magnitude of the centripetal force is 2140 N, what is the car's tangential speed?

ANSWERS: 22. 0.157 rad/s 23. 86.2 N 24. 180 N 25. 38.7 m 26. 35.0 m/s

Set 4: Gravitational Force

27. Find the gravitational force between two 0.800 kg masses if the distance between their centers is 39.2 cm.

G:

U: S:

E: S:

28. Mars has a mass of 6.4×10^{23} kg, and its moon Phobos has a mass of 9.6×10^{15} kg. If the gravitational force between the two bodies is 4.6×10^{15} N, how far apart are the centers of Mars and Phobos?

G:

U: S:

E: S:

29. The gravitational force between two objects is 7.11×10^{-12} N and their centers are 19.5 cm apart. If one object is twice as massive as the other, find the mass of the heavier object.

30. Pluto has mass 1.25×10^{22} kg and radius 1.20×10^{6} m. Find Pluto's acceleration due to gravity.

G:

U: S:

E: S:

31. Mars has mass 6.4×10^{23} kg and an acceleration due to gravity of 3.7 m/s^2. Find Mars's mean radius.

G:

U: S:

E: S:

ANSWERS: 27. 2.78×10^{-10} N 28. 9.4×10^{6} m 29. 0.0900 kg 30. 0.579 m/s^2 31. 3.4×10^{6} m