

CP Physics Exam #5 Practice- Circular Motion and Mousetrap Cars

Name: _____

Section 1 - True/False - Write the word "true" or "false" in the space provided (2 pts each)

1. Tangential speed is a type of linear speed _____
2. In order to produce torque, a force must have a component perpendicular to the lever arm _____
3. Rotational velocity and angular velocity are the same thing _____
4. A legitimate unit of torque is the ft-lb _____
5. A legitimate unit of angular velocity is rad/s^2 _____
6. If you attach a longer lever arm to the mousetrap in your mousetrap car, the mousetrap will produce more torque _____
7. Gear Ratio is defined as the ratio of input gear diameter to output gear diameter.
8. When talking about circular motion, centripetal force always points toward the center of the circle _____
9. All points on a solid, rotating disc have the same angular speed _____
10. It is possible for an object to experience tangential acceleration without experiencing centripetal acceleration _____
11. You attach an empty paint can to the end of a string, and whirl it in a horizontal circle over your head. The centripetal force on the can is produced by the string _____
12. A mousetrap car with a high gear ratio theoretically (without friction) has a higher top speed than a car with a low gear ratio _____
13. A mousetrap car with a low gear ratio would theoretically (no friction) be better at a tug-of-war contest than a car with a high gear ratio _____
14. Using larger drive wheels on your mousetrap car resulted in longer distances because the ground exerted more force on the wheels _____
15. If the Earth were to start spinning faster on its axis, you would start to feel heavier _____
16. When you spin an object on the end of a string (like in your lab), the object exerts a centrifugal force on the string _____
17. When you turn the steering wheel in your car, the force that turns your car is caused by the tires _____
18. On a rotating carousel, the tangential speed of the horses on the outer edge is greater than the tangential speed of the horses towards the middle _____
19. Every state in the United states experiences the same angular velocity around the axis of the Earth _____

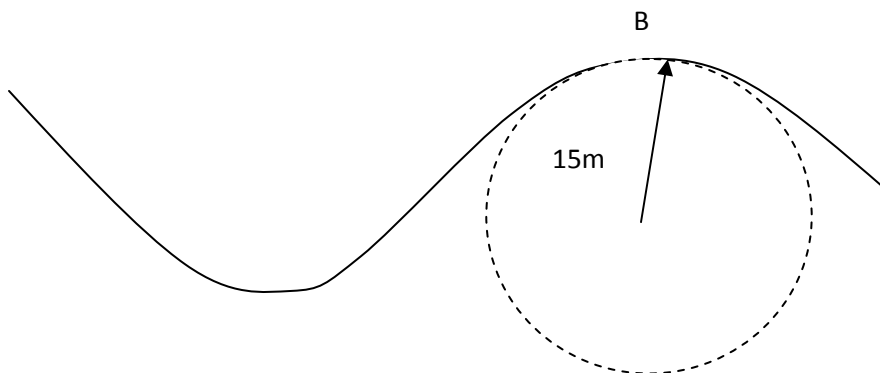
20. Astronauts orbiting the Earth in the space shuttle experience "zero-g" because they are constantly accelerating toward the center of the earth at a rate of about 10m/s^2
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Section 2 - Think and Explain (5 pts. each)

1. Distinguish between linear speed and angular speed.
2. Explain how it is possible for a car to have centripetal acceleration but no tangential acceleration.
3. Why would you weigh slightly less at the equator than you would at one of the poles?
4. Imagine you are in a space station that simulates normal gravity. Now imagine the space station beginning to rotate more quickly. Explain and show why astronauts would feel like they weigh more.
5. What do physicists mean when they say that the moon is constantly "falling toward the earth"?
6. Draw a sketch of the wheels on a train, and discuss why they are designed that way.

Section 3 - Problems (5 pts. each)

1. You attach one end of a string to a 2.0kg object. You hold the other end, 0.50m away, and spin the object over your head in a horizontal circle. If the string has a breaking strength of $2,000\text{N}$, how fast can you spin the object before the string breaks? *Give your answer as an angular speed.*
2. How fast could you spin the object in problem #1 if you spun it in a *vertical* circle?
3. A gravity-simulating space station has a radius of 0.1km . How fast must it spin in order for people inside it to feel *half* their normal body weight?
4. A roller coaster car speeds up a hill past point B. What is the maximum speed the car can have at pt. B in order for the car to stay on the track?



Section 4 - Take-Home Essay (10 pts)

In your mousetrap car project you explored the use of gears (pulleys, actually) to try to make your sprint car go faster and your distance car go farther. Discuss and explain what is meant by the term '**gear ratio**', and how it affects the amount of torque delivered to the drive wheels of your car. What type of gear ratio makes the car accelerate quickly off the start line? What type of gear ratio gives the car a high top speed? Why/how do these gear ratios work this way? What part did friction play in your decision to use a high or low gear ratio?