Name_____

Date _____

Hills and Dips - Buckle Up!

Assume that the car shown below is going at a constant speed

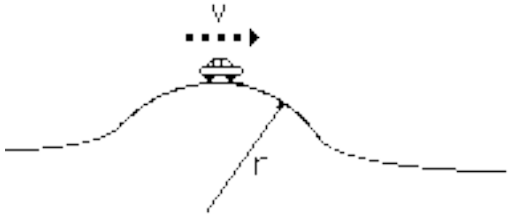

Fig 1

1. Make a motion map of the car in Figure 1, showing the direction of velocity and acceleration vectors.

2. In what direction is the car experiencing an acceleration? Explain how you know.

3. Construct a qualitative free body diagram for the car when it's at the top of the hill. Label the forces.

4. Suppose the speed of the car is 11.1 m/s (≈ 25 mph), its mass is 1200 kg and the radius of curvature (r) is 25 m; determine the magnitude of the centripetal force acting on the car.

5. Now, construct a **quantitative** force diagram for the car.

6. What is the acceleration (magnitude and direction) of the car?

7. How fast would the car have to be traveling if the normal force were reduced to zero?

8. Suppose the car were going faster than the speed that you calculated for question 7; describe what would happen to the car.

Assume that the car in Figure 2 is going at a constant speed.

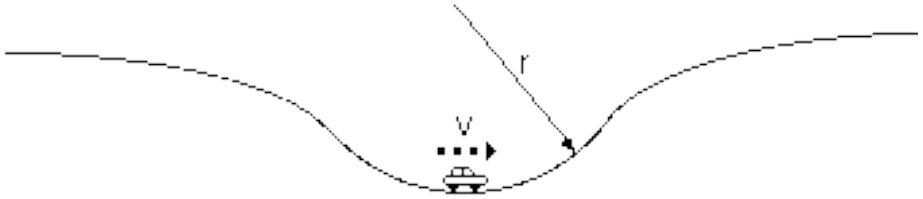

Fig 2

9. Construct a qualitative motion map of the car in Figure 2

10. In what direction is the car in Figure 2 experiencing an acceleration? Explain how you know.

11. Construct a qualitative force diagram for the car when it's at the bottom of the hill. (Justify the relative forces in your force diagram.)

12. Suppose the speed of the car in Figure 2 is 15.6 m/s (≈ 35 mph), its mass is 1200 kg and the radius of curvature (r) is 23 m; determine the magnitude of the centripetal acceleration of the car, and the centripetal force.

13. Now, construct a **quantitative** force diagram for the car. Remember, the normal force and the weight must add to give the net force on the car, which is the centripetal force.

14. If the driver of the car weighs 540 N,
    a) calculate the mass of the driver.
    b) find the magnitude of the upward force that the seat exerts on the driver, who has the same accelration as the car.

15. Compare the force from 14b) to the normal weight of the driver. When the driver goes through the curve, he feels heavier, as though he is being pushed down. What is he really experiencing?