Inertia 3 (level 3) Name ____________________

Inertia 3: Inertia and the Definition of Velocity:

Velocity

The definition of velocity is change in position per unit time.

Velocity is a *vector*, meaning it has magnitude and direction.

The magnitude of velocity is the speed of an object.
But velocity also includes the *direction* an object is moving.

Acceleration

Acceleration is *change in velocity* per unit time.

Acceleration refers to a change in either the speed *or* the direction of an object.
Any acceleration is a change in velocity.

For each of the following situations **1-4**, state if the object is *accelerating* or not:
If the object is accelerating, classify it by stating it is either *speeding up*, *slowing down*, or *changing direction*.

1. A car that was moving stops at a red light.

2. A car that was stopped at a red light begins moving when the light turns green.

3. A car drives 55 mph straight on the highway.

4. A car turns to the right.

Read the definitions of velocity and acceleration carefully before answering the following question:

5. A go-kart is moving in a circle at a constant speed of 8 m/s. Is the go-kart *accelerating*. Answer by referring **explicitly** to the definitions of velocity and acceleration?

Inertia 3 (level 3) Name ________________________

Newton's First Law two laws and inertial mass

Newton's First Law An object at rest with a net force of zero stays at rest An object in motion with a net force of zero stays in motion at a constant velocity. Because velocity includes both magnitude (speed) and direction, this means that the object must move with both a constant speed and a constant direction if the net force is zero.
Newton's Second Law as an equation As an equation: $\Sigma\vec{F} = m\vec{a}$ Or $\vec{a} = \frac{\Sigma\vec{F}}{m}$
Newton's Second Law, conceptually If the net force on an object is not zero, the object *accelerates*. However, there are *three different types* of acceleration: (as described above) - increasing in speed - decreasing in speed - changing direction If the net force vector on an object is *in the same direction as* the velocity vector, the object increases in speed. If the net force vector on an object is *in the opposite direction as* the velocity vector, the object decreases in speed. If the net force vector on an object is *perpendicular to* the velocity vector, the object changes direction.
Inertial mass (also called simply *inertia*) The more inertial mass an object has, the more difficult it is to *change velocity* of the object. Because velocity includes both magnitude (speed) and direction, if an object has more inertial mass, it is more difficult to *increase speed*, *decrease speed*, or *change direction* of an object.

Inertia 3 (level 3) Name ___________________________

6. Can an object in motion with a net force of zero *change direction*?
Answer by referring **explicitly** to Newton's First Law and the definition of velocity.

7. If an object that is already moving has more mass, it is _______________ to change the direction of the object's velocity.

a) harder
b) easier
c) no harder or easier

Defend your answer by **explicitly** referring to Newton's Second Law and the definitions of velocity and inertial mass above

8. A lion attacks a wildebeest! The lion charges towards the wildebeest at full speed. In order to survive, instead of trying to run away from the lion, the wildebeest runs *directly at* the lion. The wildebeest runs past the lion and begins running away. In order to catch the wildebeest, it must first turn around. Note also that the lion has *a lot* of mass.
Explain how this strategy helps the wildebeest survive by **explicitly** referring to Newton's Second Law and the definitions of inertia and velocity.

9. One of the most important positions in football is the defensive back. When another player (a receiver) is trying to catch a ball, a defensive back must follow them, step by step, in order to make sure they cannot. Defensive backs need to be extremely agile. In order to follow highly athletic players, they need to be able to speed up, slow down, and change direction very quickly.
Typically, defensive backs weigh much less than other football players. Explain why this might be by referring **explicitly** to Newton's First and Second laws and the definitions of inertia and velocity.