Learning Target: I can analyze and interpret data to identify patterns in the relationships between velocity and acceleration.

FSI Reading for Meaning: Understanding the Relationship Between Velocity and Acceleration

When objects move, scientists describe their motion using terms like **speed**, **velocity**, and **acceleration**. While these words are often used interchangeably in everyday language, they have specific meanings in science.

Velocity describes how fast an object is moving **and** the direction in which it is moving. For example, a car traveling 20 meters per second to the east has a different velocity than a car traveling 20 meters per second to the west, even though their speeds are the same.

Acceleration occurs when an object's velocity changes. This change can happen in three ways:

- when an object **speeds up**,
- when it **slows down**, or
- when it **changes direction**.

Because velocity includes direction, an object can be accelerating even if its speed stays the same. For example, a runner moving around a circular track at a constant speed is still accelerating because their direction is continuously changing.

Scientists often use **graphs** to analyze motion. A **distance-time graph** shows how far an object travels over time. A straight line on this graph means the object is moving at a constant speed. A curved line shows that the object's speed is changing.

A **velocity-time graph** is especially useful for understanding acceleration. If the line on a velocity-time graph is horizontal, the object has constant velocity and zero acceleration. If the line slopes upward or downward, the object is accelerating.

Understanding how velocity and acceleration are related helps scientists explain patterns in motion, predict future movement, and analyze real-world situations such as driving, sports, and amusement park rides.

1. (DOK 2) Which statement best describes **velocity**?

A. How fast an object moves
B. How far an object travels
C. How fast an object moves and its direction
D. How an object changes speed

2. (DOK 2) Which situation shows that an object is **accelerating**?

A. A car parked at a stoplight
B. A runner moving in a straight line at constant speed
C. A bicycle slowing down before stopping
D. A book resting on a table

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3. (DOK 2) Which changes can cause **acceleration**?
Select all that apply.

A. An increase in speed
B. A decrease in speed
C. A change in direction
D. Remaining still
E. Constant speed in a straight line

4. (DOK 2) What does a **straight line** on a distance-time graph indicate?

A. The object is accelerating
B. The object is not moving
C. The object is moving at a constant speed
D. The object is changing direction

5. (DOK 2) What does a **horizontal line** on a velocity-time graph represent?

A. Increasing acceleration
B. Constant velocity with no acceleration
C. Decreasing speed
D. Changing direction

6. (DOK 3) A student says a car moving around a circular track at constant speed is **not accelerating**. Which explanation best evaluates this claim?

A. The student is correct because speed does not change
B. The student is correct because velocity stays the same
C. The student is incorrect because direction changes, causing acceleration
D. The student is incorrect because distance is changing

7. (DOK 3) Which pieces of evidence would best support the claim that an object is accelerating?
Select all that apply.

A. The object's velocity-time graph has a sloped line
B. The object's direction changes while speed stays the same
C. The object remains at rest
D. The object speeds up over time
E. The object moves the same distance each second

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8. (DOK 3) A velocity-time graph shows a line sloping downward. What does this indicate?

A. The object is moving at constant speed
B. The object is not moving
C. The object is accelerating because its velocity is changing
D. The object's direction is constant

9. (DOK 3) Which statement best explains why **velocity-time graphs** are useful for understanding acceleration?

A. They show total distance traveled
B. They directly show changes in velocity over time
C. They always show direction
D. They measure speed only

10. (DOK 3) How could understanding velocity and acceleration help improve **real-world safety**?

A. By making objects move faster
B. By predicting how objects will change motion
C. By eliminating motion
D. By stopping acceleration completely

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