**9.1 Describing Acceleration**

***Acceleration***

- Acceleration:

Non-uniform motion:



Uniform motion:



- When an object changes its speed or direction, there is a change in velocity:

-changes in velocity can be either positive or negative:

*1) Positive change in velocity*

*A person on a bike increases their velocity from 6 m/s forward to 9 m/s forward. What is their change in velocity?*

*2) Negative change in velocity*

*A person on a bike applies the brake, slowing down from 9 m/s forward to 2 m/s forward. What is their change in velocity?*

**Positive and Negative Acceleration**

An object’s acceleration (+ or -) is dependent on two factors:

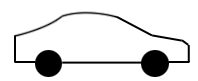
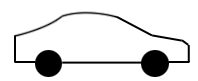


Rule #1:

*Example 1: The car is moving to the right and begins to decrease its velocity*

*→ →*

*vi = +20 m/s vf = +6 m/s*

**

*Acceleration: \_\_\_\_\_*

*Example 2: The car is moving to the left and begins to decrease its velocity*

*→ →*

*vf = -6 m/s vi = -20 m/s*

**

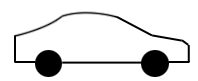
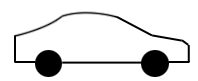
*Acceleration: \_\_\_\_\_*

Rule #2:

*Example #3: The car is moving to the right and begins to increase its velocity.*

*→ →*

*vi = +6 m/s vf = +20 m/s*

**

*Acceleration: \_\_\_\_\_*

*Example # 4: The car is moving to the left and begins to increase its velocity.*

*→ →*

*vf = -20 m/s vi = -6 m/s*

**

*Acceleration: \_\_\_\_\_*

**9.2 Calculating Acceleration**

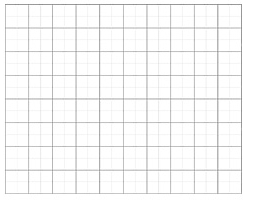
**Velocity-Time Graphs**

Velocity-time graphs are graphs of an object’s velocity during corresponding time intervals

*Example: Velocity of a roller coaster*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Time (s)* | *0* | *1* | *2* | *3* | *4* |
| *Velocity (m/s)* | *0* | *12.5* | *25.0* | *37.5* | *50.0* |

Velocity vs. Time



Velocity

(m/s [forward])

Time (s)

Average acceleration is the slope of a velocity-time graph:

→ →

a= slope = rise = *Δv*

run *Δt*

= (\_\_\_\_\_m/s) – (\_\_\_\_\_m/s)

(\_\_\_\_\_s) – (\_\_\_\_\_s)

= \_\_\_\_\_ m/s2

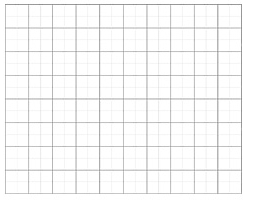
- The slope of a velocity-time graph can be positive, neutral, or negative:

+ slope:

0 slope:

* slope:

Velocity vs. Time



Velocity

(m/s [North])

Time (s)

**Calculating Acceleration**

Acceleration: Change in velocity: Time interval:

*→ → → → →*

*a= Δv Δv = (a)(Δt) Δt = Δv*

*Δt →*

*a*

*Examples:*

*1. A car starting from rest accelerates to 15 m/s [E] in 5.0 s. What is the car’s acceleration?*

*2. A skier moving 6.0 m/s forward begins to slow down, accelerating at -2.0 m/s2 for 1.5 s. What is the skier’s velocity at the end of the 1.5 s?*

*3. A motorcycle is travelling north at 11 m/s. How much time would it take for the motorcycle to increase its velocity to 26 m/s [N] if it accelerated at 3.0 m/s2?*

**Gravity**

Gravity:

Acceleration due to gravity:

*g* =

*g* =

- Objects fall at different rates on Earth because of air resistance

- Objects dropped in the vacuum of space fall at the same rate

Calculating motion due to gravity

Ignore air resistance. Use *g* = - 9.8 m/s2

*Examples:*

*1. What is the change in velocity of a hailstone that falls for 3.0 S?*

*2. A ball is thrown up into the air. How much time does it take to go from 16 m/s [up] to 2.0 m/s [up]?*