Acceleration Worksheet. Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Acceleration

* In general, if an object is accelerating it means that the object is either speeding up or slowing down. The greater the acceleration the more quickly the velocity is changing. Mathematically this can written as:

$$Acceleration= \frac{change in velocity}{elapsed time}= \frac{final velocity-initial velocity}{final time-initial time^{\*}}$$

$$\vec{a}= \frac{Δ\vec{v}}{Δt}= \frac{ \vec{v}\_{f}- \vec{v}\_{i}}{t\_{f}- t\_{i}} $$

 \*initial time is usually zero!

* The units for acceleration will be the units for velocity divided by the units for time. So the units for acceleration will be $(\frac{m}{s})$ divided by $s$ or $\frac{(\frac{m}{s})}{s}$ (meters per second, per second).

This can algebraicly be reduced to $\frac{m}{s^{2}}$ (meters per second squred)

* Acceleration is a ***vector*** quantity meaning it has direction. **REMEMBER THAT WE USE + AND – TO INDICATE DIRECTION IN CALCULATIONS.**
* When an object accelerates it means that its velocity changes, so it is slowing down or speeding up.
* If acceleration and velocity are in the ***same direction*** the object will ***speed up***.
* If acceleration and velocity are in ***opposite directions*** the object will ***slow down***.

**EXAMPLES:**

FOR EACH OF THE FOLLOWING EXAMPLES ASSUME

 **+ MEANS RIGHT ; – MEANS LEFT.**

1. A skater changes her velocity from -2.0 m/s to -14.0 m/s in 3.0 seconds. What is the skater’s acceleration?

|  |  |
| --- | --- |
| **Looking for**Acceleration of the skater | **Solution** |
| **Given**Beginning (initial) velocity = -2.0 m/sFinal velocity = -14.0 m/sChange in time = 3 seconds |
| **Relationship**$$\vec{a}= \frac{Δ\vec{v}}{Δt}= \frac{ \vec{v}\_{f}- \vec{v}\_{i}}{t\_{f}- t\_{i}}$$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the skater speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

2. A car brakes from +16m/s to 1.0m/s in 2.0s. What is the car’s acceleration?

|  |  |
| --- | --- |
| **Looking for**Car’s acceleration | **Solution** |
| **Given**Initial velocity = +16 m/sFinal velocity = +1.0 m/sTime 2.0s |
| **Relationship**$$\vec{a}= \frac{ \vec{v}\_{f}- \vec{v}\_{i}}{t\_{f}- t\_{i}}$$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the car speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

3. A can of sardines in olive oil accelerates from -80.0m/s to -20.0m/s in 30s, what is the can of sardines in olive oil’s acceleration?

|  |  |
| --- | --- |
| **Looking for**Acceleration of the can of sardines in olive oil | **Solution** |
| **Given**Beginning (initial) velocity = -80.0 m/sFinal velocity = -20.0 m/sChange in time = 30 seconds |
| **Relationship**$$\vec{a}= \frac{ \vec{v}\_{f}- \vec{v}\_{i}}{t\_{f}- t\_{i}}$$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the can of sardines in olive oil speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

4. A leather glove filled with sriracha sauce changes its velocity from 3m/s to 23m/s 5.0 seconds. What is the leather glove filled with sriracha sauce’s acceleration?

|  |  |
| --- | --- |
| **Looking for**Acceleration of the leather glove filled with sriracha sauce | **Solution** |
| **Given**Beginning (initial) velocity = 3 m/sFinal velocity = 23 m/sChange in time = 5.0 seconds |
| **Relationship**$$\vec{a}= \frac{ \vec{v}\_{f}- \vec{v}\_{i}}{Δt}$$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the leather glove filled with sriracha sauce speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

Like all mathematical formulas, the acceleration formula can be rearranged in order to solve for any of the variable quantities.

We can write the formula in the following ways:

$$Δ\vec{v}= \vec{a}Δt$$

$$\vec{v}\_{f}= \vec{v}\_{i}+ \vec{a}Δt$$

$$t= \frac{Δ\vec{v}}{\vec{a}}= \frac{\vec{v}\_{f}- \vec{v}\_{i}}{\vec{a}}$$

**EXAMPLES:**

5. A man’s wallet with assorted deli meat where the bills should be accelerates at -4.0m/s2 for 2.0s. What is the change in its velocity?

|  |  |
| --- | --- |
| **Looking for**Change in velocity of the man’s wallet with assorted deli meat where the bills should be | **Solution** |
| **Given**Acceleration = -4.0m/s2Change in time = 2.0s |
| **Relationship**$$Δ\vec{v}= \vec{a}Δt$$ |

Follow up questions:

1. From the given information can you determine the direction of initial velocity?
2. Can you determine if the man’s wallet with assorted deli meat where the bills should be speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

6. How much time is required for a truck to speed up from -7.0m/s to -19m/s if the acceleration is 8.0m/s2 to the left?

|  |  |
| --- | --- |
| **Looking for**Time for the truck’s velocity to change | **Solution** |
| **Given**Initial velocity = -7.0m/sFinal velocity = -19m/sAcceleration = -8.0m/s2 |
| **Relationship** $t= \frac{\vec{v}\_{f}- \vec{v}\_{i}}{\vec{a}}$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the truck speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

7. A tube sock that has lost its elasticity so now it always slouches down around your ankle has an initial velocity of 6.0m/s to the left. The tube sock that has lost its elasticity so now it always slouches down around your ankle then accelerates to the right at 7.0m/s2 for 4.0s. What is the final velocity of the tube sock that has lost its elasticity so now it always slouches down around your ankle?

|  |  |
| --- | --- |
| **Looking for**Final velocity of the tube sock that has lost its elasticity so now it always slouches down around your ankle | **Solution** |
| **Given**Initial velocity = Acceleration = Time = |
| **Relationship**$$\vec{v\_{f}}= \vec{v}\_{i}+ \vec{a}Δt$$ |

Follow up questions:

1. What direction is the initial velocity?
2. Is the tube sock that has lost its elasticity so now it always slouches down around your ankle speeding up or slowing down?
3. Is the acceleration positive or negative?
4. What direction is the acceleration?

**QUESTIONS:**

1. While traveling along a highway a driver slows from 24 m/s [N] to 15 m/s [N] in 12 seconds. What is the automobile’s acceleration?

2. A parachute on a racing dragster opens and changes the speed of the car from -85 m/s to -15 m/s in a period of 4.5 seconds. What is the acceleration of the dragster?

3. The table below includes data for a ball rolling down a hill. Fill in the missing data values in the table and determine the acceleration of the rolling ball.

|  |  |
| --- | --- |
| Time (seconds) | Velocity (m/s) |
| 0 (start) | 0 (start) |
| 2 | 3 |
|  | 6 |
|  | 9 |
| 8 |  |
| 10 | 15 |

 Graph the data and calculate the acceleration

4. A car traveling at a speed of 30.0 m/s encounters an emergency and comes to a complete stop. How much time will it take for the car to stop if it decelerates at -4.0 m/s2?

5. A cart rolling down an incline for 5.0 seconds has an acceleration of 4.0 m/s2. If the cart has a beginning speed of 2.0 m/s down the incline, what is its final speed?

6. A cart is rolling up an incline at 4.0m/s. The acceleration of the cart is 4.0m/s2 down the incline. What is the velocity of the cart after 3.0s.

 Sketch a velocity vs. time graph of the motion.

7. How much time is requires for a rock to change its velocity from 20m/s up to 10m/s down if it’s acceleration is 10m/s2 down?

8. A car is traveling at 60.0km/h [W] when Jared Fogle leaps into the road waving a pair of giant pants. The driver slams on the brakes and the car comes to a complete stop in 2.2s. What is the acceleration of the car?