Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period: 1 2 3 4 5 6

Newton’s Second Law

1. What are the three main ideas associated with Newton’s second law of motion? List them using your own words.

 **1. Acceleration is the result of unbalanced forces.**

 **2. A larger force makes a proportionately larger acceleration.**

 **3. Acceleration is inversely proportional to mass.**

2. What conditions are necessary for acceleration to occur?

 **Unbalanced forces need to be acting on the object.**

3. One kilogram-meter per second squared is also equal to what unit?

 **1 Newton (N)**

4. How much force would you need to cause a 20-kilogram object to accelerate in a straight line to 20 m/s2?

 **F = ma**

 **F = 20 kg x 20 m/s2**

 **F = 400 N**

5. Different forces are applied to cars of different masses. The acceleration is measured for each combination of force and mass. Graph the data and determine the acceleration. Force goes on the y-axis and mass goes on the x-axis. Be sure to label each axis and give your graph a title.



|  |  |
| --- | --- |
| Force (N) | Mass (kg) |
| 5 | 1 |
| 10 | 2 |
| 15 | 3 |
| 20 | 4 |



6. A 2-kilogram rabbit starts from rest and is moving at 6 m/s after 3 seconds. What net force must be exerted on the rabbit (by the ground) to cause this change in speed?

 **First you must determine what the acceleration is. a = Vf - Vo = 6 m/s – 0 m/s = 2 m/s2**

 **t 3 s**

**Now you can plug your value you calculated for acceleration into the force equation to determine the force on the object.**

**F = ma**

**F = 2 kg x 2 m/s2 = 4 N**

7. Explain how changing force or mass affects the acceleration of an object. Provide one example to support your answer.

**Increasing the force on an object increases the acceleration of the object. Decreasing the force on an object decreases the acceleration of the object.**

**ex: pulling a wagon: the more force you pull with, the faster the acceleration of that wagon.**

**Increasing the mass of an object decreases the acceleration of the object. Decreasing the mass of an object increases the acceleration of the object.**

**ex: a grocery cart full of groceries will acceleration slower than an empty grocery cart.**

8. A tow truck pulls a 1,500-kilogram car with a net force of 4,000 newtons. What is the acceleration of the car?

**F = ma**

**F = 4, 000N**

**m = 1,500 kg**

**a = ?? m/s2**

**a = F/m a=4,000N / 1,500 kg a = 2.7 m/s2**

9. A potato launcher uses a spring that can apply a force of 20 Newtons to potatoes. A physics student launched a 100-gram potato, a 150-gram potato, and a 200-gram potato with the launcher. Which potato had the greatest acceleration?

**You can go through and calculate the acceleration for each of the potatoes OR you can use the meaning of Newton’s second law to figure out which potato will have the greatest acceleration. Remember, the greater the mass, the slower the acceleration. Therefore, the potato with the smallest mass will have the greatest acceleration which is the 100 gram potato.**

10. An experiment measures the speed of a motorcycle and rider (total mass = 250 kg) every 2 seconds. The motorcycle moves in a straight line. What is the net force acting on the motorcycle and rider?

**First, you need to calculate acceleration using the chart to the left. By looking at the chart you can determine that the acceleration on the motorcycle is constant because the speed is increasing by the same amount every 2 seconds. Therefore, you can pick any 2 pieces of data on the chart. I would pick speed 0 m/s and time 0 s as one of the data points.**

**a = Vf – Vo = 5 m/s – 0 m/s = 2.5 m/s2**

 **t 2 s**

**F = ma**

**F = ?? N**

**m = 250 kg**

**a = 2.5 m/s2**

**F = 250 kg x 2.5 m/s2**

**F = 625 N**