Newton’s Second Law of Motion

How fast does it go?



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

Homework:

***Practical Experiment***

1. Equipment:
* 1 Plastic Volleyball
* 1 Basketball
* 1 Tennis Balls
* 3 different coloured markers
1. Instructions:
* Students will be in groups of 3.
* You will compete to throw each of these further than each other from a set position.
* Each student will be assigned a different coloured marker to mark how far they threw
* You will need to record the distance of ONE of your group members.
* Record the data in meters.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Volleyball** | **Basketball** | **Tennis Ball** |
| Test 1: |  |  |  |

1. How do the results show Newton’s Second Law? (We can come back to this later) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Remember Newton’s First Law?***

1. An unbalanced force causes something to \_\_\_\_\_\_\_\_\_\_ (accelerate).
2. What was the unbalanced force in your experiment above? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Acceleration***

1. **Acceleration is directly related to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_of the force.**
2. **It accelerates in the direction you \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_ it.**

Fill in the missing arrows and labels.

1. In other words….

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. And . . .

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. So. . . if you push twice as hard, it accelerates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. But it depends on the size of the mass.

Use the diagram to below to fill in question 12.

1. if I use the same amount of force (F) on a . . .
	1. large \_\_\_\_\_\_\_ then it will have a \_\_\_\_\_\_\_\_\_\_\_\_ acceleration (a) compared to a
	2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which would have a \_\_\_\_\_\_\_\_\_\_\_ acceleration.

***Newton’s Second Law***

1. Newton observed those “rules” of \_\_\_\_\_\_\_\_\_\_\_\_\_ and came up with his second law of motion.
2. It is both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

***Newton’s Second Law***

1. **An object will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. **The size of this acceleration depends upon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Newtons Second Law Formula***

**Fnet = ma**

**or**

**Force = \_\_\_\_\_\_\_\_\_\_ x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

****

1. You need to know the units of Force, Mass & Acceleration.

|  |  |  |
| --- | --- | --- |
| **Name** | **Units** | **Symbol** |
| Force |  |  |
| Mass |  |  |
| Acceleration |  |  |

1. Solve these using the formula:
2. *m* = 7kg, *a* = 2 m/s2, therefore *F* = \_\_\_\_\_
3. *m* = 500kg, *a* = 3 m/s2, therefore *F* = \_\_\_\_\_
4. *m* = 6kg, *F* = 18 N, therefore a = \_\_\_\_\_
5.  *F* = 25 N, *a* = 5 m/s2, therefore *m* = \_\_\_\_\_

***Class Demonstration***

* 1 Medicine Ball
* 1 Basketball
* Questions:
	1. Hypothesis: Which ball will do you think hit the ground first? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. Give an explanation of why you think that. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. How close was the time between them hitting the ground? (Circle one)
		+ Exactly the same/half a second/one second/three seconds
	4. Was your hypothesis correct? \_\_\_\_\_\_\_\_\_\_\_
	5. Why or why not? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**End of Second Law**

***Practice Calculations***

1. Rearrange the following equation to solve for mass and acceleration.

**Fnet = ma**

1. Practice Newton’s Second Law calculations by completing the following table;

|  |  |  |
| --- | --- | --- |
| **Force** | **Mass** | **Acceleration** |
| 56 N |  | 6 m/s2 |
| 108 N |  | 2.5 m/s2 |
|  | 3.4 kg | 12 m/s2 |
|  | 120 kg | 1.4 m/s2 |
| 10 N |  | 2.0 m/s2 |
| 118 N |  | 6.8 m/s2 |
| 5.5 N | 15,000 kg |  |
| 1.2 N | 3,500 kg |  |
|  | 8.2 kg | 1.2 m/s2 |
|  | 196 kg | 38 m/s2 |

***Newton’s Second Law - Concept Questions***

1. If the forces exerted on a 2-kg object are 50 N east and 30 N west, what is object’s acceleration?
2. Suppose a cart is being pushed by a certain net force. If the net force is doubled, by how much does the acceleration change?
3. Suppose a cart is being moved by a certain net force. If a box is dumped into the cart, so its mass is doubled, by how much does the acceleration change?
4. If a loaded truck can accelerate at four m/s2 and loses its load so it is only half as massive, what acceleration can it attain for the same driving force?
5. A rocket fired from its launching pad not only picks up speed, but also has a significant increase in its acceleration as firing continues. Why is this so?
6. Harry the painter swings year after year from his boson’s chair. His weight is 500 N and rope unknown to him, has a breaking point of 300 N.
* Why doesn't the rope break when he is supported as shown in the first figure to the right?
* One day, Harry is painting near a flagpole, and for a change, he ties the free end of the rope to the flagpole instead of to his chair. What happens to Harry?
1. The force of gravity is twice as great on a 2-kg rock as on a 1-kg rock. Why then does the 2-kg rock not fall with twice the acceleration?



1. If you pulled a low but heavy crate with a rope and greased the bottom to reduce friction, would it help more to use a short rope or a long rope?

***Extension Questions***

1. What is the net force acting on a 10 kg freely falling object?



* What is the net force when it encounters 15 N of air resistance?
* How much air resistance does it experience when it falls at terminal velocity?

1. An elevator (mass = 1000 kg) is supported by a single cable.



1. When the elevator is at rest, what is the tension in the cable?
2. The elevator starts to move upwards at 1m/s/s. Is the scale reading more, less, or the same?
3. When the elevator is ascending upward at a constant speed, is the tension more, less, or the same as (a)?
4. The elevator begins to slow as it reaches the proper floor. Is the tension more, less, or the same as (a)?
5. The elevator now starts to descend at an increasing speed. Is the tension more, less, or the same as (a)?
6. If the cable snapped and the elevator fell freely, what would be the tension?