Study Guide for The Notion of Motion

Questions

1. What's the First Law of Motion? Give an example.
2. What's the Second Law of Motion? Give an example.
3. What's the Third Law of Motion? Give an example.
4. Which two Laws of Motion are in effect when the space shuttle takes off? Discuss.
5. What is a force?
6. Which Law of Motion is in effect for each of the following:
    1. the Pioneer Space Craft speeding past Mars.
    2. a wrecking ball hitting a building.
    3. a person pulling on a boat oar.
    4. a car going around a banked turn.
7. Why does a snow plow work better when it's full of sand?
8. If you're driving with your mom and she hits the breaks suddenly will you be thrown forward or pushed backward into your seat? If you were holding a helium balloon at the time which direction would the balloon go? Why? Now go home and ask your mom to buy you a helium balloon and try it (tell her it's for science).
9. Who would be harder to push on a tire swing, Skinny Scotty or Fat Albert? Why?
10. Which would drive a nail deeper into a piece of wood, a heavy hammer or a light hammer?
11. Cindy is standing in a canoe at the end of the dock but she has forgotten to tie the canoe up. Cindy starts to walk in the canoe. What will happen to the canoe? Which Law does this demonstrate?
12. You start pushing your shopping cart toward the cookies, your mom pushes from the other end of the shopping cart with an equal force but she is pushing the cart toward the vegetables in the opposite direction. Where will the cart go? Why?
13. Your little red wagon is full of rocks, your sister's little red wagon is full of feathers, you tie them together with a bungee cord, pull them apart and let go. What will happen to the wagons? Who's wagon will go faster? How mad will your mom be when she sees what you've done to your and your sister's wagon?
14. Which has more inertia, your Father in front of the TV during the Super bowl or you in your bed on Monday morning?

Possible Answers

1. 1st Law of Motion: An object at rest will stay at rest and an object in motion will stay in motion (until an outside force acts upon it). INERTIA. An example would be the rolling bowling ball on the stage, it stops when it hits Dr. Quark or the wall otherwise it would stay in motion. The ball at rest would stay at rest until someone pushes it acting as an outside force to put it in motion.
2. 2nd Law of Motion: If a force acts on an object, the object will accelerate in the direction of the force, How much depends on the size of the force. F= ma (Force = mass x acceleration). An example would be if you were to put a trash can at the end of your drive way and roll a bowling ball at it. Then using the same speed try rolling a basketball at the trash can. The bowling ball will push the trash can more than the basketball because even though they rolled at the same speed the mass of the bowling ball was greater than the mass of the basketball, therefore the force generated by the bowling ball was greater than the force generated by the basketball. Now imagine that you are driving your mom's car. You push the gas peddle down 1/4 of the way and you will feel pushed back into your seat. Then you try it again but this time you push the peddle down 3/4 of the way, you still have the same amount of mass but because the car has more acceleration the force pushing you back into your seat is greater.
3. 3rd Law of Motion: For every action there is an equal action in the opposite direction. Action & Reaction. An example of this would be watching a hunter fire his rifle. When the bullet is discharged out of the barrel of the gun, the gun will 'kick' or push backward into the hunters shoulder. The reason the gun doesn't go as far as the bullet is because the gun has a far greater mass than the mass of the bullet.
4. The answer is primarily the 2nd & 3rd although all 3 laws are always in effect. The gas is being discharge making as action for which the reaction is the space shuttle going up into space (3rd). At the same time the expulsion of gas generates a great force which accelerates the mass of the rocket into space (2nd).
5. FORCE is a push or a pull.
6.
    1. Law #1, INERTIA, there is very little friction in space so an object in motion will stay in motion.
    2. Law #2, F= ma, there is a big force (wrecking ball) hitting a building which sends the building in the direction of the force.
    3. Law #3 Action & Reaction, you pull one way and the boat goes the other direction.
    4. Law # 1, INERTIA, the car wants to keep going straight, the banked turn helps the car get around the corner.
7. Because of the 2nd Law of Motion, the truck exerts more force on the snow and moves it more easily because it has more mass.

8. You would be pushed forward against your seat belt. The helium balloon would go backward while you went forward because while you had more mass than the air in the car the helium balloon has less mass than the air in the car .

9. Fat Albert would be harder to push than Skinny Scotty because of Law # 1, INERTIA. Fat Albert has more mass and therefore more INERTIA to stay at rest than Skinny Scotty.

10. The heavy hammer would drive the nail further than the light hammer because of Law # 2, F = ma. The heavy hammer has more mass and therefore more force against the nail than the light hammer.

11. As Cindy walks toward the dock the canoe will be pushed back away from the dock. The effect being that Cindy will remain the same distance from the dock. This demonstrates Law # 3 Action & Reaction. The action is Cindy walking forward, the reaction is the canoe going backward.

12. The shopping cart will stay in the same spot because of Law # 3. Your action is being countered by an equal reaction of your mothers and the cart goes nowhere. You don't get the cookies but look at the bright side, your mom doesn't make it to the broccoli either.

13. The wagons will be pulled back together by the bungee cord. The wagon of feathers will be pulled faster than the wagon of rocks because it has less INERTIA to stay where it was.

14. Whichever has more mass has more INERTIA to remain at rest. If your father weighs more than you do he has more INERTIA in front of the TV, if you weigh more than your father than you have more INERTIA in bed on Monday.

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Students and teachers with questions, comments, or suggestions for other things you'd like to see can write Dr. Quark at the above address! He loves mail and will try to answer what he gets!