Physics

Newton's Laws Homework

1. On your first mission aboard the International Space Station, you're handed two identical unmarked boxes. One contains batteries and the other contains blankets. Both boxes are completely full, so the contents won't rattle around. How can you tell which box is which without opening them?
2. Does a 2 kilogram iron brick have twice the inertia of a 1 kilogram brick?
3. Which is harder to stop, a 10 metric ton (10 Mg) truck or a 100-kg go-cart, assuming both vehicles are moving at 10 meters/second? Which vehicle is harder to accelerate from 10 meters/second to 20 meters/second? Explain your answers **using physics terminology**.
4. Your friend is explaining why there's a limit to how far anyone can throw a baseball and states, "When you throw a baseball, you apply a force to it. The ball will only keep going until that force is completely used up." Comment on your friend's interpretation.
5. Does a 2 kilogram iron brick have the twice the **mass** of a 1 kilogram brick? Twice as much **weight**? Twice as much **volume**? Twice as much **density**?
6. Would it be any easier to lift a refrigerator on the Moon than it is on the Earth? Which of the following properties of the refrigerator are different in the two environments and which remain unchanged: mass, weight, density, volume, and inertia.
7. Calculate the weight of Mr. Schneider's 2.75 kg puppy **in SI units**.
8. What is the mass of a 1.5 newton apple?
9. 25 newtons of force are applied to a 10 kg sled, skating it across the ice. What acceleration does this produce? If this force is applied continuously, how fast will the sled be moving after 12 seconds (assuming it starts from rest)? How far will it have traveled during this time?
10. If the force is doubled in **Problem #9**, how will this affect the acceleration?
11. If instead, the mass is doubled in **Problem #9**, how will this affect the acceleration?
12. Without changing the force in **Problem #9**, how could you get twice as much acceleration?
13. Which will hit the ground first when dropped from the Tower of Pisa, a 10 metric ton (10 Mg) bag of Styrofoam, or a 100-gram dart? Which does the Earth pull harder on?
14. How much force does gravity exert on a 10-kilogram rock? How about a 20 kg rock? Explain why they both experience the same acceleration after you drop them.
15. If an object has no acceleration, can you conclude that there are no forces acting on it? Explain why or why not.
16. Complete **Cases #1-5** and **#7-9** on the **Vector Diagrams** practice sheet (the one with the rocks).
17. Complete the **Statics** practice sheet (the one with Nellie & Harry).
18. Finish **Cases #6** and **#10-12** on the **Vector Diagrams** practice sheet (the one with the rocks).
19. Complete the **Newton's 2nd Law** practice sheet (the one with the skydiver).

20. For each of the following forces, what is the equal and opposite force required by Newton's third law? (a) The force of gravity pulling down on a book. (b) The force of a helicopter blade pushing down on the air. (c) The force of a hammer on a nail. (d) The force of air resistance acting on a thrown baseball.
21. Suppose you hold an apple over your head. (a) Identify all the forces acting on the apple and their reaction forces. (b) When you drop the apple, identify all the forces acting on it as it falls and the corresponding reaction forces.
22. Complete **Newton's 3rd Law** practice sheet (the one with the football on it).
23. The Starship *Enterprise* is being pursued in space by a Klingon warship. What happens to the speed of the Klingon ship when it fires a projectile at the *Enterprise*? What happens to the speed of the *Enterprise* when it returns fire? Explain what this has to do with the conservation of momentum. Also explain what this has to do with Newton's third law.
24. A 55 kg astronaut floating in the space shuttle's bay suddenly tosses a 1.0 kg wrench to her crewmate. If the wrench travels toward the crewmate at 3.0 meters/second, how fast is the first astronaut now moving, and in what direction?
25. Should a boxer being hit with a punch try to increase or decrease the length of time their face is in contact with their opponent's glove? Should a karate expert try to increase or decrease the length of time their hand is in contact with their opponent's body?
26. How long should you apply a 5.0-newton force to a 4.0 kg object in order to accelerate it from rest until it's moving at 2.5 meters/second to the east? Calculate the magnitude and direction of the impulse vector.
27. Calculate the momentum of a 100.0-kilogram football player running at 10.0 meters per second. Suppose that he collides with a stationery 150-kilogram opponent, and that their collision is completely inelastic. Immediately after the collision, what is the total momentum of the two players? What is the speed of each player immediately after the collision?