Physical Science Chapter 12 Calculating Force-C

(Do not write on this sheet) Show the set up in the equation for each problem

Force equals mass times distance, or $F = m \times a$

Problems:

1. In drag racing, acceleration is more important than speed, and therefore drag racers are designed to provide high accelerations. Suppose a drag racer has a mass of 1250 kg and accelerates at a constant rate of 16.5 m/s2. How large is the unbalanced force acting on the racer?

2. A 5.22 X 10^7 kg luxury cruise ship is moving at its top speed as it comes into port. The ship then undergoes and acceleration equal to -0.357 m/s^2 until it comes to rest at its anchorage. How large must the unbalanced force acting on the ship be in order to bring the ship to a rest at the proper location?

3. The force that stops a jet plane as it lands on the flight deck of an aircraft carrier is provided by a series of arresting cables. These cables act like extremely stiff rubber bands, stretching enough to keep from slowing down the plane to suddenly. A Hornet jet with a mass of 1.3 X10^4 kg lands with an acceleration of -27.6 m/s^2. How large is the unbalanced force that the arresting cables exert on the plane?

4. The giant sequoia redwood trees of the Sierra Nevada Mountains in California are said never to die from old are. Instead, an old tree dies when its shallow roots become loosened and the tree falls over. Removing a dead mature redwood from a forest is no easy feat, as the tree can have a mass of nearly 2.0 X 10^6 kg. Suppose a redwood with this mass is lifted with an overall upward acceleration of 0.85 m/s^2. How large is the unbalanced force lifting the tree?

5. Until it was discontinued, the fastest jet plane in the skies was the Lockheed SR-71 Blackbird. However, this plane did not reach its height speed through large acceleration. The plane had a mass of 7.7 X 10^4 kg and was driven by an estimated unbalanced force of about 7.23 X 10^5 N. What was the acceleration of the Lockheed SR-71?

6. Suppose an empty grocery cart rolls downhill in a parking lot. The cart has a maximum speed of 1.3 m/s when it hits the side of the store and come to rest 0.30 s later. If an unbalanced force of 65 N stops the cart, what is the mass of the grocery cart?

7. The fastest speed achieved on Earth for any object, with the exception of subatomic particles in particle accelerators is 15.8 km/s. A device at Sandia Laboratories in Albuquerque, New Mexico uses highly compressed air to accelerate a small metal disk to supersonic speeds. Suppose the disk reaches its top speed from rest in 1.0 s. If the disk has a mass of 0.20 g, what is the unbalanced force on the disk?

(OVER)

8. "Maglev" trains use magnetic fields to levitate the train a few centimeters above the tracks. This design cuts down on friction so that the train can travel much faster than trains that roll on the tracks. The fastest maglev train is an experimental Shinkansen train consisting of 3 cars. This train has reached a speed of 550 km/h. assume that the mass of this train is 1.33×10^5 kg and that the unbalanced force needed to accelerate the train to its top speed is 7.07×10^4 N. What is the train's acceleration?

9. Meteorites are rocks that enter the Earth's atmosphere and only partially burn up during entry, so that the remaining mass lands on Earth's surface. The speeds with which meteorites strike Earth's surface depends on their point of origin. I they were originally small rocks that orbited Earth, their impact speed might be as low as 10.0 km/s. If the small rocks orbited the sun, the speed with which they would collide with Earth could be as large as 70.0 km/s. Suppose a meteorite collides with Earth with a force of 6.41×10^{12} N.
   a) What is the mass of the meteorite if its impact speed is 10 km/s, so that it has an acceleration of approximately -1.00×10^8 m/s^2?
   b) What is the mass of the meteorite if its impact speed is 70 km/s, so that it has an acceleration of approximately -4.90×10^9 m/s^2?

10. The largest acceleration that a human has ever endured occurred when a race car accidentally crashed into a wall. The car was traveling at a speed of 172.8 km/h when it hit the wall. The car came to a complete stop 2.72×10^{-2} s later.
    - Calculate the acceleration of the car using the acceleration formula. Express your answer in both m/s^2 and "g's". One g is equal to the free-fall acceleration of 9.8 m/s^2.
    - Suppose the driver of the car had a mass of 70 kg. What was the unbalanced force on his body as the car underwent negative acceleration?