Forces 2

Draw free body diagrams and explain your reasoning for each of the following.

1. A small car and a large truck collide. At any instant, describe which experiences:
    a. the greater contact force.
    b. the greater acceleration.

2. The cartoon cat Tom, in order to get away from a shark, blows on the sail of his sailboat. Explain why this won't work in the real world.

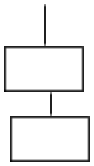
3. Mehmed (mass = 50 kg) stands at the midpoint of a tightrope whose extended length is 50 m. If the rope sags by 1.5 m, what is the tension?

4. Easton pushes a 20 kg lawn mower with a force of 80 N directed along the handle, which is inclined at 30° to the horizontal.
    a. If he moves at a constant velocity, calculate the retarding force due to the ground.
    b. He needs to speed up, but the retarding force remains constant. Calculate the force he needs to apply along the handle to speed up by 1.0 m s^{-2}.

5. A car is moving at 15 m/s. A 75 kg driver is held firmly in his seat by a seat belt. Calculate the force on the driver (assume that it is constant) if the car crashes by crumpling through a distance of :
    a. 75 cm.
    b. 25 cm.
    c. Explain cars have "crumple zones."

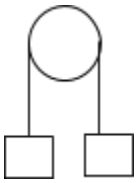
6. Allison jumps out of an airplane with a 6.0 kg parachute. After she opens the chute, she falls at a constant 5.6 m/s. Assume that Allison's mass is 50 kg.
    a. Calculate the force of the parachute on Allison.
    b. Calculate the force of the air on the parachute.

7. Two blocks hang one under the other as shown. The mass of the top block is 0.2 kg while the bottom mass is 0.3 kg. Calculate the tensions in each of the ropes in each of the following cases:

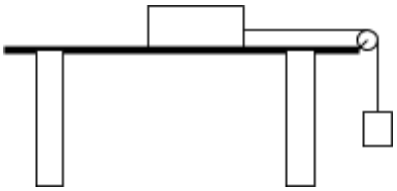


    a. The blocks are at rest.
    b. The blocks move upward at 10 m/s.
    c. The blocks accelerate upward at 2 m/s^2.
    d. They accelerate downward at 2 m/s^2.
    e. If the maximum allowable tension is 10 N, what is the maximum acceleration?

8. Two blocks are connected over a pulley. One mass is 2.0 kg while the other is 3.0 kg.
    a. Calculate the acceleration of the blocks.
    b. Calculate the tension in the rope.



9. A 6 kg block is sitting on a horizontal, frictionless table. It is connected to a 2 kg block that is hanging over the edge of the table (as shown).
    a. Calculate the acceleration of the blocks.
    b. Calculate the tension in the rope.



10. A 1.5 kg cart is placed on a straight 1.50 meter track that is inclined at 15 degrees above the horizontal. Assume the wheels are good enough that you don't have to worry about friction.
    a. Calculate the acceleration of the cart.
    b. Determine the time it will take to reach the bottom of the track if it is released from rest.

11. A block is initially sliding 5.0 m s^{-1} up a frictionless ramp that is inclined at 10 degrees.
    a. Calculate the acceleration of the block.
    b. Calculate the distance the block will travel along the ramp before coming to rest.
    c. Calculate the time from release until the block comes to rest.

12. Two blocks are on either side of a frictionless wedge as shown below. The mass of block I is 5.0 kg and the mass of block II is 6.0 kg. Calculate the acceleration of the blocks and the tension in the rope.