3 24-Hour Towing Service

Purpose

To find a technique for moving a car when its wheels are locked

Required Equipment/Supplies

7 m to 10 m of chain or strong rope
tree or other strong vertical support
automobile or other large movable mass
1-, 2-, 5-kg masses

Discussion

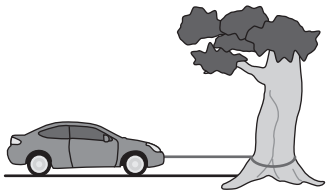
You can exert a force on a parked automobile if you push or pull on it with your bare hands. You can do the same with a rope, but with more possibilities. Even without using pulleys, you can multiply the forces you exert. In this activity, you will try to show that you can exert a far greater force with brains than with brawn.

Procedure

Step 1: Park a car on a level surface with a tree in front of it, the brakes locked, and the gear selector set on "park" or in first gear.

Step 2: Your goal is to move the car closer to the tree. You will do this by exerting force on a rope, chain, or cable tied to the car's front end. How and where the force is exerted is up to your imagination. Your own body is the only energy source you can use. Make a sketch of your method. Show the applied force and the other forces with arrows.

Devise a technique to move the parked car.



Alternative Procedure

Step 1: Pick two (strong) students to hold each end of the chain. Have the students pull on the chain hard so that it is as level as possible.

Step 2: Successively add a 1-kg, then a 2-kg, and finally a 5-kg mass—having the students attempt to pull the chain as level as possible each time. Have the students compare the force on the chain to the masses you hang on the chain.

Activity

Analysis

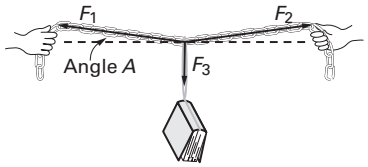


Fig. A

1. Look at Figure A. Suppose a force F_3 is applied to a chain at right angles to the horizontal. Tension in the chain can then be shown as vectors F_1 and F_2. Since the system is not accelerating, all forces must add up to zero. The force F_1 is the tension in the chain and the force on whatever it is attached to, in this case, the right hand. The same is true for F_2. The force F_3, in this case the weight of the book, is small, while F_1 and F_2 are large. As the angle A becomes smaller, the forces F_1 and F_2 become larger. This idea is explained further in Chapter 4 of your text. Use a vector diagram to explain how a small sideways force can result in a large pull on the car.

2. List other situations that could use this technique for "force multiplication."

3. This method for making a large force is used to fell trees, pull stumps, straighten dents in car fenders, and pull loose teeth! Explain how this might be possible.