Pushing a Stalled Car



Objective: The objective of this lab is to determine the mass of a vehicle

based on the acceleration produced by a net force. (Applying Newton’s Second law)

Materials: One vehicle (family mini-van), 2 force plates, video camera, 4 volunteers (2 pushing, 1 holding/operating the lab quest, and 1 video taping).

Procedure: Two students are selected to push the car with the force plates. The sum of the two plate readings provides the value of the force applied to the car. Each student will place their force plates on the back of the van. A third student will operate the lab quest. A fourth student will operate the fixed video camera allowing for as much of the motion to occur across the screen.

 Once everyone is in place the driver will direct the video camera person and the labquest person to start recording. Once that is establish the driver will then yell go (also raising his hand). The two students pushing should commence with pushing the vehicle. Once the vehicle has covered a sufficient distance (approximately 20 to 30 m) the driver will yell “stop”. The two students will stop pushing at this time and let the car coast away from them allowing the driver to brake.

 The frictional force acting on the car is found by determining the combined applied force needed to get the car moving. After that both forces will be combined for when the car is accelerating. Subtracting the two will yield the net force.

After the car is pushed students return to the classroom to analyze data. The video data will be marked for position yielding a velocity vs. time graph in logger pro. From the slope of the car’s velocity versus time graph, students determine acceleration. The net force is

found by subtracting the frictional force from the force applied by the two force plates.

Finally, the mass is found by applying Newton’s 2nd Law: m =F/a where m is the mass, F

is the net force, and a is the acceleration. The experimentally determined mass is then

compared with the mass of the car found in the owner’s manual or online.

Data:

Maximum Force to get car moving = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average Force while car is accelerating = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Net Force = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average Acceleration while the car is moving = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mass of Car = \_\_\_\_\_\_\_\_\_\_\_

Actual Mass = \_\_\_\_\_\_\_\_\_\_\_\_ % Difference \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Some observations and suggestions:

1) Safety is of paramount importance! It goes without saying that drivers of the vehicle

should drive responsibly. Once the car is positioned for a push, the engine should be

turned off, car placed in neutral and brake applied, all students are out of the path of the vehicle.

2) Make certain students push horizontally. If they push at an angle, only the horizontal

component of the applied force goes into accelerating the car. As a result, the actual

applied force will be less than the reading.