Fuel Cell Cars II
Fall 2007

Name_____
Name_____
Name_____
Name_____

Introduction/Purpose:

The objective of this lab is to further investigate the energy and structure of the fuel cell through various experiments.

Apparatus:

Fuel Cell Car, Power supply, Decade resistance box, 2 LoggerPro Voltmeter Probes, Meter stick, LoggerPro Force Probe, Banana plug test leads, Solar panel, Methanol fuel cell, Two "tracks" of different lengths and inclines, Distilled water

Theory:

According to Newton's second law, force is proportional to mass and acceleration.

$$F = m \times a \qquad (1)$$

Friction is a specific force that measures the resistance an object experiences while moving along a surface.

$$f = \mu \times N \qquad (2)$$

Where μ is the coefficient of friction and N is the normal force on the object. In today's lab, the normal force will be equivalent to the gravitational force.

$$F_g = m \times g \qquad (3)$$

Where *g* is Earth's gravitational acceleration, which is 9.81 $^{m}/_{s^2}$. Rearranging these equations gives you:

$$F = \mu \times m \times g \qquad (4)$$

Work is the measure of how much energy it takes to move an object a distance d.

$$W = F \times d \qquad (5)$$

Where the force (F) is in Newton's and the distance (d) is measured in meters. The product of a Newton and a meter is a Joule, which is a unit of energy. The force applied to the fuel cell car is equal to the frictional force assuming the car is moving at a constant velocity.

Procedure:

Friction

1. Tape the wheels powered by the generator so they are facing forward, parallel with the other wheels of the car.
2. Attach a force probe to the LabPro interface and open LoggerPro. The software should sense the force probe and adjust accordingly (consult your TA or instructor if you have any problems).
3. Hook the force probe onto the front of the fuel cell car. Hit "Collect" and drag your car along the floor using the force probe.
4. Determine the friction of the floor by finding the average force needed to pull your car along the floor.
5. Recharge your fuel cell using the same method as the previous lab.
6. Set your car on the floor and mark the starting point.
7. Start your car and measure the distance it goes. How much energy did it take the car to go that distance? What is the efficiency of the car?
8. To test the loss of energy due to friction, run the charged fuel cell on the tile without calculating friction with the force probe. Compare results with the data from the previous lab to see how much energy is lost due to friction.

Race

1. Your instructor will set up a race course. The time of the race will start when you begin charging your fuel cell and end when the car is completely across the finish line.
    a. HINT: Calculate how long you need to charge the fuel cell so it has just enough energy to cross the finish line.

Energy

1. Observe the two different tracks, one a long, straight, flat track and the other a shorter track with an incline.
2. Predict which track will take less energy for the fuel cell car to complete. Explain.
3. Charge your fuel cell car and calculate the amount of energy it takes for the car to complete both tracks. Was your prediction correct? Which track took less energy for the fuel cell car to complete? Why?

Methanol Fuel Cell

1. Partner up with another group.
2. Have one pair use a methanol fuel cell rather than a hydrogen fuel cell.
3. Charge the methanol fuel cell using the same technique described in the previous lab.

4. Race both cars. Do they both run for the same amount of time? What happens if you start the time right as you begin charging the cells as you did in the race?

Dismantling a Fuel Cell

1. Obtain a fuel cell to dismantle from your instructor.
2. Use a wrench to dismantle the fuel cell.
3. When the fuel cell is completely taken apart, lay the parts out and sketch each part on a piece of paper.
4. Label each part of the fuel cell on your paper.
5. Reassemble the fuel cell and return it to your instructor.

Solar Energy

1. Set up the circuit used to charge the car with a solar panel rather than the power supply.
2. Begin charging the car. How long does it take for electrolysis to complete?
3. Run the car. Is there any difference from when it was charged using a power supply?
4. What ways could you make the solar panel, fuel cell system more efficient?