UNIT III: Worksheet 2

For each of the problems below, you *must* begin your solution with a force diagram. Some require more than one diagram.

1. A 4600 kg helicopter accelerates upward at 2.0 m/s^2. Calculate the lift force exerted by the air on the propellers.

2. The maximum force that a grocery bag can withstand without ripping is 250 N. Suppose that the bag is filled with 20 kg of groceries, and lifted with an acceleration of 5.0 m/s^2. Do the groceries stay in the bag? Justify your answer with calculations.

3. A student, standing on a scale in an elevator at rest, sees that his weight is 840 N. As the elevator rises, his weight increases to 1050 N, then returns to normal. When the elevator slows to a stop at the 10th floor, his weight drops to 588 N, then returns to normal.
   a. Draw position, velocity, and acceleration motion maps for the entire trip

   b. Calculate the acceleration at the beginning and end of the trip.

4. A sign in an elevator states that the maximum occupancy is 20 persons. Suppose that the safety engineers assume the mass of the average rider is 75 kg. The elevator itself has a mass of 500 kg. The cable supporting the elevator can tolerate a maximum force of 30, 000 N. Calculate the greatest acceleration that the elevator's motor can produce without snapping the cable.

For these problems, you will have to use kinematic formulas as well as Newton's 2nd Law.

5. A race car has a mass of 710 kg. It starts from rest and travels 40.0m in 3.0s. The car is uniformly accelerated during the entire time. Calculate the net force acting on the car.

6. Suppose that a 1000 kg car is traveling at 25 m/s (≈55 mph). Its brakes can apply a force of 5000N. Calculate the minimum distance required for the car to stop.

7. A 65 kg person dives into the water from the 10 m platform.
   a. Calculate her speed as she enters the water.

   b. She comes to a stop 2.0 m below the surface of the water. Calculate the net force the water exerts on the swimmer.

8. During a head-on collision, a passenger in the front seat of a car accelerates from 13.3 m/s (≈ 30 miles/hour) to rest in 0.10 s.

   a. Calculate the acceleration of the passenger.

   b. The driver of the car holds out his arm to keep his 25 kg child (who is not wearing a seat belt) from smashing into the dashboard. Calculate the force he must exert on the child.

   c. Calculate the weight of the child.

   d. Convert these forces from N to pounds. (x $\frac{1 \text{ lb}}{4.45\text{N}}$). Justify if the driver can apply enough force to save the child.