Name _____ Date _____ Period _____

Unit 3 Wksht 7: Kinematics & Newton's 2nd Law

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

1. A 4600 kg helicopter accelerates upward at 2.0 m/s^2. (a) What lift force is exerted by the air on the propellors? (b) What if the acceleration changes to 4 m/s^2, what does the lift force need to change to?

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?

3. A student, standing on a scale in an elevator at rest, sees that his weight is 840 N according to the scale. As the elevator accelerates to start rising, his weight increases to 1050 N according to the scale, then returns to normal as the elevator continues to rise at a constant speed. When the elevator slows to a stop at the 10th floor, his weight drops to 588 N according to the scale, then returns to normal when the elevator is at rest. Determine 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. What is the greatest acceleration that the elevator's motor can produce without snapping the cable (assuming the elevator has the maximum occupancy)?

For these problems, you will have to use formulas from Unit 2 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. (a) The car is uniformly accelerated during the entire time. What net force is acting on the car? (b) If the acceleration remains the same but the mass of the car is doubled, how does the force change?

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

7. A 65 kg person dives into the water from the 10 m platform (assume the initial velocity is zero).
   a) What is her speed as she enters the water?
   b) She comes to a stop 2.0 m below the surface of the water. What force did the ***water*** exert 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) What is 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. What force must he exert on the child?
   c) What is the weight of the child?
   d) Convert these forces (weight and F_{arm}) from N to pounds. ($x \frac{1\ lb}{4.45N}$). What are the chances the driver will be able to stop the child?