AP Physics – Linear and Free Fall problems

Show your work, units, and box the answer. All answers must follow significant digits rules.

1. In 1934, the wind speed on Mt. Washington in New Hampshire reached a record high. Suppose a very sturdy glider is launched in this wind, so that in 45.0 s the glider reaches the speed of the wind. If the glider undergoes a constant acceleration of 2.99m/s^2, what is the winds speed? Assume the glider is initially at rest.

2. The fastest speeds traveled on land have been achieved by rocket-powered cars. The current speed record for one of these vehicles is about 1090 km/h, Suppose a car that is capable of reaching a speed of 1090 km/h is tested on a flat, hard surface that is 25.0 km long. The car starts at rest and reaches a speed of 1090 km/h when it passes the 2.00 x 10^4 m mark.
   a. If the car's acceleration is constant, how long does it take to make the 2.00 x 10^4 m drive? (in seconds)
   b. How long will it take the care to decelerate if it goes from its maximum speed to rest during the remaining 5.00 x10^3 m stretch?

3. Mary Rife, of Texas, set a women's world speed record for sailing. In 1977, her vessel, *Proud Mary*, reached a speed of 3.17x10^2 km/h. Suppose it takes 8.0 s for the boat to decelerate from 3.17 x 10^2 km/h to 2.00x10^2 km/h. What is the boat's acceleration? What is the displacement of the *Proud Mary* as its slows down?

4. The skid marks left by the decelerating jet-powered car *The Spirit of America* were 9.60 km long. If the car's acceleration was –2.00 m/s^2, what was the car's initial velocity?

5. The tallest Sequoia sempervirens tree in California's Redwood National Park is 111 m tall. Suppose an object is thrown downward from the top of that tree with a certain initial velocity. If the object reaches the ground in 3.80 s, what is the object's initial velocity?

6. Cages in mine shafts are used to move workers in and out of the mines. These cages move much faster than an commercial elevators. Speeds of up to 65.0 k/h are attained. The mine has a depth of 2072 m. Suppose two cages start their downward journey at the same moment. Cage 1 quickly attains the max speed 65.0 Km/h (an unrealistic situation), then proceeds to descend uniformly at that speed all the way to the bottom. Cage 2 starts at rest and then increases its speed with a constant acceleration of 4.00 x 10^{-2} m/s^2 . How will the trip take for each cage? Which cage will reach the bottom of the mine shaft first?