Drag Force Problems

1. A ball is dropped from 5.0 meters above the ground.
    a. Calculate the time it would take for the ball to reach the ground if there is no air resistance.
    b. Compare this to the time when air resistance is present.

2. A ball is thrown directly up in the air. If there is air resistance:
    a. Compare the maximum height to the case where there is no air resistance.
    b. Compare the time to reach the top of the motion to the case where there is no air resistance.
    c. Compare the speed of the ball at the bottom of the motion to the case where there is no air resistance.

3. The Pumpkin Chunkin world record is 1430 meters in Delaware. The Guinness world record for a launched pumpkin is 1690 meters in Moab, Utah.
    a. Explain why the Utah shot would travel a greater distance than the Delaware shot.
    b. Calculate an approximate launch speed of the pumpkin.
    c. On a single picture, sketch the following paths:
        i. Ideal (no air) launch.
        ii. Utah launch.
        iii. Delaware launch.

4. A penny falls from the top of a very tall building.
    a. Draw the free body diagram the instant it is dropped.
    b. Draw the free body diagram when it has reached half of its terminal velocity.
    c. Draw the free body diagram when it has reached terminal velocity.

5. The terminal velocity of a human in the "belly to Earth" position is 55 m s^{-1}. This is based on a 90 kg person. When using the equation $Drag = \frac{1}{2}C\rho A v^2$ we often define a new variable $b = \frac{1}{2}C\rho A$ because these variables typically don't change during the portion of the motion.
    a. For the 90 kg person whose terminal velocity is 55 m s^{-1} calculate the value for *b*.
    b. If the person changes position to the "head down" orientation, they can reach 120 m s^{-1}. Calculate by what factor has the effective cross-sectional area changed to achieve this speed.

6. A car traveling 25 m s^{-1} experiences an air resistance force of approximately 270 N.
    a. Identify the type of force that allows the car to maintain a constant speed.
    b. Calculate the air resistance if the car increases its speed to 30 m s^{-1}.