Physics 1135 Homework #2: 1-d Kinematics - Problems

Recipe for Kinematics Problems:

- Draw a complete diagram. Every symbol you use in your calculation must be defined in the diagram.
- Begin with a starting equation from the equation sheet.
- Work in symbols and derive symbolic expressions before using numerical values.

1. On a planet where the free fall acceleration is 8 m/s^2, a ball is launched vertically upward with unknown velocity. The ball reaches a maximum height of 25 m.
Derive symbolic equations and calculate numerical values for the ball's initial velocity and the time it takes to reach the highest point.

2. A flying dragon is rising vertically at a constant speed of 6.0m/s. When the dragon is 30.0m above the ground, the rider on its back drops a small golden egg which, subsequently, is in free fall.
a) What is the maximum height above the ground reached by the egg?
b) How long after its release does the egg hit the ground?
c) What is the egg's velocity immediately before it hits the ground?
d) Sketch, qualitatively, position, velocity, and acceleration of the egg as functions of time.

3. A truck that had been waiting at a traffic light starts with a constant acceleration of 3m/s^2 as soon as the light turns green. At the same instant, a car traveling with a constant speed of 20 m/s passes the truck.

a) Write equations for the position of the car and for the position of the truck as functions of time, respectively.
b) At what time does the truck overtake the car, and how far from the starting point does this happen? (Hint: positions are equal.)
c) What is the truck's velocity when it passes the car?
d) Sketch, qualitatively, the position-vs-time graph and the velocity-vs-time graph for both vehicles.

4. A helicopter is starting from rest at the ground and is taking off with a constant vertical acceleration of 5m/s^2. 10s after the start, the helicopter runs out of fuel and the engines shut off.
a) Find the height and speed of the helicopter at the instant the engines shut off.
b) What is the maximum height reached by the helicopter? (Hint: The acceleration changes.)
c) Sketch, qualitatively, position, velocity, and acceleration as functions of time. Identify the point where the engine shuts off and the highest point.