

Physics 1135 Homework for Recitation 2: 1-d Kinematics - Problems

1. A pickup truck is driving with a constant speed of 20 m/s when it passes a stationary police car. At that moment, the police car starts with a constant acceleration of 4.0m/s^2 .

- How far from its starting point does the police car overtake the truck?
- What is the police car's velocity when it passes the truck?
- Sketch, qualitatively, the position-vs-time graph and the velocity-vs-time graph for both vehicles.

2. A ball is launched vertically upward from the edge of a cliff. The ball reaches its maximum height 1.6 seconds after launch. Barely missing the edge of the cliff as it falls downward, the ball strikes the ground 6 seconds after being launched.

- What was the ball's initial velocity?
- What is the maximum height the ball reached above the cliff?
- How tall is the cliff?

3. 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.

- What is the maximum height above the ground reached by the egg?
- How long after its release does the egg hit the ground?
- What is the egg's velocity immediately before it hits the ground?
- Sketch, qualitatively, position, velocity, and acceleration of the egg as functions of time.

4. The engine of a rocket initially at rest on the ground is ignited, causing the rocket to rise vertically with a constant upward acceleration of magnitude $a=2g$. At altitude L , the rocket's engine shuts off.

- Derive an expression for the speed of the rocket at the moment the engine is shut off.
- To what maximum height H does the rocket rise above its initial position?
- Derive an expression for the total time the rocket is in the air, i.e. from start until it hits the ground.
- Sketch, qualitatively, position, velocity, and acceleration as functions of time. Identify the point where the engine shuts off and the highest point.