PHYS 1410: PHYSICAL SCIENCE (FW 2012/2013)

Additional problem for Oct. 2

A ball is thrown from the ground of planet Exidor at $t = 0$ s, and it follows a parabolic trajectory. The ball's velocity vector at $t = 1.0$ s is $\vec{v}(t = 1.0 \text{ s}) = (2.0\hat{\imath} + 2.0\hat{\jmath})$ m/s. At $t = 2.0$ s the ball reaches its maximum height.

1. Sketch the situation indicating the velocity vectors at $t = 1.0$ s and $t = 2.0$ s.
2. Use Newton's second law to determine the acceleration vector $\vec{a} = a_x\hat{\imath} + a_y\hat{\jmath}$.
3. Show that the ball's velocity vector has the form

   $$\vec{v}(t) = v_0 \cos\theta\hat{\imath} + (v_0 \sin\theta - gt)\hat{\jmath},$$

   where v_0 is the initial speed and θ the launch angle.
   Hint: check $\vec{v}(t = 0)$ and show that $\frac{d}{dt}\vec{v}(t) = \vec{a}$.
4. Use the above information on the velocity to obtain the values of g on Exidor, θ, and v_0.
5. At what time will the ball hit the ground?
6. What is the range of the ball (i.e., the horizontal distance travelled)?