Use calculus to solve each of the following problems. Show your work neatly organized.

1. A particle moves on a straight line with acceleration a = 8 – 6t (ft/s^2), where t ≥ 0. If it is 3 feet from a fixed point P on the line when t = 1s and 12 feet from P (in the same direction) when t = 4s, then how fast is it moving when t = 2s?

2. A stone is propelled downward from a point that is 200 feet above the ground. If the initial velocity of the stone is 40 fps, then a) how long will it take for the stone to hit the ground, and b) what will be its speed as it hits the ground?

3. A girl wants to throw a ball up to a window that is 60 feet above her head. What is the minimum upward speed needed for the ball to reach the height of the window?

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4. The acceleration of a particle is proportional to the square root of the time t (in seconds) where t ≥ 0. If the particle starts from rest and is going 12 fps after 4 seconds, then how far will it move during the first 9 seconds?

5. A particle moves on the x-axis in such a way that its x-coordinate at time t (in seconds) where t ≥ 0 is given by the equation $x = t^3 - 7t^2 + 10t$. When does it go through the origin and what is its speed then?