## Supplementary Problem III for Physics 6 (from an old exam)

In the 2006 Winter Olympics, Thomas Morgenstern of Austria won a gold medal in one of the ski jumping events; his longest jump was R = 140.0 m. The picture below shows a simplified diagram of his jump. (It's not to scale.)



He takes off from point A at an angle of  $\alpha = 15.0^{\circ}$  above the horizontal, with an initial speed  $v_0 = 26.9$  m/s. The dotted curve roughly shows his trajectory; he lands at point B. Notice that the landing hill is curved, and is quite steep near point B. You should ignore air resistance in this problem.

a) How long is he in the air? (That is, how long does it take him to get from A to B?)

b) Find the magnitude and direction of his velocity just before he lands at B.

c) Based on your answer to part (b), explain why it is safer for ski jumpers to land on a steep slope than on a flat surface. (Hint: a large sudden *change* in velocity requires a large impact force.)

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d) On the axes below, sketch x - t, y - t,  $v_x - t$ ,  $v_y - t$ ,  $a_x - t$ , and  $a_y - t$  graphs for the ski jumper's motion. Mark on each graph the time when he reaches his highest point. Say where you have chosen the origin to be and which direction is positive for each coordinate.

