Épreuve de section européenne

A mathematical analysis of Felix Baumgartner's skydive

On Sunday, October 14th, 2012, Austrian skydiver Felix Baumgartner broke the world records for highest manned balloon flight, highest skydive, and greatest speed achieved without vehicular power. He rode the Red Bull Stratos helium balloon to a height of 39,045 meters above New Mexico before free falling in a pressure suit and parachuting back to the ground. He reached a maximum velocity of 1,342 kilometers per hour after falling for 42 seconds, becoming the first person to travel faster than sound without vehicular power. The free fall lasted 4 minutes and 20 seconds before Baumgartner pulled his parachute.

Now let us compare what happened with the theoretical calculations of what should have happened.

The gravitational attraction felt by Baumgartner was roughly $g = 9.7026\ \mathrm{m.s^{-2}}$ when he started his free fall. The velocity formula $v(t) = v(initial) + g.t$ gives a velocity after 42 seconds of 407.5 meters per second (1,467 kilometers per hour).

This is 9.3% faster than Baumgartner's actual maximum velocity.

From a text written by Matthew Reece
http://www.examiner.com/article/a-mathematical-analysis-of-felix-baumgartner-s-skydive

Questions

1. Check that 1,342 kilometers per hour is about 372.8 meters per second.
2. Why do we obtain a result that is "*faster than Baumgartner's actual maximum velocity*"?
3.
   a. "The velocity formula $v(t) = v(initial) + g.t$ gives a velocity after 42 seconds of 407.5 meters per second". Check that result.
   b. The distance covered in t seconds is given by the formula: $d(t) = \frac{1}{2} g.t^2$. Compute the distance between Felix's position at the beginning of his jump, and his position after the 42-second free fall.
   c. Explain the link between g , $v(t)$, and $d(t)$.