# NEWTON'D 2ND LAW

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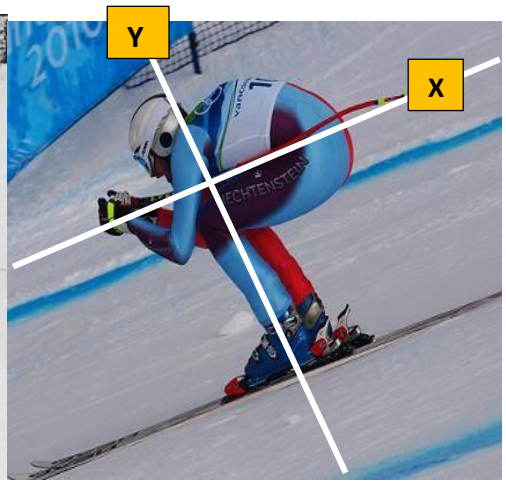
# *Jean Vuarnet, a Downhill Skiing Innovator, Dies at 83*




**Jean Vuarnet of France at the 1960 Winter Olympics in California. He won on metal skis, not the traditional wooden ones.**

**INTRODUCTION:** **Purpose of this application is to show quantitatively that skiing in a tuck position causes a skier to have more speed. Air friction depends on four factors: $F = \frac{1}{2} C \rho A v^2$**
**C = drag coefficient ( usually 0.4 -1.0)**
**ρ = air density , A = frontal area of skier**
**v = velocity of skier**

**QUESTIONS:** **(a) Sketch on diagram at left four vector forces on skier in tuck: (1)Normal force $F_N$ , (2) Air friction force ON skier F, (3) Component of skier's weight [mg sin.Θ] downhill, (4) Component of skiers weight [mg cos.Θ] in y direction ?**

Jean Vuarnet, a Frenchman who **won the gold medal in downhill skiing at the 1960 Winter Olympics using an innovative approach to aerodynamics** and decades later endured the deaths of his wife and his youngest son in a doomsday cult's murder-suicide ritual, died on Monday in Sallanches, France. He was 83. The cause was a stroke, the French National Olympic and Sports Committee announced. Vuarnet was 27 when he arrived in Squaw Valley, Calif., for the 1960 Games. He was not France's best hope for a medal, but **he was a student of skiing technique and had helped write several books on the subject. In search of extra speed, he raced the 10,154-foot course in an unprecedented way — (((with his knees *bent in a tuck position* to reduce the drag on his body from the wind.)))** The tuck requires skiers to squat, with their backs parallel to the slope and their rear ends raised slightly above their heads. The position, which came to be known as l'oeuf ("the egg"), appeared to be revolutionary, but to some, it was more of a variation on earlier racing positions. "The tuck seems so obvious and self-evident that we forget someone had to invent it," Steve Porino, a former downhill racer for the United States team, said in an interview. "You cannot survive without a tuck in ski racing." After winning at Squaw Valley, Vuarnet licensed his name to a popular brand of high-end anti-glare sunglasses. He became the head of Morzine's office of tourism and helped to develop the Avoriaz ski resort in Morzine.

**QUESTIONS CONTINUED:** **(b) "If" the skier is moving downhill at constant velocity, no acceleration exists. Set up Newton's second law equation in the X direction showing what the net force is comprised of? Consider the frictional force equation is $\frac{1}{2} C \rho A_1 v_1^2$ . (c) Same question as (b), but consider frontal area reduced by half to $A_2 = A_1/2$ by going into the tuck position. (d) Find speed $v_2$ ( as a function of $v_1$) if frontal area $A_2 = A_1/2$ (as being in a tuck position)?**

**HINTS:** **$F_{NET} = m a$ ,**

**ANSWERS:** **(a)_____,(b) - $m g \sin\Theta + 1/2 C \rho A_1 v_1^2 = 0$ , (c) – $m g \sin\Theta + \frac{1}{2} C \rho A_2 v_2^2$ , (d) $v_2 = 1.414 v_1$**

**COMMENT:** **As expected, reducing air friction force on skiers body causes the speed to increase since the force downhill is still the same [ m g sin. Θ]. With skier's speed increasing $m g \sin\Theta = \frac{1}{2} C \rho A_2 V_2^2$ . $A_2$ less, $V_2$ bigger.**