Notes for teachers and learners who would like to use this TRZ file.

1. The fy is parameterize for the ease of modelling.

m = mass of human body

A\_h = surface area of human body

A\_p = surface area of parachute

g at 2000 m height

d = density of air

Cd = drag coefficient of human body

Cd2 = drag coefficient of parachute

g2 = g near surface of Earth

T – duration for parachute opening in Model A

Model A(Red): Parachute opens slowly over T seconds

Fy function:

if(t<35,m\*g-A\_h\*0.5\*d\*Cd\*vy^2,if(t<35+T,m\*g-0.5\*d\*Cd2\*(A\_h+(t-35)/T\*A\_p)\*vy^2,if(t<55,m\*g-0.5\*d\*Cd2\*(A\_h+A\_p)\*vy^2,if(vy>0,-m\*g,0))))

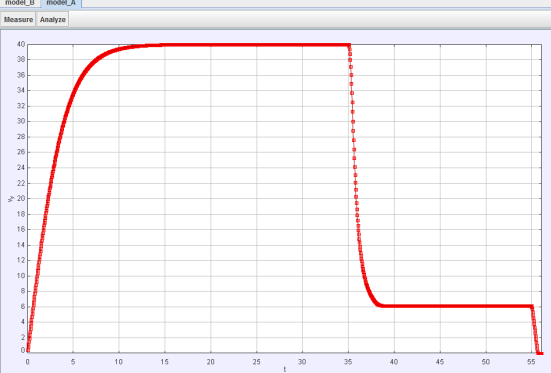
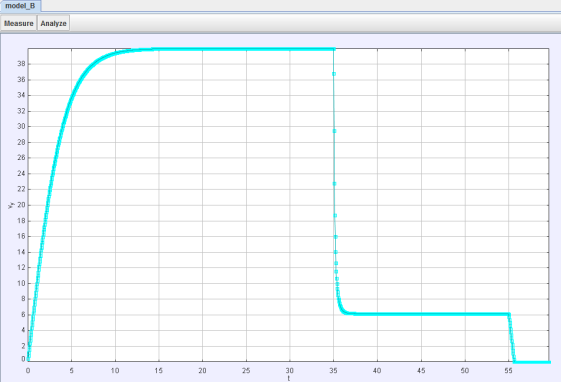
Model B(Blue): Parachute opens fully immediately

Fy function:

if(t<35,m\*g-A\_h\*0.5\*d\*Cd\*vy^2,if(t<55,m\*g-0.5\*d\*Cd2\*A\_p\*vy^2,if(vy>0,-m\*g,0)))

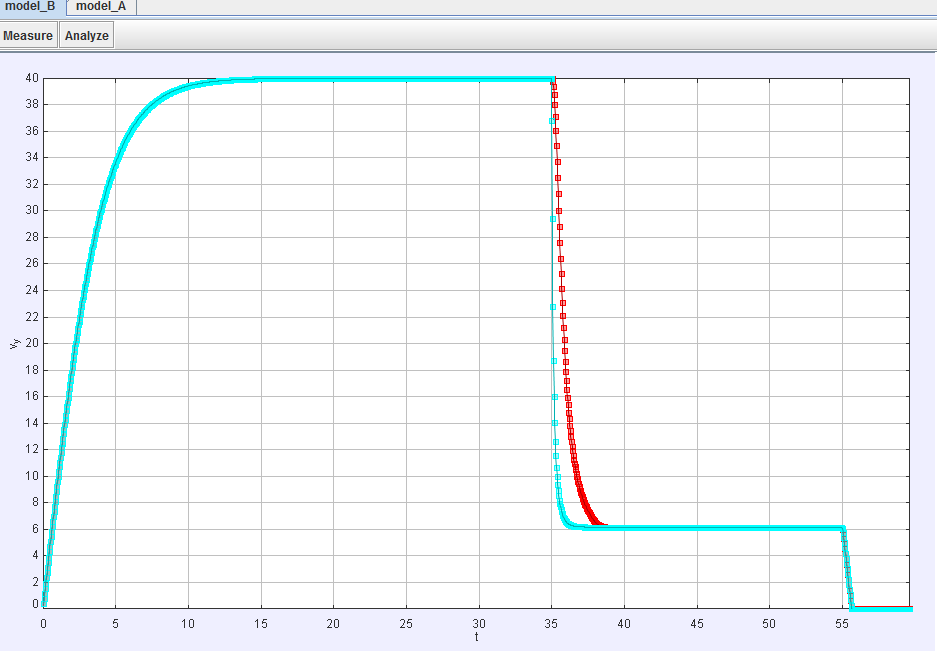
**Velocity-time graph**

Model A Model B

Model B, where the parachutes opens immediately, shows a steeper deceleration due to large upward air resistance, compared to Model A, the parachutes opens in 3 seconds.

Model B compared to Model A

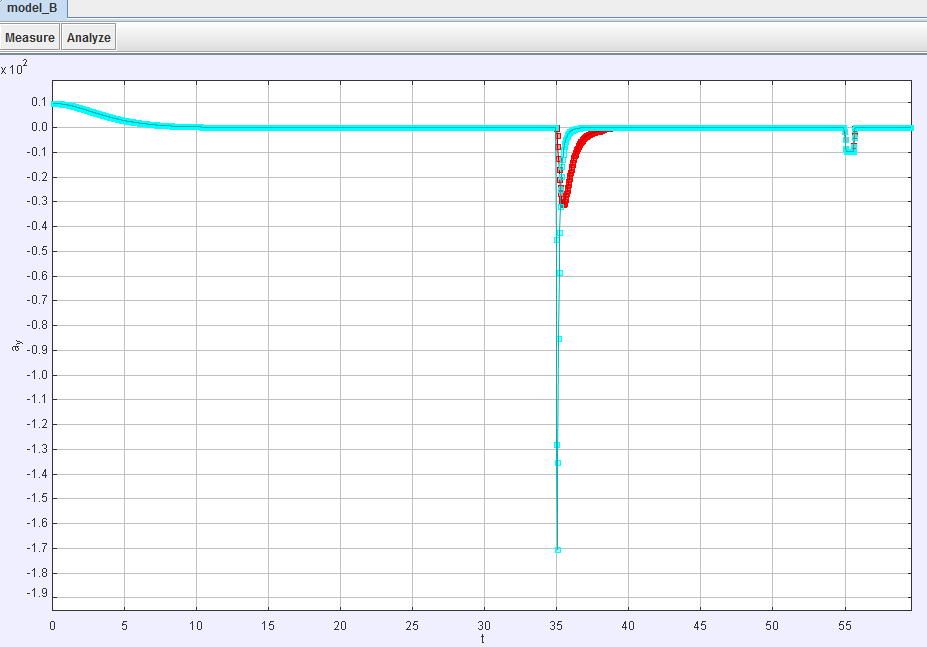


Note: Increasing the parachute opening time shows gentler deceleration. Download the TRZ Tracker file to play with the parameters.

<http://iwant2study.org/ospsg/index.php/interactive-resources/physics/02-newtonian-mechanics/03-dynamics/247-tracker-modelling-skydiving#faqnoanchor>

Acceleration-time graph

Model B compared to Model A



Model B has a deceleration of 17*g*, while Model A’s deceleration is 3.1*g*.

I think it is a bad idea to open the parachute immediate while the parachutist is falling at 40 m/s. In real life, according to a Discovery Education Channel video (<https://www.youtube.com/watch?v=ur40O6nQHsw>), the parachute takes about 2-3 seconds to open fully.

**Ideas for teaching and demonstration:**

Adjusting the parameters and compare the velocity-time graph and acceleration-time graph.

Related Singapore O Level Physics question: **5058/2010/P1 Q3**