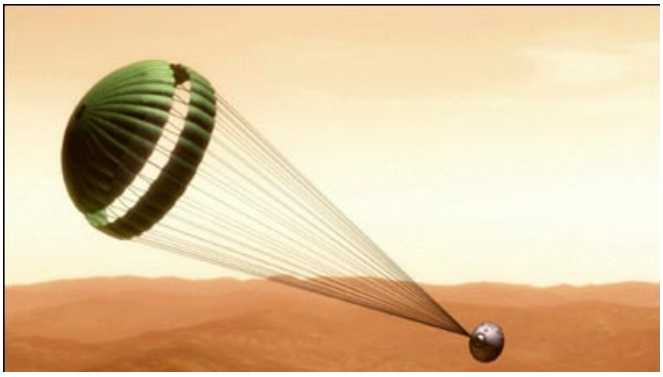
A parachute was used during part of the landing sequence to deposit the *Spirit* rover on the Martian surface. The parachute had a fully-open, projected diameter of 14.1 m and was designed to slow the landing package (lander and rover) to a terminal speed of 65 m/s (retro-rockets were used to bring the landing package to a near zero vertical velocity). If the mass of the landing package was 544 kg, what was the drag coefficient for the parachute? Assume the gravitational acceleration on Mars is 3.72 m/s^2 and that the density of the Martian atmosphere near the surface is 0.016 kg/m^3.



SOLUTION:

At terminal speed, the weight of the landing package must be balanced by the drag acting on the parachute (neglecting the drag on the landing package itself),

$$\sum F_y = 0 = D - W \,, \tag{1}$$

where,

$$D = c_D \tfrac{1}{2} \rho V_T^2 A \,, \tag{2}$$

$$W = mg \,. \tag{3}$$

Substitute and re-arrange to solve for the drag coefficient,

$$c_D \tfrac{1}{2} \rho V_T^2 A - mg = 0 \tag{4}$$

$$\boxed{c_D = \frac{mg}{\tfrac{1}{2} \rho V_T^2 A}} \tag{5}$$

Using the given data,

m = 544 kg
g = 3.72 m/s^2
ρ = 0.016 kg/m^3
V_T = 65 m/s
A = 156.1 m^2 (=π/4*(14.1 m)^2)
$\Rightarrow$ $\boxed{c_D = 0.38}$