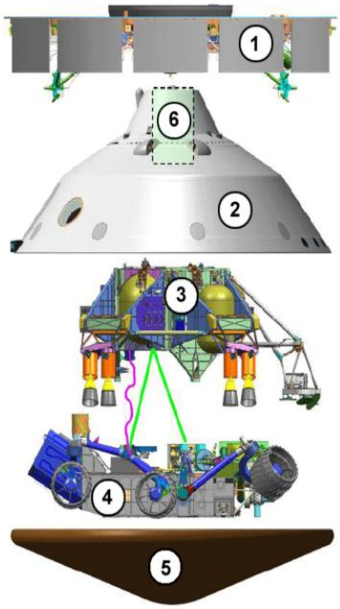
NEWTON'S SECOND LAW*

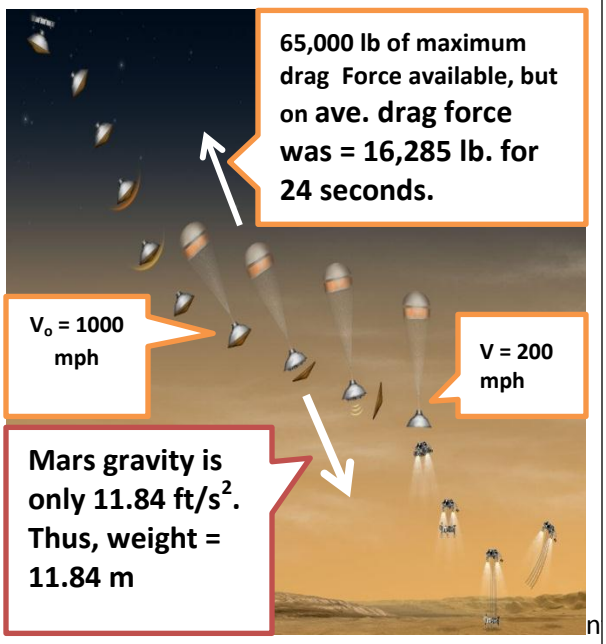
Unit 6 & 7 Dr. John P. Cise, Professor of Physics, Austin Community College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & NYTimes July 31,2012 by Kenneth Chang

View this video first. http://www.youtube.com/watch?feature=player_embedded&v=P4boyXQuUIw

A Drop-In Looking for Signs of Company

Right now, a spacecraft containing Curiosity — a car-size, nuclear-powered planet rover — is coasting at 8,000 miles per hour toward Mars, nearing the end of a journey that began in November. Over the coming week, the pull of gravity will accelerate the spacecraft to 13,000 miles per hour, and early Monday morning Eastern Daylight Time, **it is scheduled to execute a series of astoundingly complicated maneuvers and place the rover on the surface.** In the control room at NASA's Jet Propulsion Laboratory in Pasadena, Calif., it will still be Sunday evening when the nervous wait begins. First will come word that the spacecraft containing Curiosity has entered the Martian atmosphere. Just seven minutes later**, the spacecraft must flawlessly execute a series of complex maneuvers to land the rover on the surface.** If all goes as planned, the friction of Mars' thin air rushing past the heat shield will **have slowed the spacecraft to(((1,000 miles per hour))).** A 51-foot-wide **parachute will pop out, generating up to 65,000 pounds of drag force**. Then the heat shield will pop off so that the radar can find the landing site in Gale Crater. **Even with the parachute drag, the spacecraft will be barreling toward the surface at(((200 miles per hour))).** Next it will cut away the parachute and ignite its descent engines to slow down further. The spacecraft flight system had a **(((weight at launch of (8,580 lb),)))** consisting of an Earth-Mars fueled cruise stage(1), (539 kg (1,190 lb)), **(6,2,5)the entry-descent-landing (EDL) system (2,401 kg (5,290 lb**) + 390 kg (860 lb) of propellant**), and (4)a 899 kg (1,980 lb) mobile rover with an integrated instrument package.**[28][29]





INTRODUCTION: **Newton's 2nd law will be used here to get the mass and weight(as mentioned above)of curiosity spacecraft flight system(as seen in far left graphic). When the parachute opens to slow down the spacecraft it is traveling at 1000 mph. After 24 seconds of an average drag force of 16,285 lb. the spacecraft's speed is 200 mph and the parachute is released from the spacecraft(see middle graphic at left). Take direction of motion as positive.**

PRELIMINARY HINTS: **F_{net} = ma**
a =(v –v_o)/t , 60 mph = 88 ft/s
g_{mars} = 11.84 ft/s^2 , motion direction +

QUESTIONS: **(a) Convert 1000 mph and 200 mph into ft/s? (b) Find the spacecraft's deceleration while the parachute is attached for 24 s? (c)Set up a working equation using Newton's 2nd law applied to this spacecraft as it decelerates due to a net force o:f(1)average drag force of 16,285 lb , (2) pull of mars gravity(weight due to mars)?**

QUESTIONS(CONTINUED): **(d) Using the Newton's 2nd law working equation in question(c) find the spacecraft's mass? (e)Find the Spacecraft's earth weight? (f) Does answer to (e) confirm stated weight in the above article? NOTE: $m_{mars}=m_{earth}$,W_{earth}= m g_{earth} = m 32ft/s^2**

ANSWERS: **(a) 1000 mph = 1466.7 ft/s , 200 mph = 293.3 ft/s**
(b)- 48.9 ft/s^2 , (c) _____, (d)~ 268 slugs, (e)~8578 lb. ,(f) ?