NEWTON'S 2ND LAW & WORK-ENERGY Units 10,11,6,&7

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& New York Times, October 15, 2016 by Jonathan Corum, Dedicated to Dr. Cise's HS Math teacher, 1956 Mr. Lucian, RB HS

The ExoMars Spacecraft Approaches the Red Planet

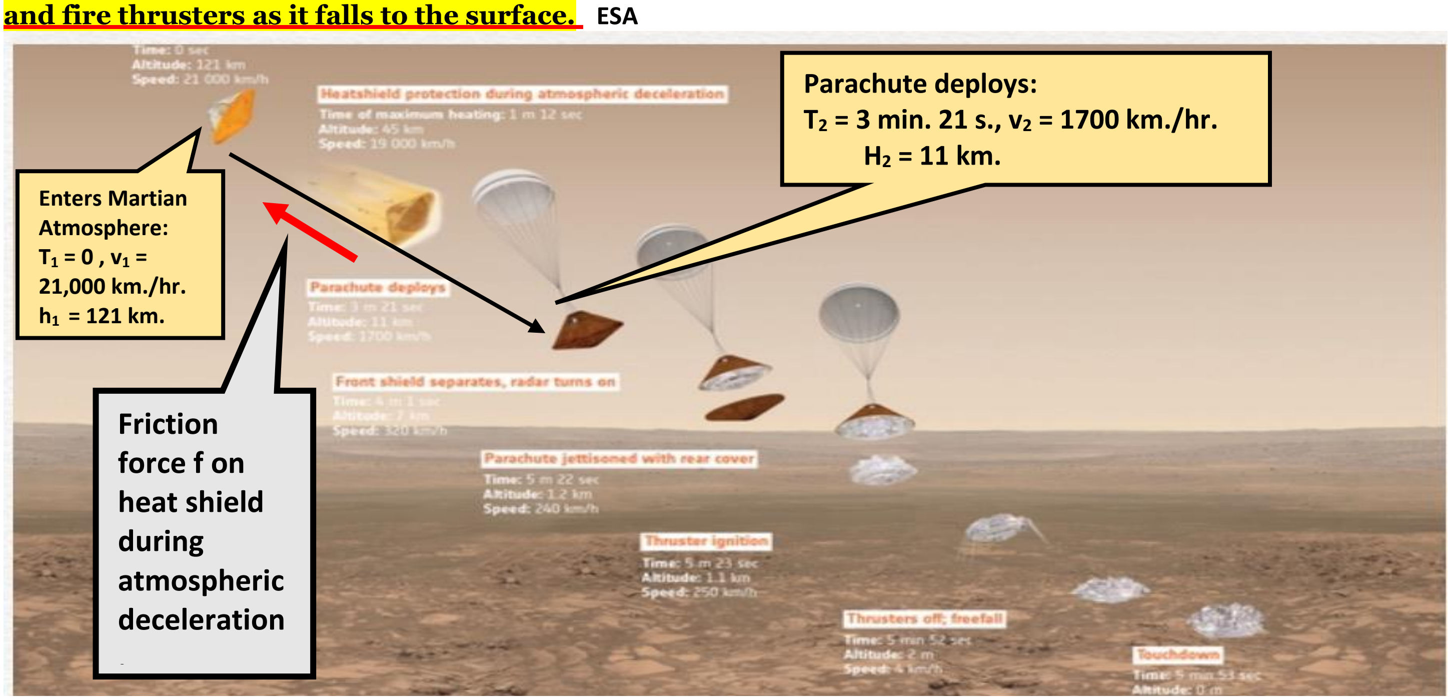
The European-Russian ExoMars spacecraft will release a lander on Sunday. Both spacecraft and lander will arrive at Mars Wednesday.

Schiaparelli lander Trace Gas Orbiter
European Space Agency/ATG Medialab

INTRODUCTION: Oct. 19, 2016, Europe's Schiaparelli lander (m = 600 kg.) will enter Martian atmosphere 5 min. 53 seconds prior to landing on Mars. It's initial speed will be 21,000 km./hr.(v_1) at a altitude of 121 km.(h_1). At 3 min. 21 seconds before landing the Lander will be 11 km. above Martian surface slowed down to 1700 km./hr.(v_2) by atmospheric friction.

QUESTIONS: (a) Convert v_1 & v_2 to m./s. ? (b) Find initial kinetic energy (K_1) and final kinetic energy (K_2) of the lander ?, (c) Find initial gravitational potential energy (U_1) and final gravitational potential energy (U_2) of the lander? CONTINUED BELOW

The ExoMars spacecraft has two components: the solar-powered Trace Gas Orbiter and the Schiaparelli lander. The lander will carve through the atmosphere, release its parachute, separate from its outer shell and fire thrusters as it falls to the surface. ESA



QUESTIONS(CON.): (d) Find work done by atmospheric friction while slowing down the lander capsule? Use work-energy concepts ($W = \Delta K + \Delta U$). (e) Find time in seconds between t_1 and t_2 ?, (f) Find average velocity between t_1 and t_2 ?, (g) Find distance traveled (x) between t_1 and t_2 ? (h) Find atmospheric friction force(f) on Lander?, (i) Find rate of deceleration between t_1 and t_2 ?, (j) Knowing mass m = 600 kg. of lander, find frictional force (f) using Newton's 2nd law …..$F_{NET} = m a$? (k) Comment of frictional force (f) computation by work-energy vs. $F_{NET} = m a$?

HINTS: 0.2777 m./s = km./hr. , $K = ½ m v^2$, $U = m g h$, g(Martian) = 3.711 m./s.^{2} , $W = f x$, $v_{AVE} = (v_1 + v_2)/2$
$X = v_{AVE}\, t$,

ANSWERS: (a) v_1 = 5833.33 m./s. , v_2 = 472.22 m./s., (b) $K_1 = 10.208 \times 10^9$ J , $K_2 = 0.0669 \times 10^9$ J, (c) $U_1 = 0.269 \times 10^9$J , $U_2 = 0.0245 \times 10^9$ J , (d) $W = - 10.3856 \times 10^9$ J , (e) 201 s., (f) v_{AVE} = 6,069.44 ft./s. , (g) $x = 0.633715 \times 10^6$ m (h) f = - 16,388.44 N , (i) a = - 26.67 m./s.^{2} , (j) f = - 16,002 N , (k) f is close in each case. (j) a bit low due to small Martian Gravitational force component in slightly below horizontal direction not considered in $F_{NET} = m a$.