KE + PE
1926.9 + 682

Net Force Calculations via Energy

1. A model rocket with a mass of 0.65kg is fired straight up with a burn of 2.7 seconds. After the burn is complete the rocket is at a height of 105m.
   a. What is the force provided by the rocket engine?
   b. What is the maximum height of the rocket?

$F \cdot d = KE + PE$
$\frac{1}{2}(.65)77^2 + .65 \cdot 10 \cdot 105 = 2609\,J$

$d = \frac{2609}{109}$
$23.9N$

$Energy = PE = mhg$
$2609 = 0.65 \cdot h \cdot 10$
$h = 401m$

$y_f = y_i + v_i t + \frac{1}{2}at^2$
$105 = 0 + 0 + \frac{1}{2}a(2.7)^2$
$a = \frac{105 \cdot 2}{2.7^2} = 28.8\,m/s^2$

$v_f = v_i + at$
$0 + 28.8(2.7) = 77\,m/s$

2. A German V-2 missile is fired straight up. The missile has a mass of 10909kg and its engine can provide 200507N of thrust. $(10909 \cdot 10 = 109090N)$ FW
   a. What is the rocket's speed after traveling for 20sec?
   b. What is the rockets net acceleration?
   c. How much work is done by the engine?
   d. What is the power of the engine?

$v_f = v_i + at$
$0 + 8.37(20) = 167\,m/s$

$a = \frac{\Sigma F}{m} = \frac{(F_a - F_g)}{m}$

$8.37\,m/s^2$

$200507 - 109090 = 91417N$
$\frac{91417N}{10909\,kg}$

$KE + PE = work$
$\frac{1}{2}(10909)167^2 + 10909 \cdot 10 \cdot 1674m \rightarrow 334,737,210\,J$

$Power = Energy/time$
$\frac{334,737,210\,J}{20sec} = 16.7E7J$

height
$y_f = y_0 + v_i t + \frac{1}{2}at^2$
$0 + 0 + \frac{1}{2}(8.37)20^2$
$1674m$

3. A missile leaves the surface of earth at 240m/s.
   a. What is its maximum height?
   b. What will its speed be 100m above the surface?

$KE = PE$
$\frac{1}{2}mv^2 = mhg \quad \frac{v^2}{2g} = h \quad \frac{(240)^2}{2 \cdot 10} = 2880m$

$KE = KE + PE$
$\frac{1}{2}mv^2 = \frac{1}{2}mv^2 + mhg$

Solve
$\frac{1}{2}(240)^2 = \frac{1}{2}v^2 + 100 \cdot 10$
$v = 235\,m/s$

4. A 1000kg car is pushed with 150N for a total of 50M. (Uk = 0.01)
   a. How much energy (work) was used to push the car?
   b. How much work(energy) was done by friction?
   c. How fast is the car going at 50m?
   d. How far will the car roll after the 50m mark?

$F \cdot d = Energy \quad 150 \cdot 50m = 7500\,J$
$mgud = TE \quad 1000 \cdot 10 \cdot .01 \cdot 50 = 5000\,J$
$7500 - 5000 = 2500 = \frac{1}{2}mv^2$
$v = 2.23\,m/s$

$2500J = TE$
$2500 = mgud$
$2500 = 1000 \cdot 10 \cdot (.01)d$
$d = 25m$