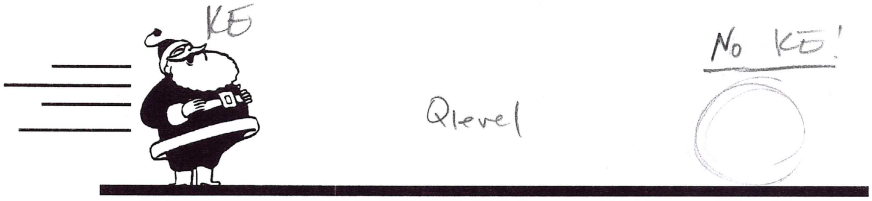
Final Review Installment 3

1. A 120 kg Santa slides at 13 m/s on a patch of ice. How far along the level surface will he travel before coming to a stop? The coefficient of friction is 0.5.



$KE = Q_{level}$

$\frac{1}{2}mv^2 = m \cdot g \cdot \mu \cdot d$

$\frac{1}{2}(13)^2 = (9.8)(0.5)(d)$

$\frac{84.5}{4.9} = \frac{4.9d}{4.9}$

$d = \boxed{17.24 m}$

2. (a) What is the initial KE of a 0.25 mg flea that leaves the ground at a speed of 50 cm/s? (b) How high will the flea go?

PE_g

(a) $KE = \frac{1}{2}mv^2$

$m = (0.25)(10^{-6})$

$m = 2.5E-7\ kg$

$v = 0.5\ m/s$

$KE = \frac{1}{2}(2.5E-7)(0.5)^2$

$KE = \boxed{3.125E-8\ J}$

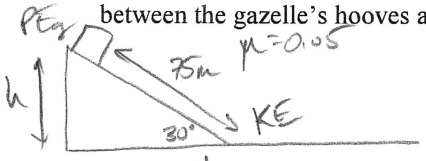
KE

(b) $KE = PE_g = m \cdot g \cdot h$

$\frac{3.125E-8}{(2.5E-7)(9.8)} = \frac{(2.5E-7)(9.8)h}{(2.5E-7)(9.8)}$

$h = \boxed{0.013\ m}$

3. A gazelle initially at rest on a 30 degree incline, slides 75 meters before reaching the foot of the hill. If the coefficient of friction between the gazelle's hooves and the hill is 0.05, how fast will the gazelle be traveling at the bottom of the slope?



$\sin 30° = \frac{h}{75}$

$h = 75 \sin 30°$

$h = 37.5\ m$

$PE_g = KE$

$m \cdot g \cdot h = \frac{1}{2}mv^2$

$(9.8)(37.5) = \frac{1}{2}v^2$

$v = \sqrt{2(9.8)(37.5)} = \boxed{27.11\ m/s}$

4. A 2 g bullet leaves the barrel of a gun at a speed of 500 m/s. If the length of the barrel is 50 cm, find the average force exerted on the bullet by the expanding gases as the bullet moves the length of the barrel.

$M = 0.002\ kg$

$v_f = 500\ m/s$

$v_i = 0\ m/s$

$\Delta x = 0.5\ m$

$a = ?$

$v_f^2 = v_i^2 + 2a\Delta x$

$a = \frac{v_f^2 - v_i^2}{2\Delta x}$

$a = \frac{500^2}{2(0.5)} = 250000\ m/s^2$

$F = m \cdot a$

$F = (0.002)(250,000)$

$= \boxed{500\ N}$

5. A projectile is shot upward from the earth with a speed of 40 m/s. How high is it when its speed is 8.0 m/s?

0 KE + PE

$KE_1 = KE_2 + PE_g$

$\frac{1}{2}mv_1^2 = \frac{1}{2}mv_2^2 + m \cdot g \cdot h$

$\frac{1}{2}(40)^2 = \frac{1}{2}(8)^2 + (9.8)h$

$800 = 32 + 9.8h$

$h = \frac{800 - 32}{9.8} = \boxed{78.37\ m}$

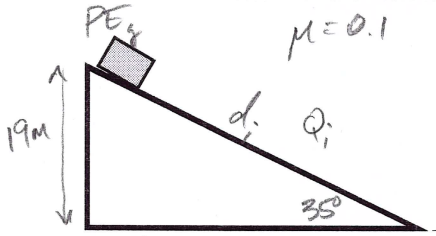
KE

6. What is the spring constant of a spring that stretches 0.25 m when a force of 5 N is placed on it?

$F = -kx$

$k = -\frac{F}{x} = +\frac{5\,N}{0.25\,m} = \boxed{20\ N/m}$

7. A 100 kg mass is 19 meters **high** on a 35 degree incline. The coefficient of friction between the mass and the incline is 0.1. How far from the bottom of the incline will the box come to a complete stop?



$\mu = 0.1$

$PE_g = Q_i + Q_L$

$m \cdot g \cdot h = m \cdot g \cdot \cos\theta \cdot \mu \cdot d_i + m \cdot g \cdot \mu \cdot d_L$

$19 = \cos(35)(0.1)(33.13) + (0.1)(d_L)$

$19 = 2.71 + 0.1\,d_L$

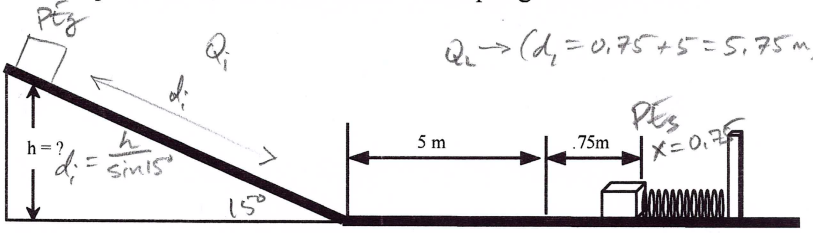
$d_i = \frac{19}{\sin 35°}$

$d_i = 33.13\ m$

$d_L = \frac{19 - 2.71}{0.1}$

$d_L = \boxed{162.9\ m}$

8. How high will the 60 kg box slide up the 15 degree ramp? The coefficient of friction is 0.015 and the distance from the spring's rest position to the incline is 5 m. The spring constant is 600 N/m.



$Q_L \rightarrow (d_L = 0.75 + 5 = 5.75\ m)$

$\mu = 0.015$

$m = 60\ kg$

$k = 600\ N/m$

$PE_s = Q_L + Q_i + PE_g$

$\frac{1}{2}kx^2 = m \cdot g \cdot \mu \cdot d_L + m \cdot g \cdot \cos\theta \cdot \mu \cdot d_i + m \cdot g \cdot h$

$\frac{1}{2}(600)(0.75)^2 = (60)(9.8)(0.015)(5.75) + (60)(9.8)(\cos 15)(0.015)\left(\frac{h}{\sin 15}\right) + (60)(9.8)(h)$

$168.75 = 50.715 + 32.92h + 588h$

$118.035 = 620.92h$

$h = \boxed{0.19\ m}$

The final will be comprehensive. Review the math on these sheets and review your notes. The test will be multiple choice. Some questions will be conceptual and some will involve problem solving. If there is one section that was more difficult than the others spend more time on it.

The questions on these reviews are samples of the types of problems you should be able to solve. Review the formula chart and make sure you know how to apply and solve problems involving any of the listed formulas.

Don't forget to bring your **NOTES** and your **CALCULATOR** to the final.