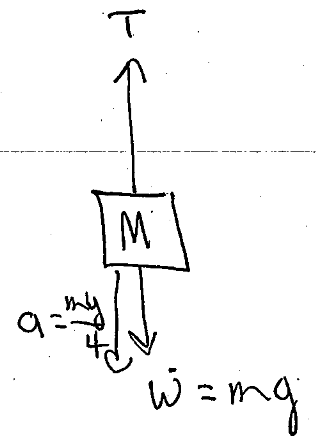
1.) A cord is used to vertically lower an initially stationary block of mass M at a constant downward acceleration of $g/4$. When the block has fallen a distance d find (a) the work done by the cord's force on the block, (b) the work done by the weight of the block and (c) the kinetic energy of the block.



- Work done by each force is

$$W = Fd\cos\theta$$

→ To find T, Note that (taking + direction to be upwards)

$$T - Mg = ma = -M\left(\frac{g}{4}\right)$$

so $T = Mg - M\left(\frac{g}{4}\right) = \frac{3}{4}Mg$

a.) For T, $\theta = 180^\circ$ so

$$W = Td\cos\theta = -Td$$

$$\boxed{W = -\frac{3}{4}Mgd}$$

b.) For the ~~[illegible]~~ weight $\theta = 0^\circ$ so

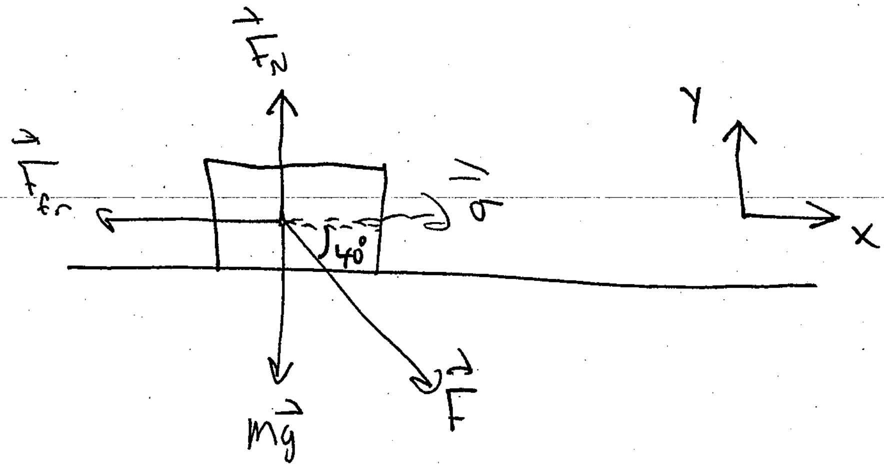
$$\boxed{W = Mg\cos 0^\circ = Mg}$$

c.) Work energy Theorem says $W = \Delta K$

or, since $K_i = 0$ $W = K_f$

$$\boxed{\text{so } W = Mg - \frac{3}{4}Mg = \frac{1}{4}Mg}$$

2.) A 3.5 *kg* block is pushed along a horizontal floor by a force that makes an angle 40° below the horizontal. The coefficient of kinetic friction between the block and the floor is 0.25. What is the acceleration of the block?



– Use $\vec{F} = m\vec{a}$, so first need to find components

	x-comp	Y-comp
$\vec{F}_{fr}$	$-\mu_K F_N$	0
$\vec{F}_N$	0	F_N
$m\vec{g}$	0	$-mg$
$\vec{F}$	$+F\cos 40^\circ$	$-F\sin 40^\circ$
$\vec{a}$	a	0

So x-comp Eqn

$$F\cos 40^\circ - \mu_K F_N = ma$$

Y-comp Eqn

$$F_N - mg - F\sin 40^\circ = 0$$ so

$$F_N = mg + F\sin 40^\circ$$

$$a = \frac{F\cos 40^\circ - \mu_K(mg + F\sin 40^\circ)}{m}$$

$$a = \frac{(15\,N)\cos 40^\circ - 0.25\,\left((3.5\,kg)(9.8\,m/s^2) + (15\,N)\sin 40^\circ\right)}{(3.5\,kg)} = \boxed{0.14\,m/s^2}$$

3.) A particle moves in one dimension and experiences an acceleration that varies with time, given by $a = At + Bt^2$, where $A = 15\ m/s^3$ and $B = 25\ m/s^4$. (a) What is the particles speed after 2 s? (b) How far does it travel between $t = 1\ s$ and $t = 2\ s$? (initial speed is zero)

a.) Since a is a function of time, must integrate to get velocity:

$$V = \int a\,dt = \int (At + Bt^2)\,dt$$

$$V = \frac{1}{2}At^2 + \frac{1}{3}Bt^3 + C$$

– Since $V = 0$ at $t = 0$, $C = 0$

$$V = \frac{1}{2}At^2 + \frac{1}{3}Bt^3 \quad \text{so} \quad V = \frac{1}{2}(15\,m/s^3)(2s)^2 + \frac{1}{3}(25\,m/s^4)(2s)^3$$

$$\boxed{V = 96.7\,m/s}$$

b.) Get position with time from $x = \int V\,dt$

so

$$X = \frac{1}{6}At^3 + \frac{1}{12}Bt^4 + C$$

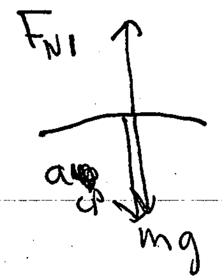
So, distance is $X(t=2) - X(t=1)$

$$d = \frac{1}{6}(15\,m/s^3)(2s)^3 + \frac{1}{12}(25\,m/s^4)(2s)^4 - \frac{1}{6}(15\,m/s^3)(1s)^3 - \frac{1}{12}(25\,m/s^4)(1s)^4$$

$$\boxed{d = \boxed{48.8\,m}}$$

4.) A student with a weight of 800 N is riding on a Ferris wheel that rotates at constant speed. At the top of the ride they experience a normal force of 700 N. What normal force do the experience at the bottom of the ride?

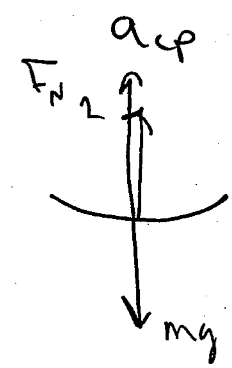
At top



so

$$F_{N1} - mg = -\frac{mv^2}{r}$$

At Bottom



$$F_{N2} - mg = +\frac{mv^2}{r}$$

so from first eqn: $\frac{mv^2}{r} = mg - F_{N1}$

so

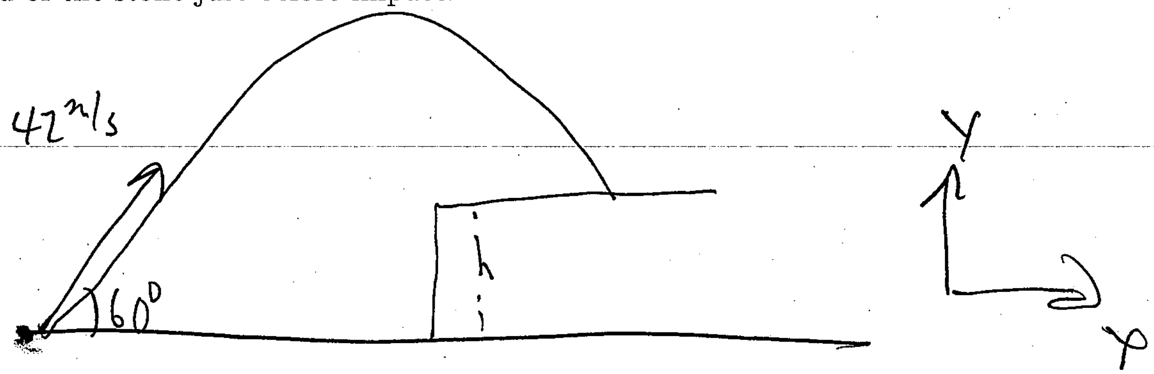
$$F_{N2} - mg = mg - F_{N1} \quad \text{or}$$

$$F_{N2} = 2mg - F_{N1} \quad \text{so} \quad F_{N1} = 700N$$

$$mg = 800\,N$$

$$F_{N2} = 2(800N) - 700N = 900N$$

5.) A stone is projected at a cliff that has a height h above the point from which the stone was launched. The initial speed of the stone was 42 m/s, directed at an angle 60° above the horizontal. The stone lands on top of the cliff 5.5 s after being launched. Find (a) the height of the cliff h, and (b) the speed of the stone just before impact.



a.) The y-component Equation is

$$y = y_0 + V_{0y}t - \frac{1}{2}gt^2 \quad \text{with}$$

$$y - y_0 = h \qquad V_{0y} = (42\,m/s)\sin 60^\circ = 36.4\,m/s$$

so

$$y - y_0 = h = V_{0y}t - \frac{1}{2}gt^2 = (36.4\,m/s)(5.5\,s) - \frac{1}{2}(9.8\,m/s^2)(5.5\,s)^2$$

$$\boxed{h = 52\,m}$$

b.) x-comp Eqn $V = V_{0x}$ y-comp $V_y = V_{0y} - gt$

So, with $V_{0x} = (42\,m/s)\cos 60^\circ = 21\,m/s$

and $V_y = 36.4\,m/s - (9.8\,m/s^2)(5.5\,s) = -17.5\,m/s$

So total speed is $V = \sqrt{V_x^2 + V_y^2}$

$$V = \sqrt{(21\,m/s)^2 + (-17.5\,m/s)^2} = \boxed{27.3\,m/s}$$