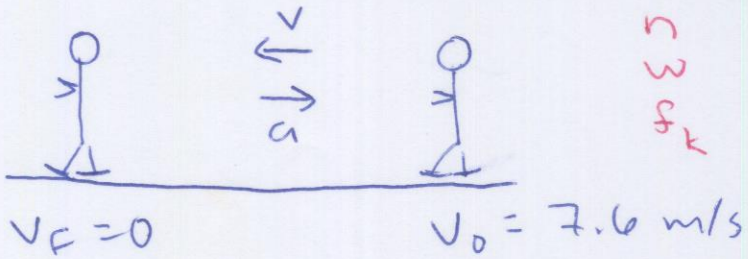
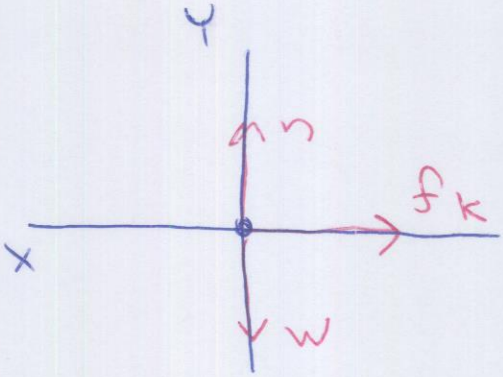
Class Group Problems: ch 5

1. A skater is moving across level ice with a speed of 7.6 m/s. He stops propelling himself and begins to coast. Drag is zero, and the coefficient of kinetic friction between skate blades and ice is 0.10. Find
   a. the skater's acceleration
   b. the distance he glides before coming to a stop.





a. $\Sigma F_x = ma_x$

$-f_k = ma_x$

$\mu n = ma_x$

$-\mu(mg) = ma_x$

$\Sigma F_y = ma_y$

$n - w = 0$

$n = mg$

$a_x = -\mu g = -(0.10)(9.8\ m/s^2)$

$a = -0.98\ m/s^2$ <$a_y = 0$, so this is total a>

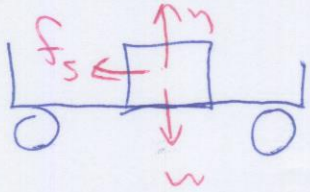
b. $v_F^2 = v_0^2 + 2a\Delta x$

$0 = (7.6\ m/s)^2 + 2(-0.98\ m/s^2)\Delta x$

$\Delta x = 29.5\ m$

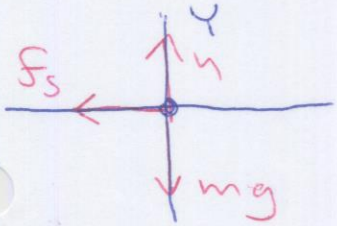
Class Group Problems: ch 5

2. A truck is traveling at a speed of 25 m/s along a level road. A crate is resting on the bed of the truck, and the coefficient of static friction between crate and truck bed is 0.65. What is the shortest distance in which the truck can come to a stop without causing the crate to shift relative to the truck?



$\rightarrow v_0 = 25$ m/s

$\leftarrow$ accel of truck. Crate must have same accel to move with it. Otherwise crate slides forward. So f_s must be opposing this slide as drawn.



$\Sigma F_x = ma_x$

$f_s = ma_x$

$\mu_s n = ma_x$

$\mu_s (mg) = ma_x$

$a_x = \mu_s g = (0.65)(9.8\ m/s^2)$

$a_x = 6.37\ m/s^2$ in dir opposite velocity.

$\Sigma F_y = ma_y$

$n - mg = 0$

$n = mg$

Kinematics: $v_0 = +25$ m/s

$v_F = 0$

$a = -6.37\ m/s^2$ $\rightarrow$ Opposite v!

$v_F^2 = v_0^2 + 2a\Delta x$

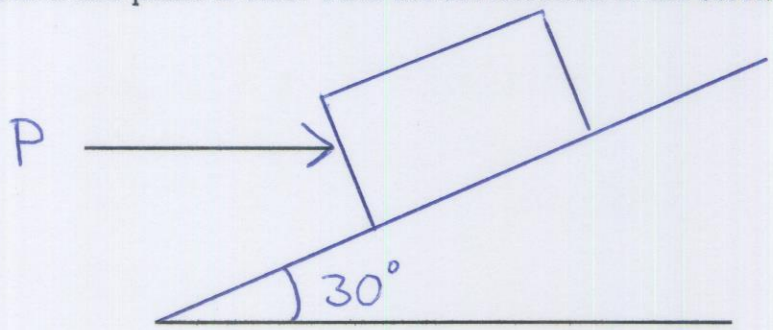
$0 = (25)^2 + 2(-6.37)\Delta x$

$\Delta x = 49$ m

Group Problems 5.2

Follow the method used in your Dynamics Worksheets on all problems.

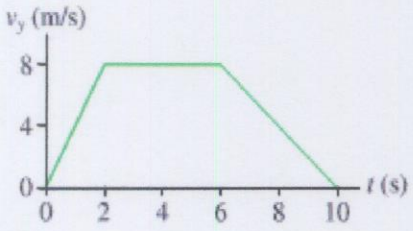
1. A block (mass = 5.0 kg) is being pushed up an inclined plane. The pushing force P is directed horizontally, as shown, and has a magnitude of150 N. The coefficient of kinetic friction between block and plane is 0.63. Find the acceleration of the block.



2. The graph shows the velocity graph of a 75 kg passenger in an elevator.

a. If Up if defined as the positive direction, describe this passenger's journey: does he go up and come back down? Just up? Just down?

b. What is the passenger's apparent weight at t= 1.0 s? At 5.0 s? At 9.0 s?

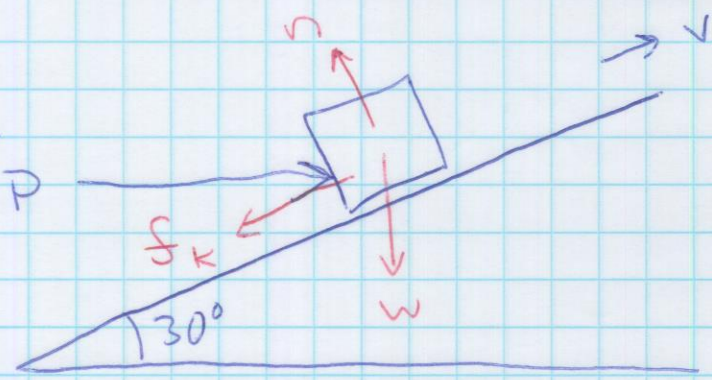


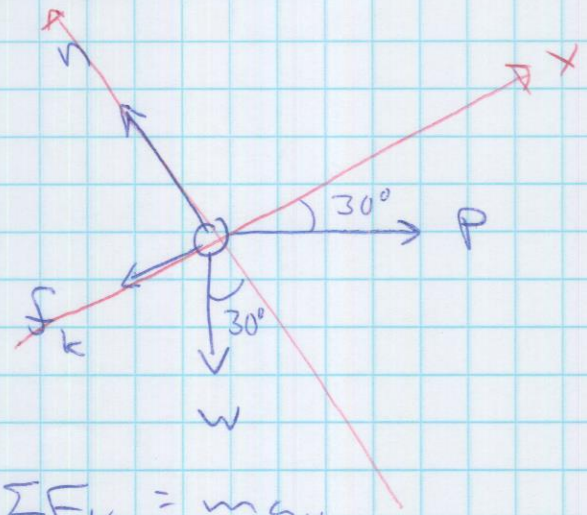
3. A penguin slides at a constant speed down a snowy slope which is angled at 6.9° above the horizontal. At the bottom of the slope, the penguin slides onto a level stretch of snow. The coefficient of kinetic friction is the same on both slope and level section. How far does the penguin slide along the level before coming to a stop?

Hints: 1. Physical conditions on the slope are not the same as on level. This is a two-part problem.

2. There is one quantity which the problem says is the same in both parts. What is it? Can you solve for it?

11.





$\Sigma F_x = ma_x$

$-f_k + -W\sin 30^\circ + P\cos 30^\circ = ma_x$

$-\mu n - mg\sin 30 + P\cos 30 = ma_x$

$\Sigma F_y = ma_y$

$n - W\cos 30^\circ - P\sin 30^\circ = 0$

$n = mg\cos 30 + P\sin 30$

$n = (5.0)(9.8)\cos 30 + 150\sin 30$

$n = 117.4\ N$

$-(0.63)(117.4) - (5.0)(9.8)\sin 30 + 150\cos 30 = (5.0)a$

$-74.0 - 24.5 + 130 = 5.0a$

$a = 6.3\ m/s^2$

2. a. From graph: v is always +.
This journey is up only.

b. $0 \to 2$ s: $v_0 = 0$, $v_f = 8$ m/s, $\Delta t = 2.0$ s.

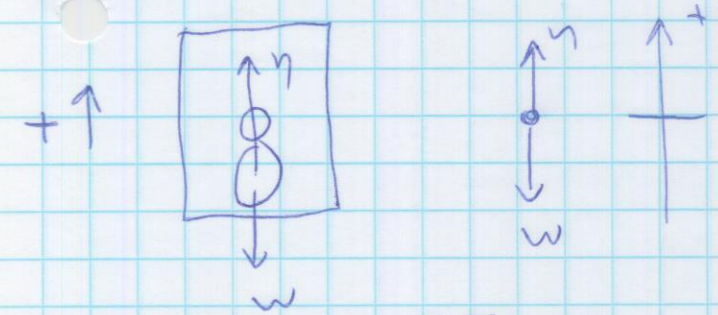
$$v_f = v_0 + a\Delta t$$
$$a = \frac{v_f - v_0}{\Delta t} = \frac{8 - 0}{2.0} = +4 \text{ m/s}^2$$

$2 \to 6$ s: $v = \text{const}$. $a = 0$.

$6 \to 10$ s: $v_0 = 8$ m/s, $v_f = 0$, $\Delta t = 4$ s.

$$a = \frac{v_f - v_0}{\Delta t} = \frac{0 - 8}{4} = -2.0 \text{ m/s}^2$$

All have same Force Diagram:



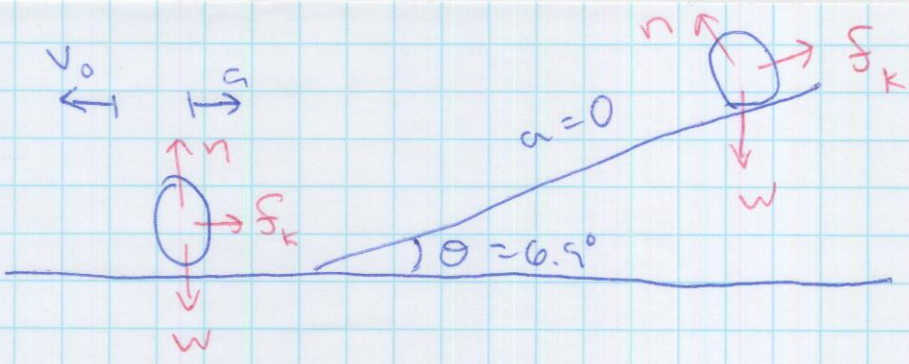
$$\Sigma F_y = ma_y$$
$$n - w = ma_y$$
$$n = w + ma_y$$

$0 \to 2$ s: $n = (75)(9.8) + (75)(+4)$
$n = 1035$ N

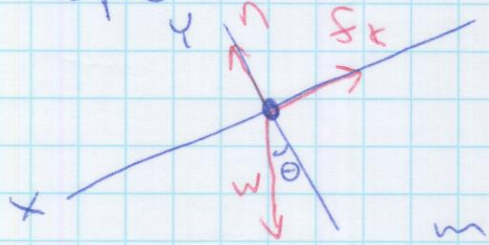
$2 \to 6$: $n = w + 0 = (75)(9.8) = 735$ N

$6 \to 10$: $n = (75)(9.8) + (75)(-2) = 585$ N

3.



Slope:



$\Sigma F_x = ma_x$ $\qquad$ $\Sigma F_y = ma_y$

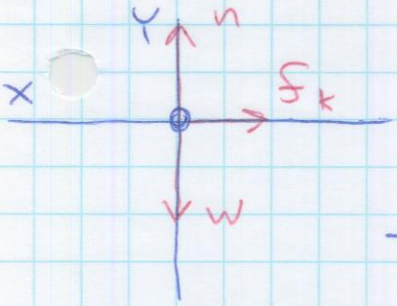
$w\sin\theta - f_k = 0$ $\qquad$ $n - w\cos\theta = 0$

$mg\sin\theta = \mu_k n$ $\qquad$ $n = mg\cos\theta$

$mg\sin\theta = \mu_k mg\cos\theta$

$\mu_k = \tan 6.9^\circ = 0.121$

Horiz:



$\Sigma F_x = ma_x$ $\qquad$ $\Sigma F_y = ma_y$

$-f_k = ma_x$ $\qquad$ $n - w = 0$

$n = mg$

$-\mu_k n = ma_x$

$a_x = -\dfrac{\mu_k n}{m} = -\dfrac{\mu_k (mg)}{m} = -\mu_k g$

$a_x = -0.121\,(9.8\ m/s^2)$

$= -1.19\ m/s^2$

$v_F^2 = v_0^2 + 2a\Delta x$

$0 = (1.4\ m/s)^2 + 2(-1.19\ m/s^2)\Delta x$

$\Delta x = 0.82\ m$