3-27-13 | 3-29-13

Test 2 Review

3-27-13
3-29-13

Quiz 7 due! (only 0.5% deduction 24 hours)

Test 2 preparation:

(A) Existing resources

Lecture notes
examples

Link	Example
3-6-13	Example 4.5
3-11-13	# Example 4.10 # fig 4.30 (a) 4.30 (b) # example 5.4 (included T=0); example 5.10 # Example 5.17 # Summary problem
3-13-13	sec 5.4

T2 REVIEW

LINK	Examples
3-22-13	#31
	#44 3RD and 2ND LAW
	54 $m_s > 0$

Then I set $m_s = 0$, and re-did #54

$m_s \neq 0$:

$$a = \frac{200 - m_B g - m_S g - m_A g}{(m_B + m_S + m_A)}$$

TOTAL inertia!

* $m_s = 0$:

$$a = \frac{200 - m_B g - m_A g}{(m_B + m_A)}$$

*SMALLER TOTAL inertia

Unit

3-22

Example

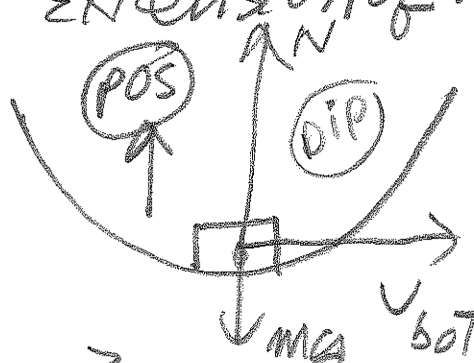
Example 5.23

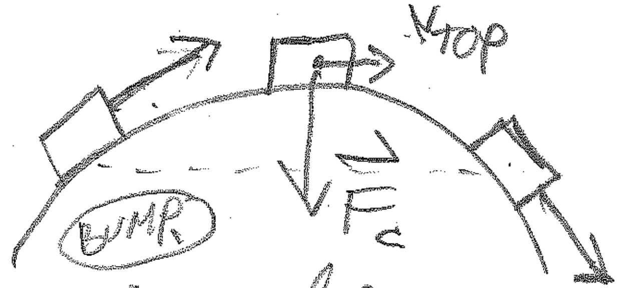
$\vec{F}_c$ = pos - neg

Pos toward center

Activphysics 4.2

Extension of ActPhysics 4.2

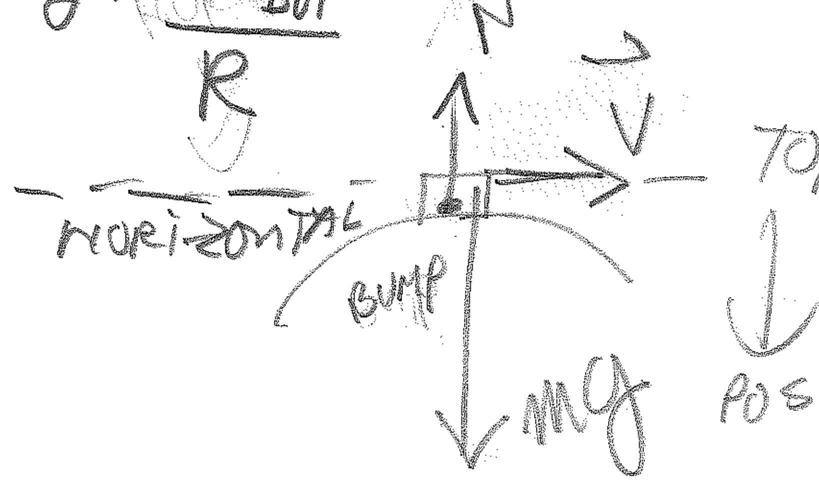




ice cube moving over a frictionless Bump.

$$\frac{mv_{bot}^2}{R} = N - mg$$

$$N = mg + \frac{mv_{bot}^2}{R}$$



TOP: ΣF = pos - neg

$$\frac{mv_{TOP}^2}{R} = mg - N$$

$$N = \frac{mv_{TOP}^2}{R} - mg$$

LINK

3-22-13

Example

CH6: 3 QUICK Examples

(A), (B), (C)

(B.) $W_g = \pm mgh$

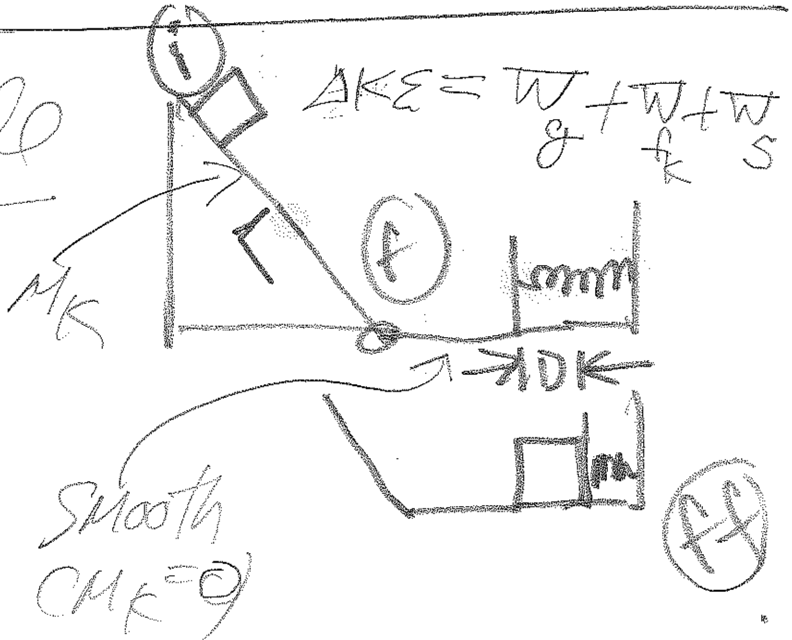
+ high to low

− low to high

(C) $\frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$

MY Example

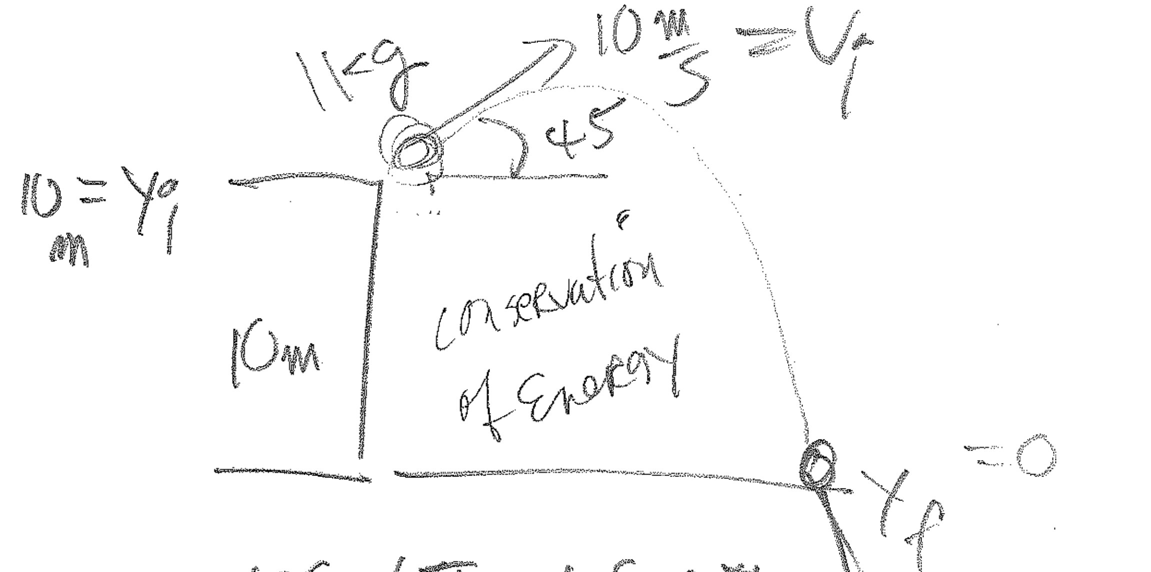
$\Delta KE = W_g + W_{fk} + W_s$



4NK

3-22

Example



$$KE_i + U_i = KE_f + U_f$$

$$\frac{1}{2}mV_i^2 + mgy_i = \frac{1}{2}mV_f^2 + 0$$

$V_f = ?$

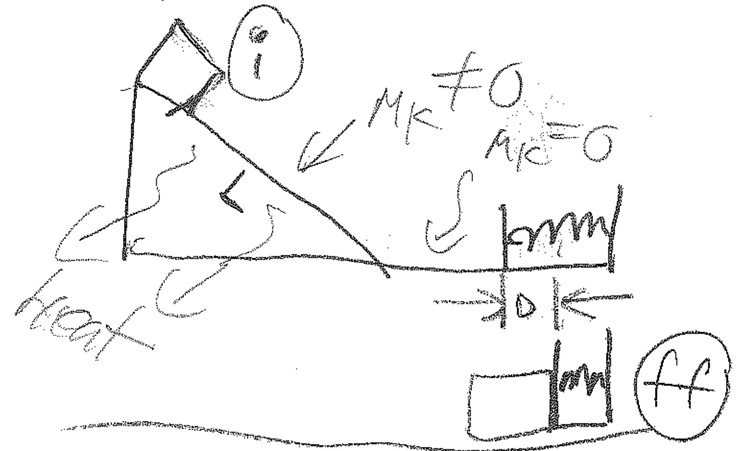
$$V_f = 17.3\ \frac{m}{s}$$

LINK

3-25

Examples

Redo



Use: $W_F + KE_i + mgy_i + \frac{1}{2}kx_i^2$

$= KE_{ff} + mgy_{ff} + \frac{1}{2}kx_{ff}^2 + \text{Heat}$

Heat $= +f_k D$ (if f_k = constant)

Heat $= -W_{f_k}$ (if $f_k \neq$ constant)

$W_F = 0;\ KE_i = 0;\ mgy_i \neq 0;\ KE_{ff} = 0;\ mgy_{ff} = 0;\ U_{ff} = \frac{1}{2}kD^2$

Heat $= f_k \cdot L$

The next section of notes
Examines in detail.

Sample Test 2 au 12 (Quiz 4,5,6)
Sample test 2 Sp 11 (Quiz 5,6,7)
Sample test 3 sp 11 (Quiz 7,8,9)
Sample Test 3 au 12 (Quiz 7,8,9,10)

not on test 2 (momentum)

TEST 2 AU '12

1. (36 POINTS)

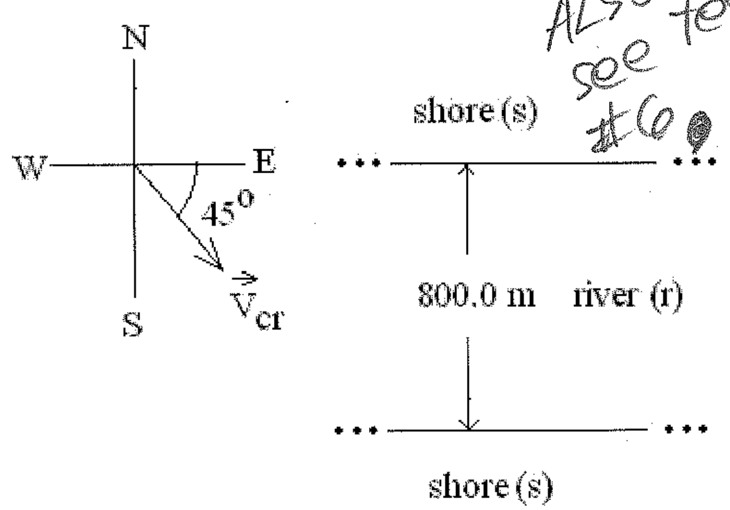
A canoe is on a river that is flowing due EAST with speed V_{rs} *relative to the shore.* River speed V_{rs} = 0.50 m/s. The canoe has a velocity $\vec{V}_{cr}$ with magnitude 0.40 m/s and *direction* southeast *relative to the river.* Let the positive x direction be East and the positive y direction be North. See the schematic of the problem below. The velocity of the canoe relative to the river is sketched in the diagram. SHOW ALL WORK!

Find:

(a) (16 points) the *magnitude* of the velocity $\vec{V}_{cs}$ of the canoe *relative to the shore.*

(b) (16 points) the *direction* of velocity $\vec{V}_{cs}$ of the canoe *relative to the shore.* Find this direction by computing the *angle* between the x axis and velocity $\vec{V}_{cs}$. In what quadrant does $\vec{V}_{cs}$ point? Make a careful sketch.

(c) (4 points) Suppose the river is 800 m wide. Suppose the canoe starts on the northern shore, i.e., upper shore, in the diagram. How long (in seconds) does it take the canoe to cross the river? Convert your answer to hours.



ALSO see test #1 (SP13) #6

MAP → #32 (1D)
#33 (2D)
CH3
Quiz 4

since equation 3.27 does not give that.

29. (NEW ED) SEE LECTURE CLASS EXAMPLES WHERE I SHOWED A PARTICLE IN UNIFORM CIRCULAR MOTION AT 4 OR SO POINTS ALONG THE PATH. SEE ALSO EXAMPLES 3.11 AND 3.12. Remember, the centripetal acceleration vector always points to the *center* of the circle whereas the velocity vector is always *tangent* to path.

For relative motion problems, covered in the next 4 exercises, always remember

$V_{PAx} = V_{PBx} + V_{BAx}$

$V_{PAy} = V_{PBy} + V_{BAy}$,

where we have written the x and y components of the following equation

vector-V_{PA} = vector-V_{PB} + vector-V_{BA} . This simply states that the velocity of a particle P relative to frame A equals the velocity of the particle relative to frame B plus the velocity of frame B relative to frame A. Remember the BART train examples. Let Frame B be the train. Let Frame A be the station, and let P be the person on a skateboard coasting along the floor inside the train. Recall in one example I said if V_{PBx} = 10 mph and V_{BAx} = 80 mph (Bart train's top speed), then V_{PAx} = 90 mph as expected.

32. (NEW ED) You are to find V_{PBx} in three cases when V_{BAx} =13.0 m/s . Discussion of (a) opens the door to the other parts:

(a) $V_{PAx} = V_{PBx} + V_{BAx}$ translates to ~~10~~ 18.0 m/s = V_{PBx} + 13.0 m/s. correction!

Solve for V_{PBx} = 5.0 m/s

(b) Same equation but now V_{PAx} = -3.0 m/s.

(c) Use the same method to reach an obvious conclusion.

33. USE (NEW ED)

$V_{PAx} = V_{PBx} + V_{BAx}$

$V_{PAy} = V_{PBy} + V_{BAy}$, .

A = EARTH FRAME

B = RIVER FRAME

P = BOAT

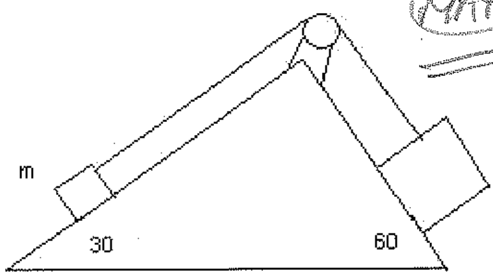
T2, Au '12

2. (36 POINTS)

Two blocks move on a *double* inclined plane. The blocks are connected by a string wrapped around a *frictionless* pulley of negligible mass compared to that of the blocks. Block masses $m = 3.00$ kg and $M =$ 20.0 kg. There is also *no friction* along the surfaces of the double plane. Assume g= 9.80 m/s^2. The angles shown are exact.

* classical!

MAP ⟹ Quiz 5 (CH 4) #23, 43, 54   Quiz 6 (CH 5) #15*, 17, 38, 34, 35, 92*, 68*



cable car THEORY

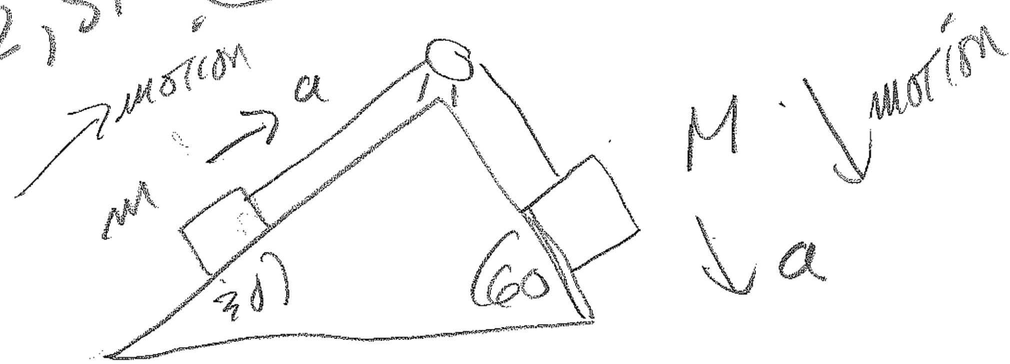
CH 5; #92*, 68*

(a) (16) What is the magnitude of acceleration *a* of the blocks ?
(b) (16) What is the tension T in the string ?
(c) (4) Suppose the two blocks start their motion *from rest* at t = 0. What is the common speed v (in m/s) of the blocks when t = 2.00 seconds

3. (37 points) On the Moon, student astronauts perform a physics experiment inside the laboratory of their parked space ship. A block of mass m is pulled upward along an inclined plane under the influence of an *applied force* of magnitude F and direction parallel to the surface. See diagram below. F = 2.000 x10^2 (N) (about 200 (N)). The incline makes an angle of exactly 30 degrees with the horizontal. Mass m = 5.00 kg.

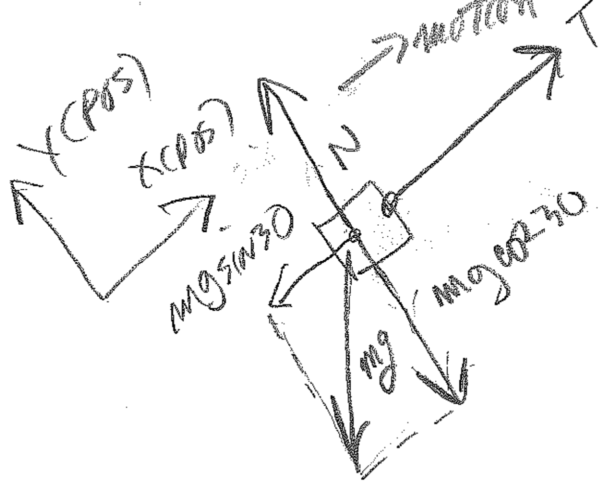
As the box moves up the incline, a friction force of magnitude f_k points opposite the motion. The kinetic friction force magnitude f_k = 4.00 (N). The gravitational force and the normal force are also shown schematically in the diagram below. On the Moon, assume the value of the gravitational acceleration g = 1.60 m/s^2.

au T2, ST2 #2



a = component of acceleration in the x(pos)-DIR.

Isolate m



$\sum F_x = pos - neg$

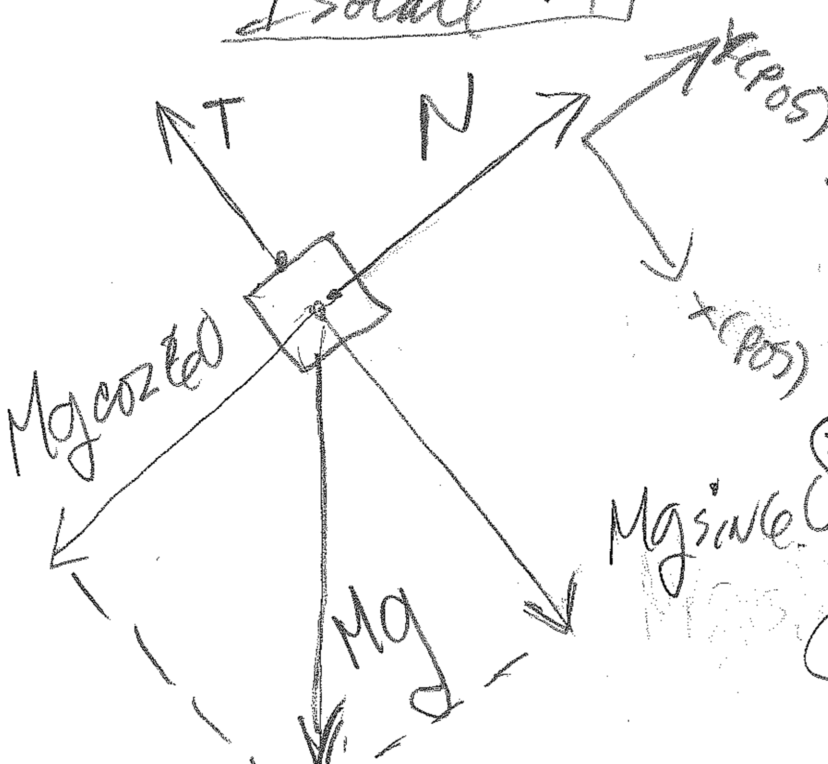
(1.) $\boxed{ma = T - mg\sin 30}$

$\sum F_y = pos - neg$

$0 = N - mg\cos 30$

$N = mg\cos 30$

Isolate M



$\sum F_x = pos - neg$

(2.) $\boxed{Ma = Mg\sin 60 - T}$

$(N = Mg\cos 60)$

$\sum F_y = 0 \Rightarrow N - Mg\cos 60$

$N = Mg\cos 60.$

T2, au 12, #2 a

ADD 2 EQ'S ① + ② cancels T:

$$a = \frac{Mg\sin 60 - mg\sin 30}{(M+m)}$$

$$= \frac{g\cdot\left[(20)(0.867) - (3)\frac{1}{2}\right]}{23}$$

$$= \frac{(9.8)\left[17.3 - 1.5\right]}{23} = 6.7\frac{m}{s^2}$$

makes sense

(b) ① $T = ma + mg\sin 30$

$$= (3)(6.7) + (3)(9.8)\left(\tfrac{1}{2}\right)$$

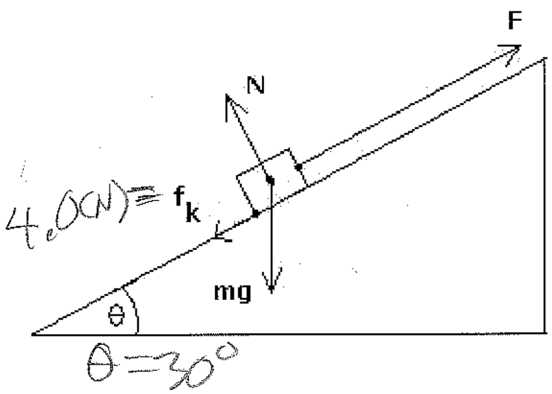
$$T = 20.1 + 14.7$$

$$T = 34.8 (N)$$

3°, ST2, AU12

(a) (30 points) Assuming the positive x-direction is upward along the incline, ***what is the acceleration a_x along the incline?***

(b) (7 points) What is the coefficient of kinetic friction μ_k between the box and incline?



MAP → Quiz 5 (CH4) Quiz 6 (CH5)

#4, 31, 38, 37, 32, 46

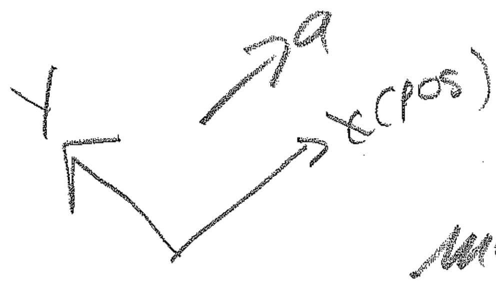
#8, #16, #19, #20, #12.

→ skip

4. (14 points) A place kicker kicks a football from a point a *horizontal* distance of 37.00 m from the goal. When kicked (at t = 0), the ball leaves the ground (at y = 0) with speed 21.00 m/s at an angle of exactly 51 degrees *with the horizontal.* Below is a schematic of the ball's complete path and the ball at the *start* of its motion. The goal location is *horizontally* 37.00 m to the right of the ball shown by the dot • . Assume $g = 9.80\ m/s^2$.

(a) (4 points) What is the vertical height h of the ball when it passes over the goal?
(b) (4 points) What is the y-component of velocity V_y when the ball passes over the goal?
(c) (2 points) What is the x-component of velocity V_x when the ball passes over the goal? Explain.
(d) (4 points) Using the Pythagorean Theorem, find the *speed* of the ball

#3 ST2, on Y2



$$ma = pos - neg$$

$$ma = F - mg\sin\theta - f_k$$

$$g = 1.6\ \frac{m}{s^2}$$

$$(5)(a) = 200 - (5)(1.6)\tfrac{1}{2} - 4$$

$$a = \frac{200 - 4 - 4}{5}$$

$$a = \frac{192}{5}\ \frac{m}{s^2}$$

$$= 38\ m/s^2$$

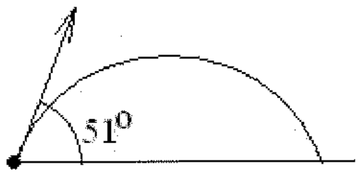
(b) $f_k = \mu_k \cdot N = 4\,(N)$

$$\mu_k = \frac{4(N)}{N}$$

$$\mu_k = \frac{4(N)}{mg\cos\theta}$$

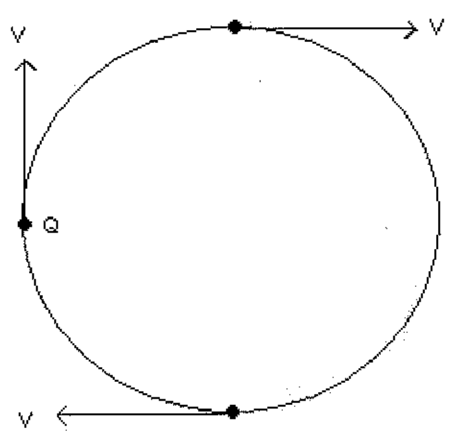
$$\mu_k = \frac{4}{(5)(1.6)(0.867)} = \boxed{0.57}$$

when it passes over the goal.



5. (10 points) see Test #1, Sp13

A 0.385-kg rock is swung in a vertical circular path on a string that is 0.480 m long. Assume the speed v of the rock is 3.90 m/s. Three points on the circular path are shown: the top, the bottom and point Q at the end of a *horizontal*, radial line segment. Assume g = 9.80 m/s^2.



What is,
(a) (5 points) the magnitude a_C of the centripetal acceleration at point Q?

(b) (5 points) the direction of the centripetal acceleration at point Q? Draw an arrow whose tip points in the correct direction.

(c) EXTRA CREDIT (3 points) What is the tension magnitude T in the

string at the bottom?

(d) EXTRA CREDIT (3 points) What is the tension magnitude T at the top?

(e) EXTRA CREDIT (3 points) What is the tension magnitude T at point Q where the rock is in a <u>horizontal</u> position relative to the center.

Short Answers. Multiple choice: Mark your scantron with a #2 pencil.

1. The horizontal component of the velocity of a projectile remains constant during the entire trajectory of the projectile. Neglect air resistance. True or False. (a) True (b) False

2. The vertical component of the velocity of a projectile remains constant during the entire trajectory of the projectile. Neglect air resistance. (a) True (b) False

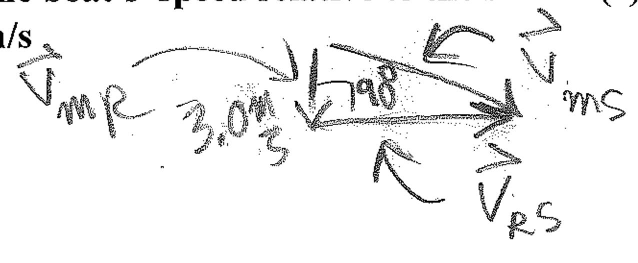
3. A projectile is launched from ground level with a certain speed. For any horizontal range less than the maximum horizontal range, there are two possible launch angles that give the same horizontal range.
(a) True (b) False

4. A projectile is launched from ground level with a certain speed. For the maximum horizontal range, the launch angle is (a) 90 degrees (b) 45 degrees (c) 0 degrees

5. The acceleration of a projectile remains constant during the entire trajectory of the projectile. Neglect air resistance. (a) True (b) False

6. Mary needs to row her boat across a river that is flowing East at 4.0 m/s. When she starts out at the shore, her initial aim direction is North. Mary can row with a speed of 3.0 m/s relative to the water.

What is the boat's speed relative to the shore? (a) 7.0 m/s (b) 1.0 m/s (c) 5.0 m/s



$\vec V_{ms} = \vec V_{mR} + \vec V_{RS}$

$V_{ms}^2 = 3^2 + 4^2 = 25$

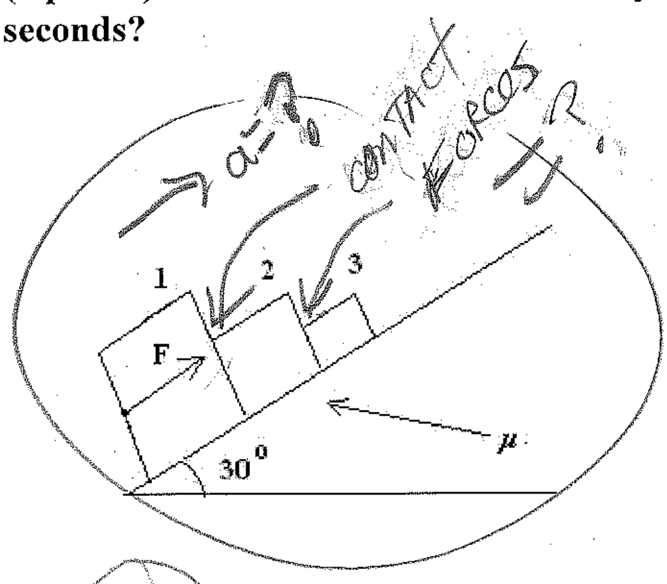
$\rightarrow V_{ms} = 5\frac{m}{s}$

TEST 2 SP'11

1. (40 points) Block 1 , Block 2 and Block 3 are in contact on a table inclined by θ= 30 degrees with the horizontal. Starting from rest, you apply a force to Block 1 of magnitude F = 101.25 N and direction parallel to incline. As shown below, we represent the force's application point with a tail at Block 1's left end. The coefficient of kinetic friction between surface and blocks is μ = 0.15. The block's masses are m_1 = 4.00 kg, m_2 = 2.00 kg and m_3 = 1.00 kg, respectively. To most clearly show your thinking, try to use these and possibly other well established *symbols* until the last step before your numerical answer, which you should box.

For parts (a), (b) and (c) *label* all vector components with symbols.

(a) (3 points) Draw a force diagram for Block 1.
(b) (3 points) Draw a force diagram for Block 2.
(c) (3 points) Draw a force diagram for Block 3.
(d) (11 points) What is the magnitude F_{12} of the force of contact between Block 1 and Block 2.
(e) (11 points) What is the magnitude F_{23} of the force of contact between Block 2 and Block 3.
(f) (5 points) What is the common acceleration of the three blocks?
(g) (3 points) What is the common velocity of the three blocks after 3.00 seconds?



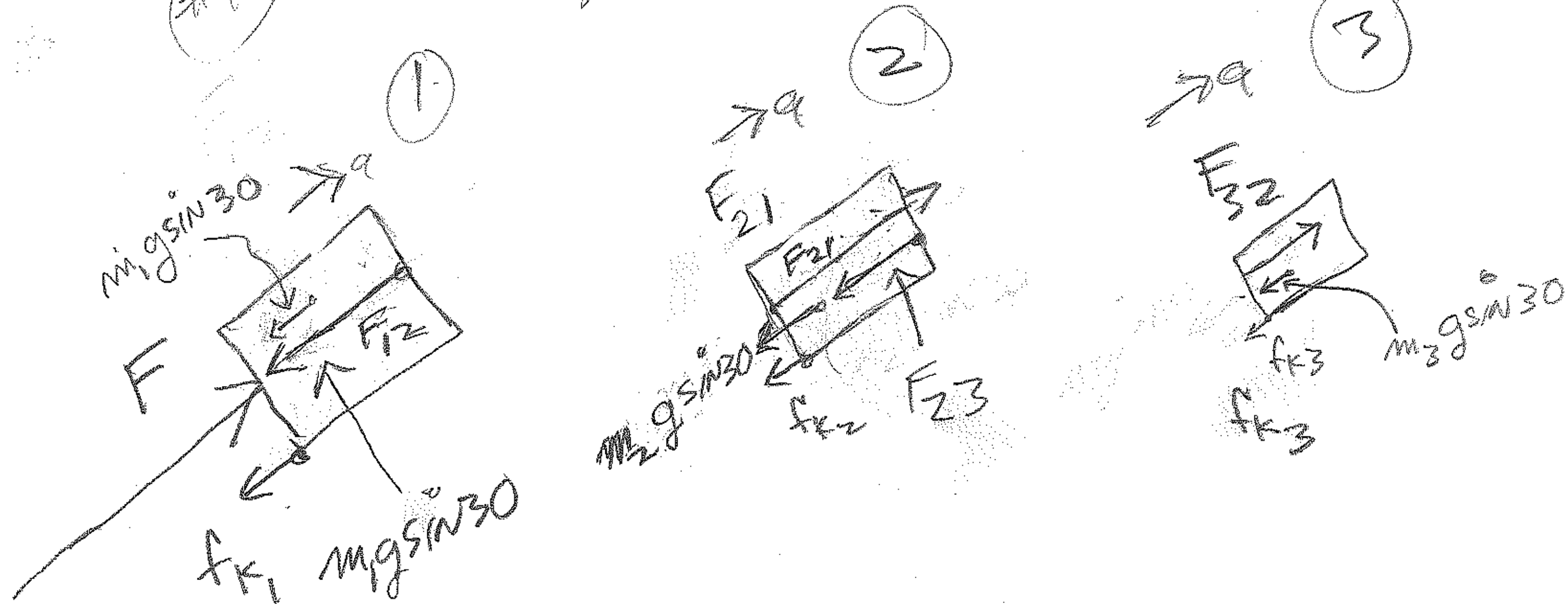
SAME MAP as ST2 Qu 12 #2

SKIP

2. (40 points) This problem deals with a game at an urban golf park. At t = 0, a golf ball is launched from the base of a ramp making a 45 degree angle with the horizontal. The golf ball is launched at *speed* 20.00 m/s at

ST2, SP11

#1



I. $m_1 a = F - m_1 g\sin 30 - F_{12} - f_{K_1}$

II. $m_2 a = F_{21} - m_2 g\sin 30 - F_{23} - f_{K_2}$

III. $m_3 a = F_{32} - m_3 g\sin 30 - f_{K_3}$

$F_{12} = F_{21}$

$F_{23} = F_{32}$

3RD LAW

$N = mg\cos\theta$

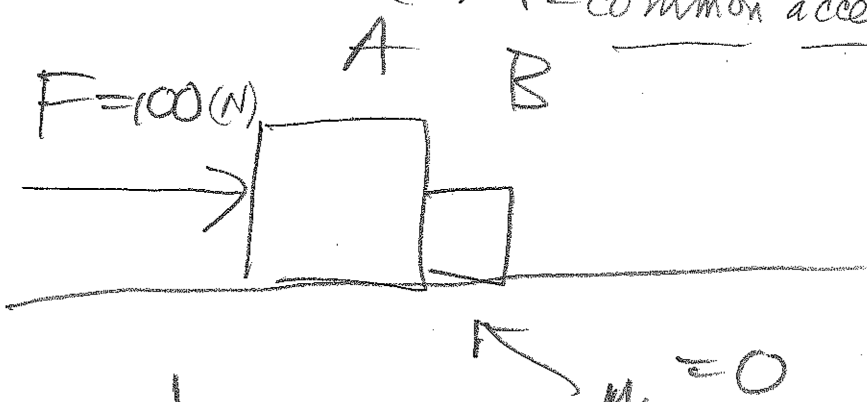
Use $f_K = \mu_K \cdot N$ 3 times

ADD I, II, III to get

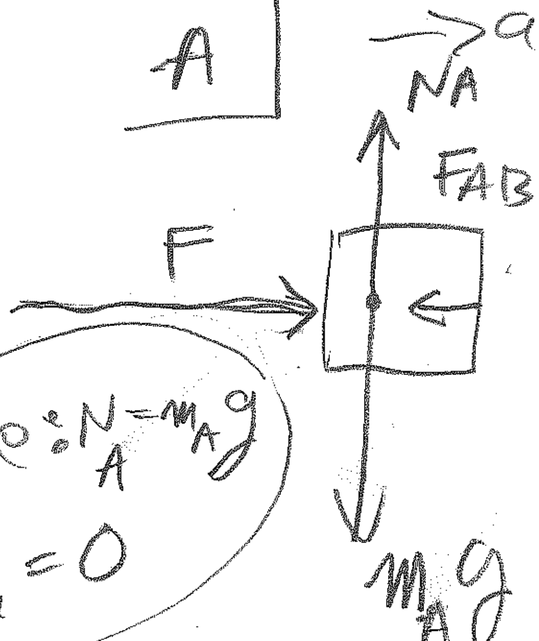
$$a = \frac{F - g\sin 30\cdot(m_1+m_2+m_3) - f_{K_1} - f_{K_2} - f_{K_3}}{(m_1+m_2+m_3)}$$

see #23, Quiz 5

→ a = common acceleration of blocks



A



→ x (pos)

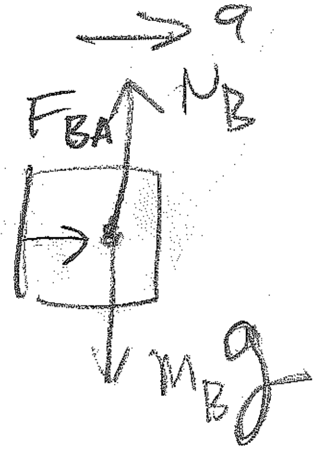
$$\Sigma F_x = \text{pos} - \text{neg}$$

$$m_A a = F - F_{AB} \quad \text{(I)}$$

NOTE: $N_A = m_A g$

$$\Sigma F_Y = 0$$

B



→ x (pos)

$$\Sigma F_x = \text{pos} - \text{neg}$$

$$m_B a = F_{BA} - 0 \quad \text{(II)}$$

NOTE: $N_B = m_B g$

$$\Sigma F_Y = 0$$

ADD (I) + (II) and use $F_{AB} = F_{BA}$

$$\Rightarrow a = \frac{F}{(m_A + m_B)}$$

23, CH 4 (Quiz 5):

$$a = \frac{100}{25} \frac{m}{s^2}$$

$$a = 4 \, m/s^2$$

$$F_{BA} = m_B \cdot a$$

$$= (5)(4) \, (N)$$

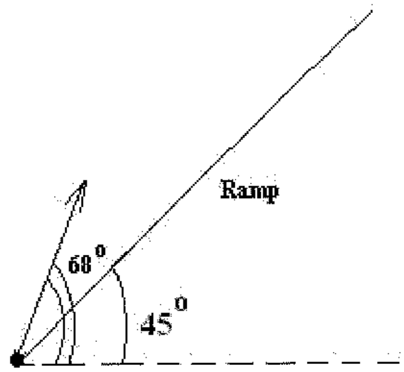
$$= 20 (N)$$

note: $F_{AB} = F_{BA} = 20 (N)$.

ST2, SP11

an angle of 68.0 degrees with the *horizontal.*

(a) (30 points) How far away does the ball land, measured *along the ramp,* from the base ? In other words, what is the distance from the base *along the ramp*?
(b) (10 points) What is the ball's *speed* just before impact with ramp?



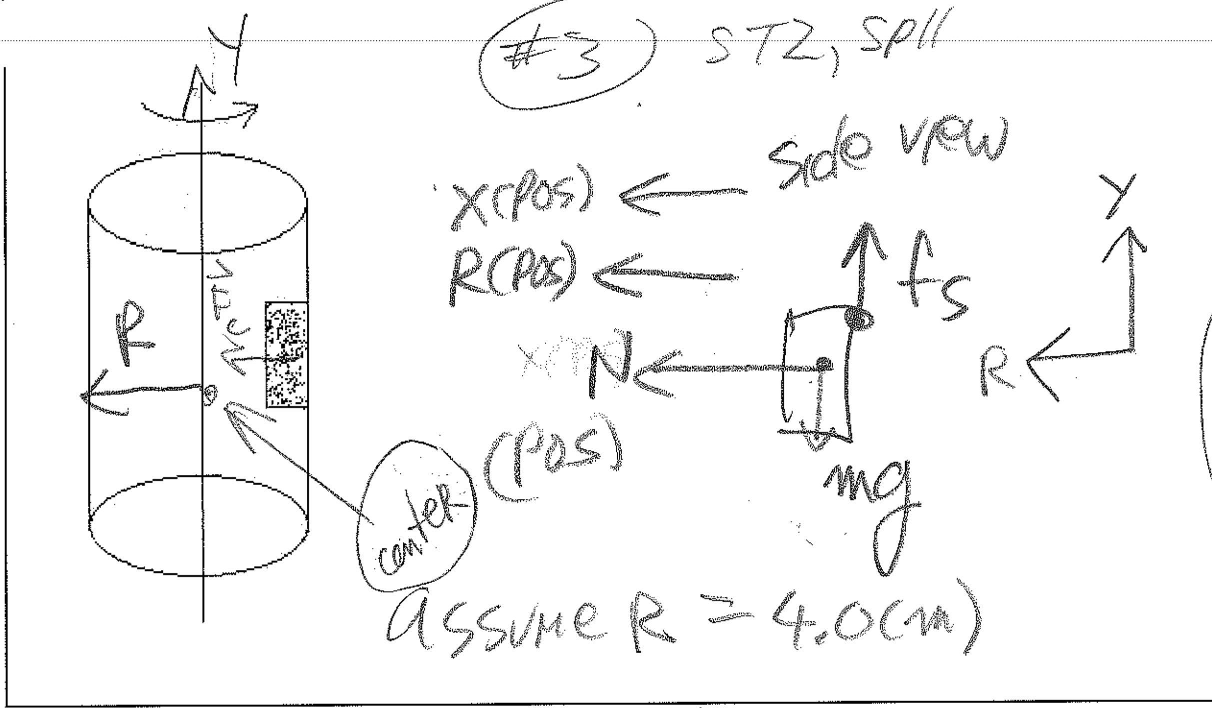
3. (40 points) Below is an engineer's diagram of a "Rotor-ride" at a carnival. People rotate in a vertical cylindrically walled room. A typical person is represented by the grey box. When the floor drops out from under her feet, the person is pinned against the wall and does not slide down as she rotates. Let the coefficient of static friction between person and wall be $\mu = 0.400$.

(a) (4 points) Draw a free body diagram for the person at the moment shown.

(b) (30 points) Find the minimum linear speed V of the person that keeps her from slipping down.

(c) (6 points) Suppose a typical teenager has mass m = 70.00 kg. What would be the magnitude N of the normal force acting on her if she rotated at the speed you computed in part (b)? Does this seem reasonable? Explain.

#3 ST2, SP11



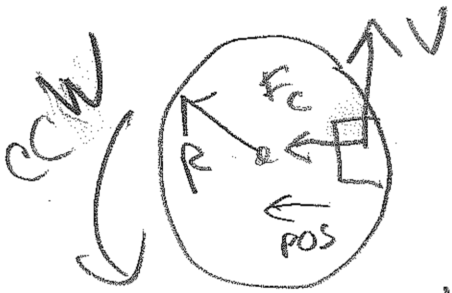
sec 5.4 Quiz

$$\Sigma F_X = pos - neg$$

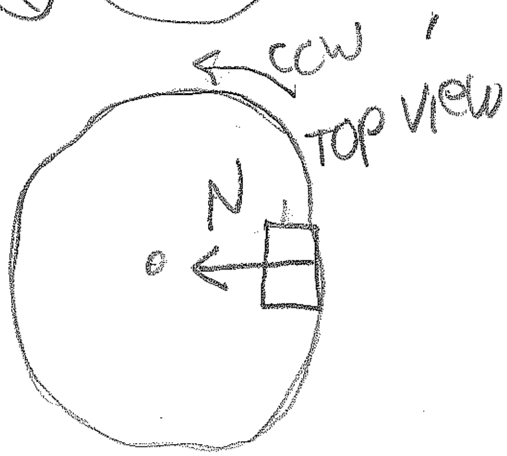
top view

$$F_c = \Sigma F_R = pos - neg$$

$$F_c = \frac{mv^2}{R} = N - 0$$



$$N = \frac{mv^2}{R}$$



$$\Sigma F_Y = pos - neg$$

$$0 = f_s - mg$$

$$f_s = \mu_s \cdot N = mg$$

SUMMARY: $\cancel{m}g = \mu_s \cdot \frac{\cancel{m}v^2}{R} \Rightarrow$ find V.

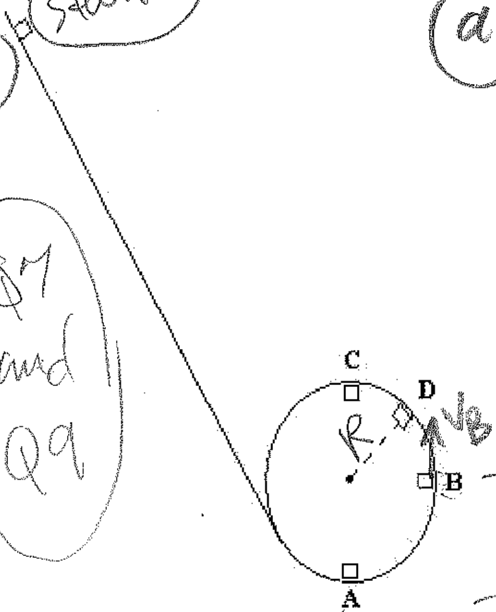
TEST 3 SP '11

1. (40 points) *Testing a car for the Loop-the-Loop ride.*
A un-manned test car whose mass *m* is 250.0 kg rolls *without friction* around a track at Great America amusement park. It starts from rest at the point shown on the inclined ramp. The ramp merges into the vertical circle of radius R = 20.0m m shown. The car rolls down the ramp, rounds the track counter-clockwise and goes through points A, B, D and C in that order of time. At point A, the magnitude N of the normal force on the car is 7 *times* the weight of the car.

CRITICAL info

start

Q7 and Q9



(a.) $N_B = ?$

$N_B = ?$

(pos) R

$\Sigma F_R = pos - neg$

$\frac{mv^2}{R} = N - 0 \Rightarrow \boxed{\frac{mv_B^2}{R} = N_B}$

R

at A

pos

N_A

v_A

mg

$\frac{mv_A^2}{R} = N_A - mg$;

Given:

$N_A = 7mg$

$\frac{mv_A^2}{R} = 6mg$

$v_A^2 = 6gR$

(a) (15 points) What is the magnitude N of the normal force at point B, which is at the end of a *horizontal diameter*?

(b) (15 points) What is the magnitude N of the normal force at point C at the *highest point* on the circle?

(c) (3 points) At point B what is the *magnitude* a_{RAD} and *direction* of the *radial* acceleration ?

(d) (3 points) At point B what is the *magnitude* $|a_t|$ and *direction* of the *tangential* acceleration ?

(e) (4 points) What is the speed of the car at point D where the *dashed* radial line shown makes an angle of *45 degrees with the vertical?*

2. (40 points) At the instant shown, a 2.00-kg block with speed

#1: ST3, SP#

a- $v_A^2 = 6gR$ from $\frac{mv_A^2}{R} = N_A - mg$ given

$= 7mg - mg$

$= 6mg$

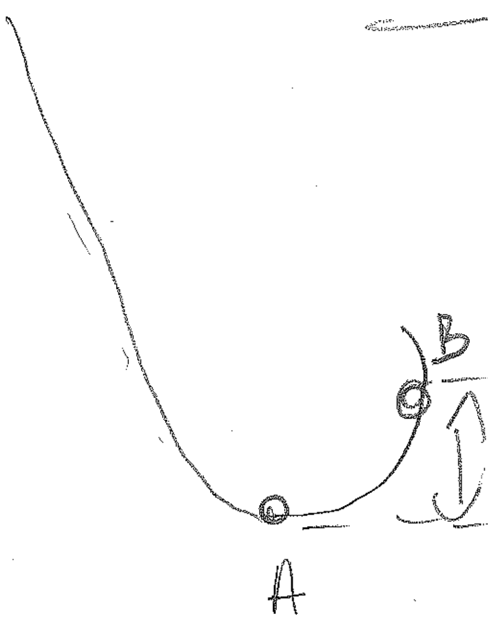
Use conservation of Energy

$KE_A + U_A = KE_B + U_B$

$\frac{1}{2}mv_A^2 + 0 = \frac{1}{2}mv_B^2 + mgR$

$\frac{1}{2}mv_B^2 = \frac{1}{2}mv_A^2 - mgR$

$\frac{1}{2}mv_B^2 = \frac{1}{2}m(6gR) - mgR$



$Y_A = 0 \Rightarrow mgY_A = 0$

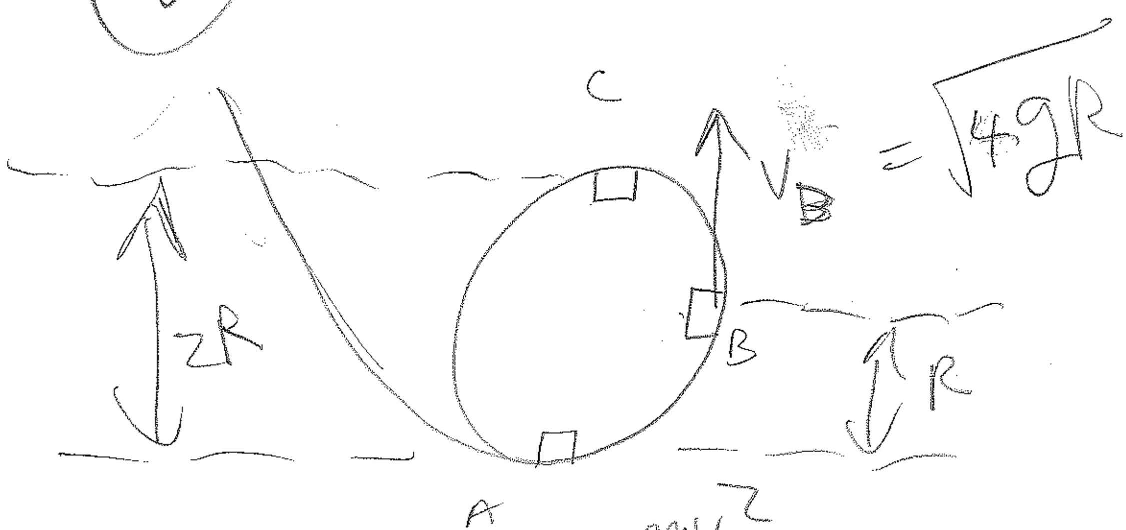
$\frac{1}{2}mv_B^2 = m(2gR)$

$v_B^2 = 4gR < v_A^2$

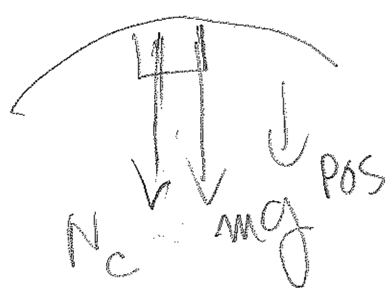
(a) $N_B = \frac{mv_B^2}{R} = \frac{m(4gR)}{R} = 4mg$

#1 ST3, SP11

b



$$\frac{mv_C^2}{R} = N_C + mg$$



$$N_C = \frac{mv_C^2}{R} - mg$$

need v_C: use energy conservation

$$\frac{1}{2}mv_C^2 + mg(2R) = \frac{1}{2}mv_B^2 + mg(R) \leftarrow KE_C + U_C = KE_B + U_B$$

$$\frac{1}{2}\cancel{m}v_C^2 + \cancel{m}g(2R) = \frac{1}{2}\cancel{m}(4gR) + \cancel{m}gR$$

OR

$$(KE_C + U_C = KE_A + U_A)$$

$$v_C^2 = 2gR$$

$$\longrightarrow N_C = \frac{m(2gR)}{R} - mg = \boxed{mg}$$

STM SPILL

#2

v = 3.00 m/s is about to contact an uncompressed, massless parallel spring. The spring has force constant k = 125.00 N/m and is attached to a wall. The diagram below shows time sequence shots of the block moving toward the spring plate *just before* contact and at the *point of maximum compression* of the spring. The *coefficient of kinetic friction* between ground and bottom of the block is μ = 0.100.

(a) (26 points) Find the maximum distance D (in m) the spring will be compressed.

(b) (10 points) What is the work done be friction (in (Joules) during this motion? Is this work positive or negative? Explain.

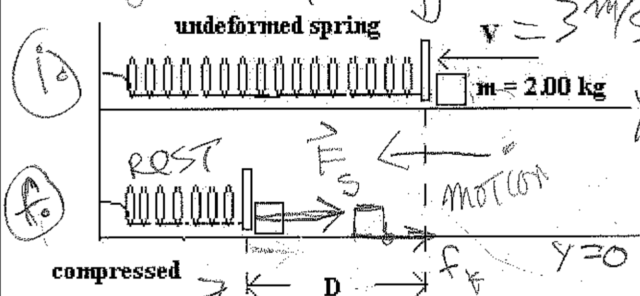
(c) (4 points) How far from the *point of maximum compression shown* will the block travel to the right before finally coming to rest?

NOTE: $U_g = 0$ $\quad x_i' = 0$

(a) CH6 STYLE

$\Sigma W = \Delta KE$

$W_s + W_{f_k} = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$



$\frac{1}{2} k x_i'^2 - \frac{1}{2} k x_f'^2 - f_k \cdot D = 0 - \frac{1}{2} m \left(3 \frac{m}{s}\right)^2$

$-\frac{1}{2} k D^2 - \mu_k \cdot N \cdot D = -\frac{1}{2} m \left(3 \frac{m}{s}\right)^2$

$x_f' = -D$

(a) CH7-style:

$KE_i + U_i = KE_f + U_f + \text{Heat}$

$\frac{1}{2} m (3 m/s)^2 + 0 = 0 + \frac{1}{2} k D^2 + f_k \cdot D \Leftrightarrow \frac{1}{2} k D^2 + \mu_k \cdot mg \cdot D - \frac{1}{2} m \left(3 \frac{m}{s}\right)^2 = 0$

3. (40 points) Pushing a Cat Part II.

NOTE: $N = mg$

Your Cat "Ms." (mass *m* = 7.00 kg, represented by box below) is trying to make it to the top of a *frictionless* ramp. The ramp is *2.00 m long* and inclined upward at 30.0 degrees with the horizontal. At point A (the bottom) the cat starts with running speed 2.40 m/s directed upward *along the incline.* Since the poor cat cannot get any traction on the ramp, you push her along the ramp but apply a steady *horizontal* force of magnitude F = 125.00 (N). See below diagram showing the cat moving upward along the incline; the distance between points A and B is 2.00 m. For full credit on this problem you must use energy related methods in Chapter 6 or 7. Otherwise you will lose points.

ST3, SP11

#2 a

$$\frac{1}{2}(125)D^2 + \underbrace{(0.1)(2)(9.8)}_{2}D - \frac{1}{2}(2)(3)^2 = 0$$

$$\approx 125D^2 + 4D - 18 = 0$$

$$D = \frac{-4 \pm \sqrt{(-4)^2 + (4)(125)(18)}}{(2)(125)}$$

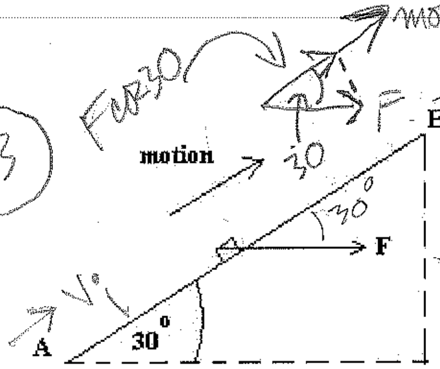
$4 \approx 3.92$

$$D \approx \frac{-4 \pm \sqrt{9016}}{250}$$

$$D = \frac{-4 + 95}{250} = \frac{91}{250}(m)$$

$$D = 0.36\,(m) = 36\,cm$$

ST3, SP11 #3



$V_i = 2.4 \frac{m}{s}$

(a) Low → high

$W_g = -mgh$

$= -(7)(9.8)(1)$

$\simeq -68.6J$

$h = 2\sin 30$
$= 1 (m)$

(a) (4 points) What is the work W_g done on the cat by gravity during her motion from A to B?
(b) (36 points) What is the cat's speed when she reaches the top (point B) ?
(c) (5 points) Extra Credit. Compute the speed at the top (B) in the presence of friction. Assume the cat starts at the bottom (A) with the same speed 2.40 m/s. Repeat part (b) if the coefficient of kinetic friction between the cat and inclined surface is μ = 0.150. Explain the difference between the cat's speed at the top in this case and the speed you computed in part (b).

(b) CH6 style $V_f = ?$

$W_F + W_g = \frac{1}{2}mV_f^2 - \frac{1}{2}mV_i^2$

Be careful!

$(F \cdot \cos 30) \cdot L - mgh = \frac{1}{2}(7)(V_f^2 - (2.4)^2)$

(c) $W_F + W_g + W_{fk} = \frac{1}{2}(7)(V_f^2 - (2.4)^2)$

$V_f = ?$

$(F\cos 30) \cdot L - mgh - \mu_k \cdot N \cdot L = \frac{1}{2}(7)(V_f^2 - (2.4)^2)$

note: $N = mg\cos 30$ (CH.4,5)

ST3, SP 11, #3

b. numerical answer (no friction)

$$\underbrace{F\cos 30 \cdot L} - \overset{mgh}{(7)(9.8)(1)} = \tfrac{1}{2}(7)\left(v_f^2 - 2.4^2\right)$$

$$(125)(0.867)(2) - 68.9 = \tfrac{1}{2}(7)\left(v_f^2 - 2.4^2\right)$$

$$\frac{216.25 - 68.9}{3.5} + 2.4^2 = v_f^2$$

$$\frac{147.35}{3.5} + 5.76 = v_f^2$$

$$42.1 + 5.76 = 47.86 = v_f^2$$

$$v_f = \sqrt{47.86}\ \frac{m}{s}$$

$$= 6.92\ m/s$$