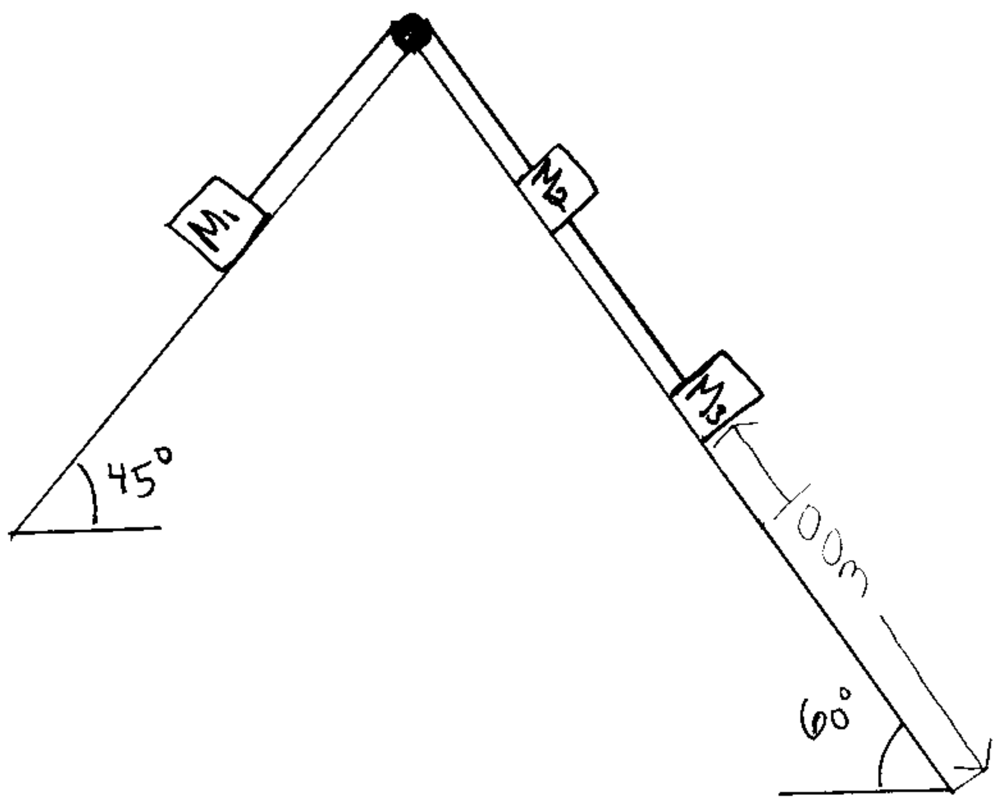
REVIEW SET 2

1.

For the system pictured, M1 = 5.00kg, M2 = 10.0kg, M3 = 10.0kg.
The coefficient of kinetic friction is 0.2 and it is 0.4 for static friction.

Show that static friction can not hold the system at rest.
Calculate the tension between M2 and M3.
If the system is released from rest, find the work done by gravity on the system when M3 reaches the bottom of its incline.
Find the minimum coefficient of static friction to hold the system at rest.



2. IN DEEP SPACE only 3 external forces exist: F_1, F_2, and F_3.

$F_1 = <2,-3,-1>$N, $F_2 = <-3, 4, 5>$N, $F_3 = <-4, 2,-3>$N

A 0.2 kg object is initially located at a position of $<-5, -10, 15>$m and its initial velocity is $<4, 6, 2>$m/s.

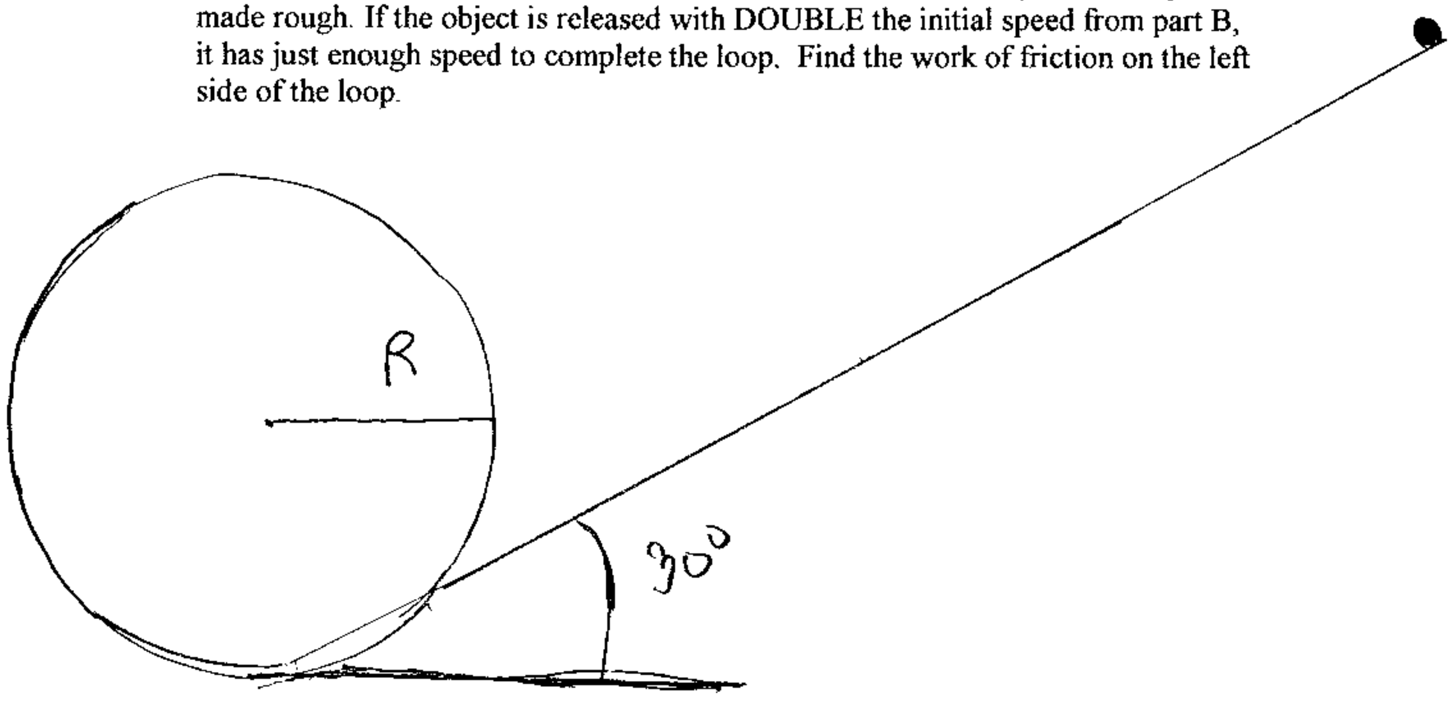
a. Calculate and describe the acceleration vector.
b. Calculate the velocity 10.0s later.
c. Calculate the net work done during the first 10.0 s.
d. Calculate the average power for the first 10.0s.
c. Calculate the instantaneous power at 10.0s.
f. Calculate the position at 10.0s.
g. Does U(r) exist? Explain fully. If yes, calculate U(r).
h. Explain why $P_{ave} \neq P$ (10.0s) MUST be true for this problem.

3. A race car weighing 15,000n experiences a drag force of 1200n. The car travels at 30m/s on a level highway. The coefficient of kinetic friction is 0.2. If the car travels for 10s at this speed, calculate the power the engine produces.

The car then goes up a 10 degree constant incline. Calculate the additional force the engine must now provide. Find the power for friction on the incline

4.

A. The incline and the loop are frictionless. Air resistance is negligible. The object is released from rest. Find the minimum height for the 2kg object to just make it around the inner loop in terms of R.
B. The 30 degree incline now has a rough surface and a coefficient of kinetic friction of 0.2. Find the minimum initial speed required at the release to complete the loop for the same height as part A.
C. The incline is still rough as in part B. Now the left hand side only of the loop is made rough. If the object is released with DOUBLE the initial speed from part B, it has just enough speed to complete the loop. Find the work of friction on the left side of the loop.



5. A100kg (man + chute) drops from rest out of a helicopter hovering at 2000m above the ground. When the man has fallen for 25s, he is moving at 50m/s and is 1000m above the ground. At 1000m his parachute deploys. He achieves a terminal speed of 5m/s at 400m above the ground.

Calculate the drag coefficient for the chute.
Calculate the work done by air resistance without the deployed chute.
Calculate the work done by air resistance with a deployed chute.
For the first 1000m drop, calculate the average power of gravity.

6.

A 1.00kg mass experiences only one force. $F = \langle 2x, 3y^2, \sin z\rangle$N. $\vec{r}_0 = \langle 1, 2, 3\rangle$m.
$t = 3.00$s, $\vec{r} = \langle 10, 20, 3\rangle$m. $\vec{v} = \langle 20, 15, 3\rangle$m/s

Explain why this is a conservative force. Calculate U ($\vec{r}$).
Find the work done by this force.
Find the average power and the instantaneous power t =3.00s.

ANSWERS SET 2

1. $\sum F_g$ (tang) = 135 N > $\sum F_s$ (max) = 53.1N
   T = 31.6N
   Wg = 13,510J
   μ_s = 1.02

2. $\vec{a}$ = constant = <-25, 15, 5>N/kg
   $\vec{v}$ = <-246, 156, 52>m/s
   w = 8,750J
   P_{ave} = 875 w
   p = 1,750w
   $\vec{r}$ = <-1215, 800,285>m
   All constant forces are conservative.
   U_1 = -2x + 3y +z U_2 = 3x -4y +5z U_3 = 4x -2y + 3z
   $P_{ave} \neq$ P (10s), Since F= constant, P_{ave} = Fave. Vave,
   $\vec{a}$ = constant such that V (5s) = $V_{ave} \neq$ V (10s)
   V(5s) + $\vec{a}$(5s) $\neq$ V(10s) since $\vec{a} \neq$ <0,0,0>N/kg

3. P_{engine} = 126kw
   ΔF_{engine} = 2559N
   P_{f_k} = -88.6kw

4. H_{min} = 2.5r
   Vo (min) = $(2\,\mu_k\, gH_{min} \cot 30^\circ)^{0.5}$
   $W_{f_k} = \Delta E$ (loop) = -3m μ_k gH_{min} cot30° = 3 Δ E(incline)

5. b = 196ns/m
   W_{air} = -855kJ
   W_{chute} = -1104kJ
   P_{ave} = 39.2kw

6. If the component of force only varies in that direction then it is conservative.
   i.e. F_x (x)

U(x,y,z) = $-x^2 - y^3$ + cosz
W = 8091J
Pave = 2697W
P = 18,400W