Physics 4A
Fall 2025

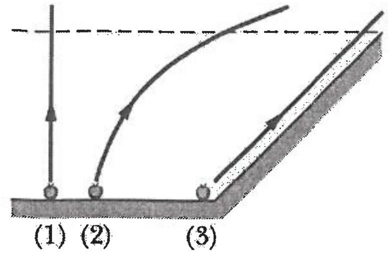
ave. = 8.2
$\sigma = 1.5$

Name Answer Key

Lab: 8:00 am 11:20 am 2:40 pm (circle one)

Quiz #8: Interactions and Potential Energy

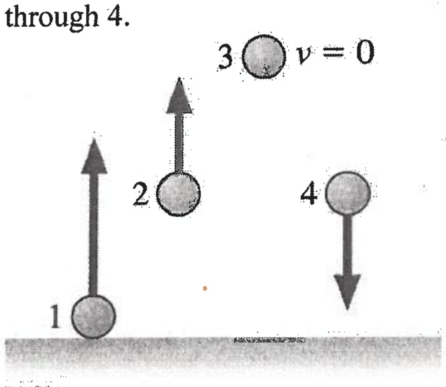
Problem 1 (2 points)
The figure shows three rocks that are launched from the same level with the same speed. One is launched straight upward, one is launched at an angle, and one is launched along a frictionless incline. Ignoring air resistance, rank the rocks according to their speed when they reach the dashed line, greatest first.



~~a) 1~~
~~b) 2~~
~~c) 3~~
d) all tie

all have same speed at dashed line by conservation of energy

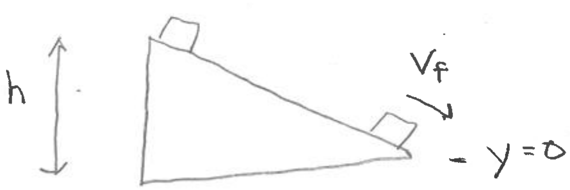
Problem 2 (2 points)
Rank in order, from largest to smallest, the gravitational potential energies of the identical balls 1 through 4.



$3 > 2 = 4 > 1$

$U_g = mgy$ → can rank by height

Problem 3 (2 points)
A block initially at rest is allowed to slide down a frictionless inclined ramp and attains a speed v at the bottom. To achieve a speed 2.50v at the bottom, how many times as high must a new ramp be? *Explain your answer.*



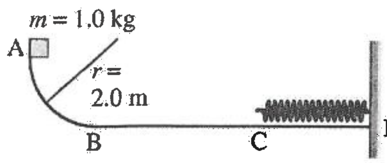
ramp must be 6.25 times as high

$K_i + (U_g)_i = K_f + (U_g)_f$, with $K_i = 0$ and $(U_g)_f = 0$

$mgh = \frac{1}{2} m v_f^2 \rightarrow h = v_f^2 / 2g$

⇒ If speed increases by a factor of 2.5, kinetic energy increases by a factor of $(2.5)^2 = 6.25$ so initial gravitational potential energy must be 6.25 time greater

Problem 4 (4 points)
Consider the track shown in the figure below. The section AB is one quadrant of a circle of radius 2.0 m and the spring constant of the spring is 435 N/m.



→ $y = 0$

System → block, earth, spring, track

external forces → none

a) If the entire track is frictionless, how far will the spring be compressed if the block is released from rest at point A.

$$K_i + (U_g)_i + (U_{sp})_i + W_{ext} = K_f + (U_g)_f + (U_{sp})_f + \Delta E_{th}$$

($K_i = 0$, $(U_{sp})_i = 0$, $W_{ext} = 0$, $K_f = 0$, $(U_g)_f = 0$, $\Delta E_{th} = 0$)

$$mgy_i = \tfrac{1}{2}K(\Delta x_f)^2$$

$$\Delta x_i = \sqrt{\frac{2mgy_i}{K}} \rightarrow \Delta x_i = \sqrt{\frac{2(1.0\,kg)(9.80\,m/s^2)(2.0\,m)}{435\,N/m}}$$

$$\boxed{\Delta x_i = 0.300\,m}$$

b) Now suppose that section BC of the track, which has a length of 2.5 m, is not frictionless. (Note: sections AB and CD are still frictionless). If the coefficient of kinetic friction between the block and section BC of the track is $\mu_k = 0.35$, how far will the spring be compressed if the block is released from rest at point A?

$$K_i + (U_g)_i + (U_{sp})_i + W_{ext} = K_f + (U_g)_f + (U_{sp})_f + \Delta E_{th}$$

($K_i = 0$, $(U_{sp})_i = 0$, $W_{ext} = 0$, $K_f = 0$, $(U_g)_f = 0$)

$\Delta E_{th} = f_k \Delta r = \mu_k mg \Delta r$

$$mgy_i = \tfrac{1}{2}K(\Delta x_f)^2 + \mu_k mg\Delta r$$

$$\Delta x_f = \sqrt{\frac{2mg(y_i - \mu_k \Delta r)}{K}}$$

$$\Delta x_f = \sqrt{\frac{2(1.0\,kg)(9.80\,m/s^2)[(2.0\,m) - (0.35)(2.5\,m)]}{435\,N}}$$

$$\boxed{\Delta x_f = 0.225\,m = 0.23\,m}$$