CSUC Spring Term 2020 Physics 204A Portfolio Problem for Week 12:
Due Monday, April 20 by Noon on our class Blackboard site: 202-PHYS204A-05-4569

Dear Class: This is the fourth (and Week12) Portfolio Problem Set. These are momentum problems. Draw lots of pictures! Don't rush! The answer is surprising – and you will have learned a ton about problem solving. This is an open book and unlimited time exercise.

1) *CENTER OF MASS*

Outdoor enthusiasts Bill (mass 90 kg) and Jill (mass 60 kg) sit 3 meters apart in a symmetrical canoe of mass 120 kg . The water is calm and to one side of Bill sits a turtle on a rock in the lake watching.

a) Find the center-of-mass position of the ***people-canoe system*** relative to Bill (and the turtle!).
b) Contrary to good practice, Bill and Jill now *switch their positions* in the canoe! Carefully **draw** (don't compute!) the resulting outcome and answer: ***Where is the center-of-mass now***?
c) Next, **simply observe what distance** the canoe **must have moved** in the process (relative to the fixed turtle). (HINT: use symmetry!)
d) If each person moved into the other's position in just 3 seconds, find the resulting *average velocity* with which each person moved! Who moved faster?

2) *INELASTIC COLLISIONS*

Bill (mass 90 kg) and Jill (mass 60 kg) form an unforgettable *acrobatic ski team*! As shown below, Bill starts from rest at the top and skis down a 200 m long straight ski slope inclined at 20º . Jill stands in the middle of the slope (i.e. half way down) and jumps into Bill's arms as he whizzes by.

a) What is their speed at the bottom of the slope ?
b) Is there an optimal position for Jill to stand so as to minimize their final speed?