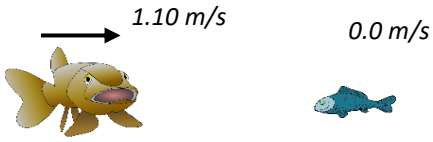
Assignment No. 8

Problem 1)

A 15.0-kg fish swimming at 1.10 m/s suddenly gobbled up a 4.50-kg fish that is initially stationary. Neglect any drag effects of water:

a) Find the speed of the larger fish after it eats the small one.

b) How much mechanical energy was dissipated during this meal?



Problem 2)

You are at the controls of a particle accelerator, sending a beam of 1.50 x 10^7m/s protons (mass m) at a gas target of an unkown element. Your detector tells you that some protons bounce straight back after a collision with one of the nuclei of the unkown element. All such protons rebound with a speed of 1.20 x 10^7 m/s. Assume that the initial speed of the target nucleus is negligible and the collision is elastic:

a) Find the mass of one nucleus of the unknown element. Express your answer in term of the proton mass *m* .

b) What is the speed of the unknown nucleus immediately after such collision?

Problem 3)

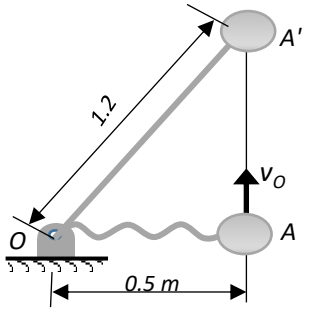
A system consists of two particles. At t= 0 one particle is at rest at the origin; the other which has a mass of 0.50 kg, is on the y-axis at y =6.0 m. At t = 0 the center of mass of the system is on the y-axis at y = 2.40 m. The velocity of the center of mass is given by (0.75 m/s^3) $t^2\underline{\boldsymbol{i}}$.

a) Find the acceleration of the center of mass at any time t.

b) Find the net external force acting on the system at t = 3.0 s

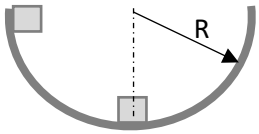
Problem 4)

A 2-kg sphere A is connected to a fixed Point O by an inextensible cord of length 1.2 m.The sphere is resting on a frictionless horizontal surface at a distance of 0.5 m from O when it is given a velocity v_O in a direction perpendicular to line OA. It moves freely untilit reaches position A', when the cord becomes taut. Determine the maximum allowable velocity v_O if the impulse of the force exerted on the cord is not to exceed exceeds 3.0 N.s.



Problem 5)

Two identical masses are released from rest in a smooth hemispherical bowl of radius R from the position shown in the Figure. Ignore friction between masses and the surface of the bowl. If they stick together when they collide, how high above the bottom of the bowl will the masses go after colliding?



Problem 6) **EXTRA POINT (10)**

Ball B is hanging from an inextensible cord BC. An identical ball A is released from rest when it is just touching the cord and acquires avelocity v_O before striking ball B. Assuming perfect elastic collision and no friction, determin the velocity of each ball immediately after impact.