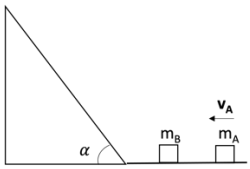
Exercise 1)
A ball of mass m_A and with speed v_A collides with another ball of mass m_B, initially at rest. As a result of the collision, ball A gives 80% of its mechanical energy to ball B. Right after, ball B goes up an inclined plane that forms an angle α with the horizontal plane. Determine:

a) the speed of ball B after the collision **2**
b) the distance, d, travelled by ball B along the inclined plane before it stops **2**
c) the time needed to travel that distance d **2**
d) the work done by the force of gravity on ball B while moving up the inclined plane **2**
e) What is the maximum value of the friciton coefficient μ_s of the inclined plane at which an object laying on the plane at rest would start moving down towards the base of the plane? **2**
Data: m_A=10g, v_A=10 m/s, m_B=10m_A, α=45º



Exercise 2)
A syringe has a piston of diameter d_s and a needle of diameter d_a. It is filled with water and lays horizontally. The water is pushed out by applying a constant force of module F on the piston. Consider absence of friction and water to be an ideal fluid. Determine:

a) The speed at which the water leaves the needle. Don't forget that the forces acting on the piston are both **F** and the atmospheric pressure **3**
b)The volume flow of the needle **1**
c) The time that's needed to empty the syringe that initially contains 5 cm^3 of water **1**
Justify the approximations.
Data: d_s=2.6 cm, d_a=0.40mm, F=4.8 N, water density ρ=1 gr/cm^3

Exercise 3)
We want to heat up 2 moles of an ideal gas from initial temperature T_i to final temperature T_f. We ca do it in two different ways: an isochoric or and isobaric transformation.

a) Draw the two transformations in the PV plane **0.5**
b) Calculate the transferred heat in the two transformations **1**
c) Calculate the change of internal energy in the two transformations **1**
d) Calculate the work done on/by the gas in the two transformations **1**

Let's now consider an isothermal compression of the gas at T=400K from initial pressure P_i to P_f.
e) Draw the transformation in the PV plane **0.5**
f) Calculate the final gas volume Vf
g) Calculate work and heat and explain whether the heat is emitted or absorbed by the gas **2**
h) If we put an iron ball at T=600K in contact with the gas at T=400K, can the ball be heated and why? **0.5**
Data: R = 8.314 J/mol*K, C_p=28.8 J/mol*K, C_p-C_V =R , P_i = 0.4 atm, P_f = 2 atm, Ti = 300 K,T_f = 400 K,
1atm=1.013*10^5 Pa

Exercise 4)
Let's consider a sphere of radius R with uniform positive charge density ρ. Calculate:
a) the electric field (intensity and direction) in a point P_1 inside the sphere at distance r1 from the center, r_1<R **3**
b) the electric field (intensity and direction) in a point P_2 outside the sphere at distance r2 from the center, r_2>R **2**
c)work done by the electric force on a probe charge that moves radially from P2 to P3, at distance r3 from the center **2.5**
Dati: R=1m, r_1=0.5m, r_2=3m, r_3=10m, ρ=6*10^{-9}, C/m^3, q=-0.3*10^{-9}C