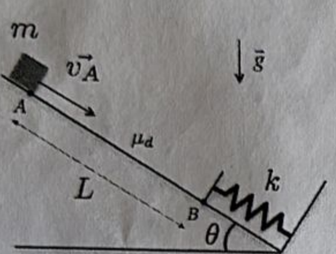
1 Mechanics and fluids:

An object of mass m slides along a plane. The plane is characterised by a dynamical friction coefficient μ_d and an inclination angle θ. At point A, the body has a velocity v_A directed along the inclined plane (see figure). After traveling a distance L, the object encounters at point B the free end of an ideal spring of elastic constant k. The spring is compressed by a distance Δx until the object is stopped.
Calculate:

1) The work done by the friction force while the body moves a distance L from A to B **(2 points)**
2) The velocity of the object at point B **(2 points)**
3) The elastic constant k **(2 points)**

Now consider a block of porcelain (density ρ_p) hanging from a rope of negligible mass. The block is kept under the water (density ρ_A) When the block is completely submerged, the rope's tension is T_0.
Calculate:

4)The volume V of the block **(2 points)**
5) The tension of the rope when the block is half submerged in the water. **(2 points)**



Adiabatic ⇒ W = n Cv ΔT

2 Thermodynamics:

Consider an isothermal expansion of n moles of an ideal gas from point A to point B and an adiabatic expansion from point A to point C, both between the same initial and final volumes V_i and $V_f=2V_i$ and with $T_A=2T_c$

1)Draw the two transformations in the PV plane explaining the difference in the slope **(2 points)**
2)Calculate the work in both transformations, which one does more work? **(2 points)**

Consider now a pan of negligible heat capacity that contains a volume V_a of water at temperature Ta. The pot is located on an electric burner of power P which transfers 60% of its power to the water. At some point, the water begins to evaporate; the stove is turned off when ΔV of water have evaporated. Water has specific heat Ca and evaporation latent heat L_a.
Calculate:

3) The heat absorbed by the water **(2 points)**
4) The time the electric burner was on in order to provide such heat **(2 points)**

3 Electromagnetism: In a region A of space there is an uniform electric field of intensity E along the $\hat{z}$ direction. An electron enters this region A with initial velocity v_A along the $\hat{x}$ axis.

1.Imagine that we want the electron to keep moving along the initial direction and with same initial velocity and that we can turn on a magnetic field B to do that. Calculate the intensity and direction of the magnetic field. **(3 points)**

2. Imagine now that an electron with initial velocity v_A along the $\hat{x}$ direction enters a region C where we apply an electric field that makes the electron bounce back after travelling some distance d. What is the intensity of the electric field?**(3 points)**

3. Consider a squared coil that rotates around the $\hat{x}$ axis with constant angular velocity ω. There is a constant and uniform magnetic field along the $\hat{z}$ axis. How does the electromotive force vary with time? **(3 points)**

4 Modern physics: What is the De Broglie wave? **(3 points)**