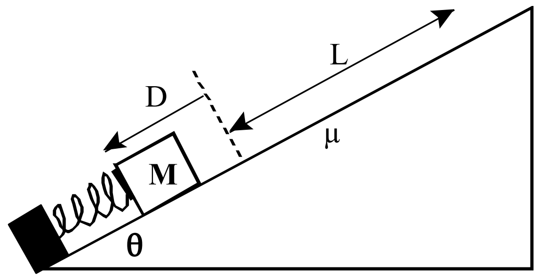
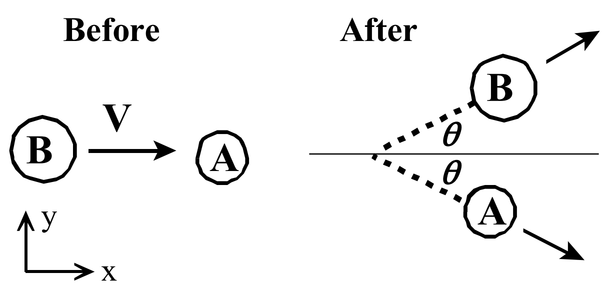
Physics 1135 **Test 2 Preparation Homework**

1. A box of mass M is on a rough incline that makes an angle θ with the horizontal. The coefficient of kinetic friction between the box and the incline is μ. The box is placed against a spring whose other end is secured to a wall at the lower end of the incline. The block is used to compress the spring a distance D and is then released from rest.



Derive an expression for the minimum spring constant k necessary to ensure that the box reaches a distance L up the incline **from the equilibrium position of the spring**. (Treat the box as a point mass.)

2. Object **A** of mass M is initially at rest on a flat, smooth frictionless surface. Object B, which has **twice** the mass of **A**, is traveling with speed V before it collides **elastically** with **A**. Immediately after the collision, both objects move off at angles $\theta > 0$ with respect to the original direction of **B**.



Calculate the value of the angle θ. [Hint: Note that the collision is **elastic**.]

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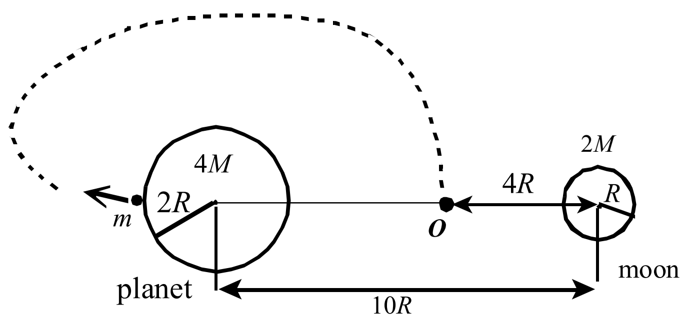
3. Scientists on a planet of mass $4M$ and radius $2R$ launch a satellite. Their moon has mass $2M$, radius R, and its center is a distance of $10R$ from the center of the planet. The satellite of mass m is shot out of a cannon from the side of the planet facing away from the moon. It follows the dashed path to point $\boldsymbol{O}$ which is on the line connecting the centers of planet and moon, a distance $4R$ away from the moon, as shown in the figure. Ignore the orbital motion of the moon about the planet.



a) Derive an expression for the difference in kinetic energies, ΔK, between point $\boldsymbol{O}$ and the launch point in terms of relevant system parameters.

b) Derive an expression for the net force on the satellite at point $\boldsymbol{O}$ in terms of relevant system parameters.