EXAM II Physics 218 2012

Name..Section Number......

USEFUL INFORMATION

$$If \quad f(x) = kx^n \qquad \frac{df}{dx} = nkx^{n-1}$$

$$If \quad f(x) = kx^n \qquad \int_A^B f(x)dx = \frac{1}{n+1}k(B^{n+1} - A^{n+1})$$

$$If \quad f(x) = kx^n \qquad \int f(x)dx = \frac{1}{n+1}kx^{n+1} + C$$

$$\int_{\vec{r}_1}^{\vec{r}_2} \vec{F}_{tot} \cdot d\vec{r} = \frac{1}{2}mv^2(\vec{r}_2) - \frac{1}{2}mv^2(\vec{r}_1)$$

If $\vec{F}$ is conservative:

$$\int_{\vec{r}_1}^{\vec{r}_2} \vec{F} \cdot d\vec{r} = -[U(\vec{r}_2) - U(\vec{r}_1)]$$

and

$$F_x = -\frac{\partial U}{\partial x} \qquad F_y = -\frac{\partial U}{\partial y}$$

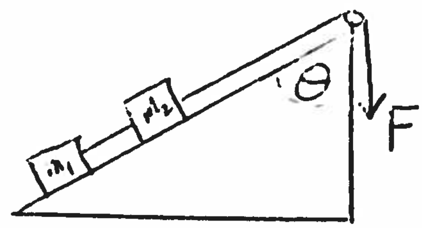
1.

2.

3.

4.

1. (25 points)Two blocks with masses, m_1 and m_2, are connected by a massless, unstretchable rope. They are being hauled up an inclines plane by a constant force of magnitude F, connected to the blocks by another massless, unstretchable rope that goes over a frictionless pulley. The coefficient of friction between the block with mass m_1 and the plane is the known constant μ. The other block has been greased so that there is no friction between it and the plane. The angle of the inclined plane is defined in the figure below.



a. Find the acceleration of the blocks.

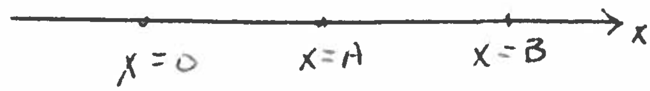
b. Find the tension in the rope connecting the two blocks.

c. Suppose the magnitude F was not large enough to move the blocks up the plane but large enough so that the blocks did not slide down the plane. Find all the forces acting on the block with mass m_1.

2. (25 points) A object of mass m starts at $x = A$ with a velocity of magnitude v_1 to the right. It is repelled from the origin by a force with magnitude

$$|\vec{F}_1| = \frac{c_1}{x^2}.$$

What constant force could be applied, in addition to $\vec{F}_1$ so that the object reaches the point $x = B$ but does not go farther to the right than $x = B$?

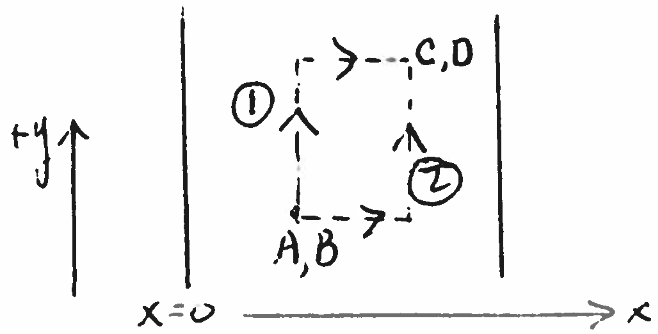


3. (25 points) A small block, mass m, is attached to a spring suspended from the ceiling. The unstretched length of the spring is L. The mass is released from rest at the point where the spring is unstretched.

a. If the spring is a perfect Physics 218 spring with spring constant k_1, how far down will the block go before starting back up?

b. If the spring is not a perfect Physics 218 spring but instead the magnitude of the force exerted by the spring is k_2 times the **cube** of the amount stretched or compressed, how far down will the block go before starting back up?

4. (25 points) A barge in a river is to be pulled from the point $x_1 = A, y_1 = B$ to the point $x_2 = C, y_2 = D$. The only forces available pull either in the x direction or in the y direction. The barge can either be pulled along path 1 or path 2. It is found that the force necessary to move the barge at a constant velocity along each segment parallel to the x axis has constant magnitude F_H. The force necessary to move the barge at a constant velocity along the segments parallel to the y axis varies with the distance from the bank of the river and has magnitude $F_V = F_0 x$ where F_0 is a constant. These applied forces required to move the barge are opposed by the force exerted by the water in the river.



a. Calculate the work done by the applied forces for path 1.

b. Calculate the work done by the applied forces for path 2.

c. What are the components of the force exerted on the barge by the water? Does this force have a potential energy function?