EXAM II Physics 218 2014

Last Name.....................................First Name.............Section Number......

USEFUL INFORMATION

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

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

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

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

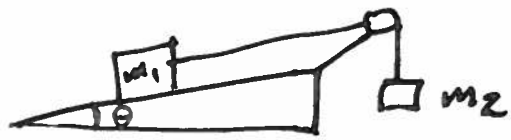
If $\vec{F}$ is conservative:

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

and

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

1. (25 points)Two masses are connected by a massless, unstretchable rope which goes over a frictionless pulley. There is friction between the block of mass m_1 and the inclined plane with coefficient of friction μ. The mass of the second block is m_2. The known masses and the known angle of the plane, θ, are such that the blocks do not move. Find the force that the block of mass m_1 exerts on the plane.

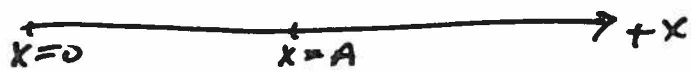


Free Body Diagrams (For blocks m_1 and m_2). Law or Definition

Application

Result

2. (25 points) A small mass m moves along the x axis. It is **attracted** to the origin with a force that has magnitude $|\vec{F}| = \frac{\alpha}{x^2}$ where α is a known positive constant. What velocity, in the x direction, must it be given at the point $x = A$ if it is to just make it to infinity, i.e. to escape from the attractive force? (There is no friction.)

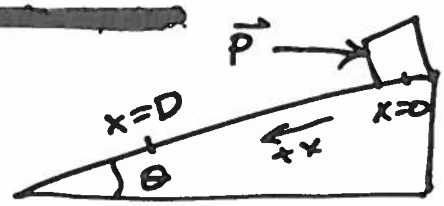


Free Body Diagram (If appropriate). Law or Definition

Application

Result (An equation for the distance is sufficient. Do not solve.)

3. (25 points)A small block of mass m starts at the point marked $x = 0$ with velocity of magnitude v_1 in the $+x$ direction. The coefficient of friction between the block and the plane is μ. A **horizontal** force $\vec{P}$ is applied to the block which has magnitude βx where β is a known constant. Find an algebraic equation that could be solved for D, the point at which the block stops. Do not solve the equation! [redacted]



Free Body Diagrams (If appropriate). Law or Definition

Application

Result

4. (25 points) A small mass, m, moves along the positive x axis. A spring-like force acting on it points to the left and has magnitude $\alpha x + \beta x^5$ where α and β are known positive constants. Find the potential energy function for this force. If the mass started at the origin with velocity v_1 to the right, find its kinetic energy as a function of x, if there is no friction.

Free Body Diagram (If appropriate). Law or Definition

Application

Result