Physics 2314, Midterm II (3/7)

M1 Two blocks of mass 1 kg each are initially moving towards each other with equal speeds 1 m/s. What is the final total kinetic energy of the system if the collision is

(a) elastic?

A. 0
B. 0.5 J
C. 1 J
D. 2 J

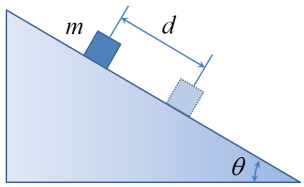
(b) perfectly inelastic?

A. 0
B. 0.5 J
C. 1 J
D. 2 J

M2 Potential energy of a particle is given by the equation $U = x^2 - x^4$, where x is in meters and U is in joules. Which of the following is true?

A. Equilibrium at $x = 0$ is stable.
B. Equilibrium at $x = 0$ is unstable.
C. Equilibrium at $x = 0$ is neutral.
D. $x = 0$ is not a point of equilibrium.

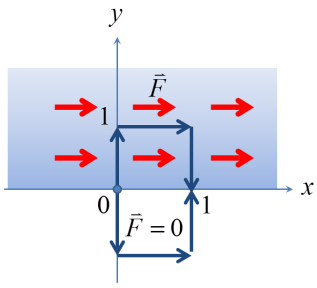
P1 A 1 kg block is placed on a frictionless incline of angle $\theta = 30°$ and released with zero initial speed. Find the speed of the block after it moves a distance of 2 m.



P2 Consider force

$$\mathbf{F} = \begin{cases} (1\mathbf{i} + 0\mathbf{j})\ \text{N}, y \geq 0 \\ 0, y < 0 \end{cases}$$

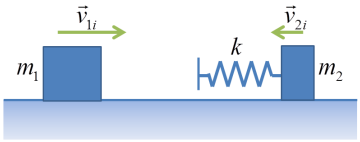
Determine the amount of work done by force $\mathbf{F}$ (a) along the path $(0,0) \to (0,1) \to (1,1) \to (1,0)$; (b) along the path $(0,0) \to (0,-1) \to (1,-1) \to (1,0)$ (all coordinates are in meters). Is $\mathbf{F}$ conservative? Why?



P3 A block of mass $m_1 = 2$ kg initially moving to the right with a speed of 3 m/s on a frictionless, horizontal track collides with a light spring attached to a second block of mass $m_2 = 1$ kg initially moving to the left with a speed of 6 m/s. The spring constant is 600 N/m.

(a) Find the final velocities of the blocks. *Hint*: ignoring any sound waves, the collision can be considered elastic.

(b) Find the maximum compression of the spring. *Hint*: at the moment of maximum compression, the two blocks are moving with the same velocity, so at that point one can use the formula for perfectly inelastic collisions.



P4 A conical pendulum consists of a ball of mass 0.1 kg suspended from a string of length 1.1 m. If the tension of the string is 2 N, find the speed of the ball.