Question 1: Block sliding on a vertical circular track

i: A block with mass .04 kg slides on a vertical circular track with radius 0.5 m. At a point A at the bottom of the track, the magnitude of the normal force on the block is 3.95N. At a point B at the top of the track, the magnitude of the normal force on the block is .680N. What is the work done by friction between A and B?

ii: Now the block has mass .05 kg, the track has a radius of 0.8 m, and the track is frictionless. At point A, the normal force on the block is 3.4 N. What is the normal force on the block at point B?

Question 2: Potential energy of a particle with mass m

The potential energy of a particle with mass m is given as:

$$U(x) = -U_1\left[\left(\frac{x}{x_1}\right)^3 - \left(\frac{x}{x_1}\right)^2\right]$$

with U_1 and x_1 constants. A plot of U vs x is given below with $U_1 = 27/4$ J and $x_1 = 1.5$m .

i: At which points x is the force on the particle 0? Are these points stable or unstable?

ii: For which maximum total energy value is periodic motion possible? What x positions does this correspond to?
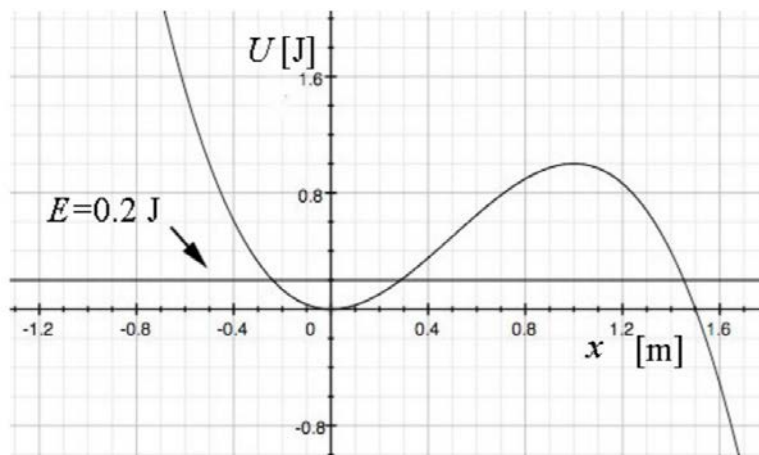
Question 3: Physics students colliding on an ice rink

8.70 ••• You and your friends are doing physics experiments on a frozen pond that serves as a frictionless, horizontal surface. Sam, with mass 80.0 kg, is given a push and slides eastward. Abigail, with mass 50.0 kg, is sent sliding northward. They collide, and after the collision Sam is moving at 37.0° north of east with a speed of 6.00 m/s and Abigail is moving at 23.0° south of east with a speed of 9.00 m/s. (a) What was the speed of each person before the collision? (b) By how much did the total kinetic energy of the two people decrease during the collision?