Homework No. 08 (Spring 2021)

PHYS 205A: University Physics

Due date: Monday, 2021 Mar 29, 11:55 AM, on D2L

Instructions

- Describe your thought process in detail and organize it clearly. Make sure your answer has the correct units and the right number of significant digits.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assesments → Assignments).

Problems

1. (**10 points.**) Consider the potential energy curve shown in Figure 1.

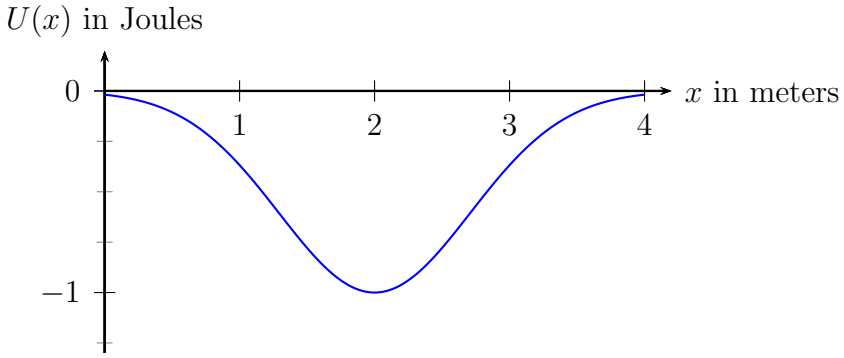

Figure 1: Problem 1.

   (a) What is the potential energy in Joules when the associated force is zero?
   (b) Sketch the curve of force versus x from $x = 0\,\text{m}$ to $x = 4\,\text{m}$.
   (c) For what range of x is the force repulsive?
   (d) For what range of x is the force attractive?

2. (**10 points.**) The potential energy of a particle moving along the x axis is given by

$$U(x) = ax^2 - bx^4, \qquad a = -4.0\,\frac{\text{J}}{\text{m}^2}, \quad b = -1.0\,\frac{\text{J}}{\text{m}^4}. \tag{1}$$

   Plot of $U(x)$ with respect to x is shown in Figure 2.

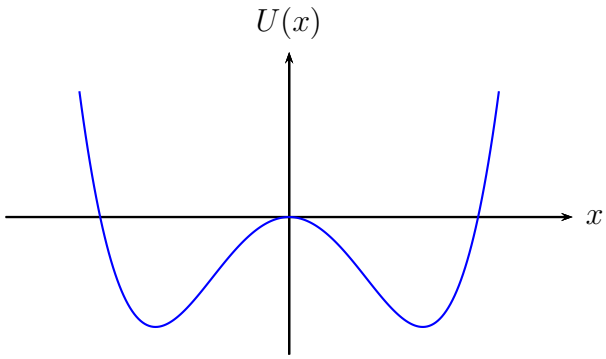

Figure 2: Problem 2.

(a) Determine the points on the x axis where the potential energy is zero.

(b) Determine the points on the x axis where the force on the particle is zero.

(c) Evaluate

$$\frac{d^2U}{dx^2} \tag{2}$$

at each of the points where the force is zero. What can you conclude about the stability of the particle at the points where the force is zero? That is, is it a stable point or an unstable point?

(d) For what range of x is the force repulsive?

(e) For what range of x is the force attractive?

3. (**10 points.**) Consider the potential energy curve shown in Figure 3, which is given by the expression ($r > 0$)

$$U(r) = \frac{\beta}{2r^2} - \frac{\alpha}{r}, \qquad \alpha = -1.0\,\mathrm{J\,m}, \quad \beta = -2.0\,\mathrm{J\,m^2}. \tag{3}$$

(a) Determine the points on the x axis where the potential energy is zero.

(b) Determine the points on the x axis where the force on the particle is zero.

(c) Evaluate

$$\frac{d^2U}{dx^2} \tag{4}$$

at each of the points where the force is zero. What can you conclude about the stability of the particle at the points where the force is zero? That is, is it a stable point or an unstable point?

(d) For what range of x is the force repulsive?

(e) For what range of x is the force attractive?

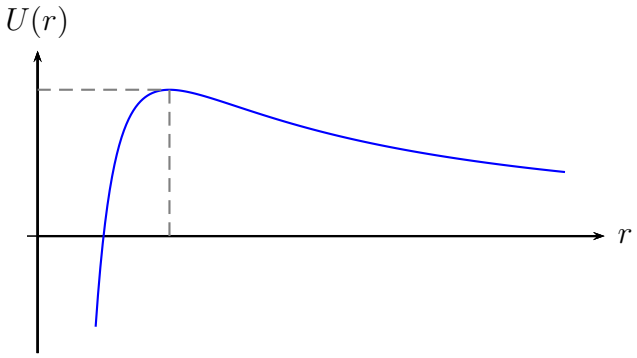

Figure 3: Problem 3.