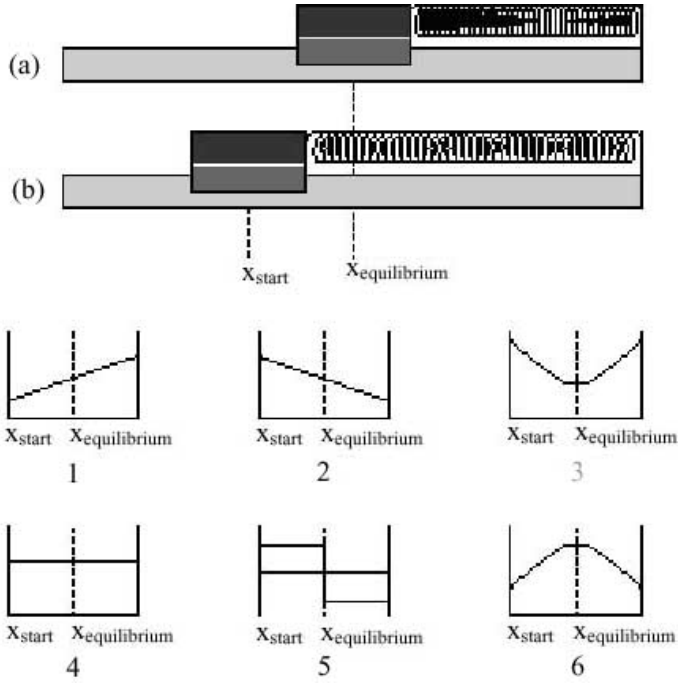
Potential Energy and Energy Diagrams
Concept Questions

Question 1 You lift a ball at constant velocity from a height h_i to a greater height h_f. Considering the ball and the earth together as the system, which of the following statements is true?

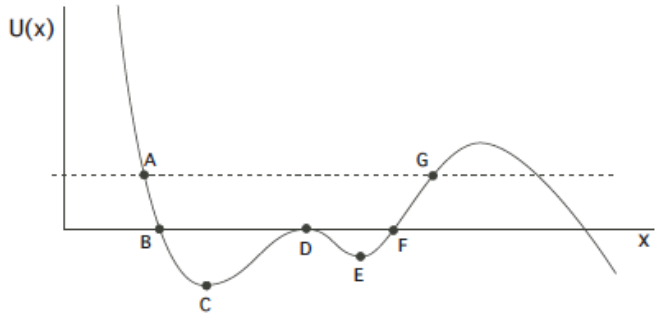
1. The potential energy of the system increases.
2. The kinetic energy of the system decreases.
3. The earth does negative work on the system.
4. You do negative work on the system.
5. The source energy of the ball increases.
6. Two of the above.
7. None of the above.

Question 2: In part (a) of the figure, an air track cart attached to a spring rests on the track at the position $x_{equilibrium}$ and the spring is relaxed. In (b), the cart is pulled to the position x_{start} and released. It then oscillates about $x_{equilibrium}$. Which graph correctly represents the potential energy of the spring as a function of the position of the cart?



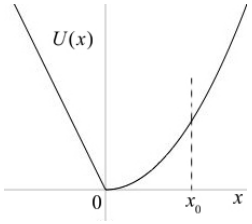
Question 3

The figure below shows a graph of potential energy $U(x)$ verses position x for a particle executing one dimensional motion along the x axis. The total mechanical energy of the system is indicated by the dashed line. At $t = 0$ the particle is somewhere between points A and G. For later times, answer the following questions.



a) At which point will the magnitude of the force be a maximum?
b) At which point will the kinetic energy be a maximum?
c) At how many of the labeled points will the velocity be zero?
d) At how many of the labeled points will the force be zero?
e) Can the motion be accurately approximated by simple harmonic motion (Y/N)?

Question 4: A particle is released from rest at the position $x = x_0$ in the potential described below.



$$U(x) = \begin{cases} -ax \; ; & x < 0 \\ bx^2 \; ; & x > 0 \end{cases}$$

Determine whether the following statements are true or false. Briefly explain your reasoning.

True False The subsequent motion is periodic.

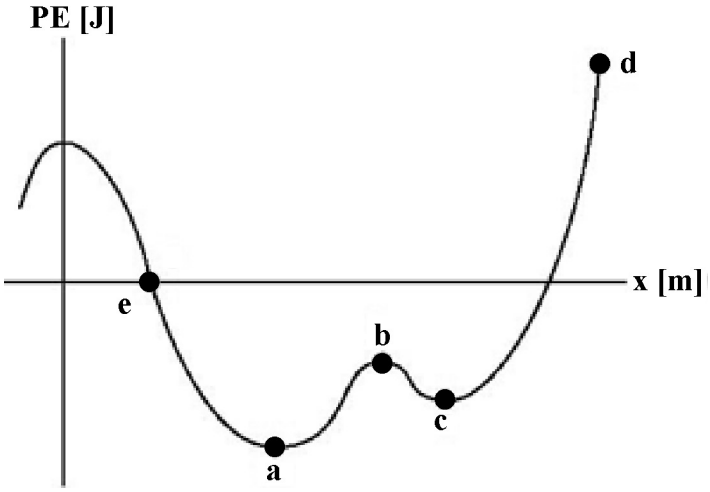
True False The velocity is a continuous function of time.

True False The acceleration is a continuous function of time.

True False The force is conservative.

Question 5

Consider the following sketch of potential energy for a particle as a function of position. There are no dissipative forces or internal sources of energy.

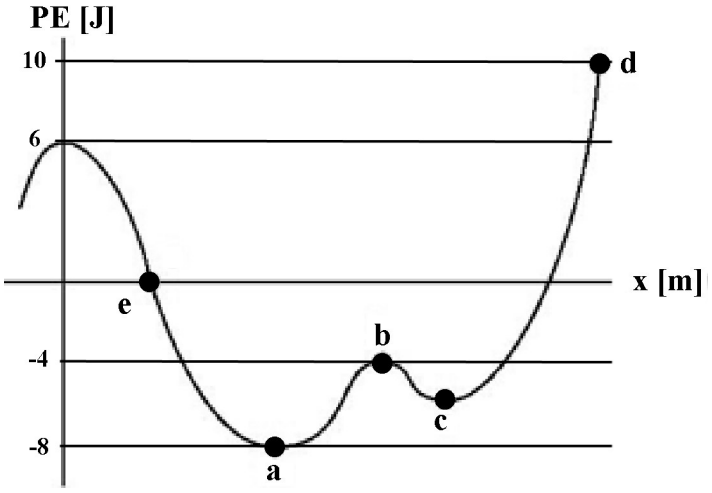


If a particle travels through the entire region of space shown in the diagram, at which point is the particle's velocity a maximum?

1. a
2. b
3. c
4. d
5. e

Question 6

Consider the following sketch of potential energy for a particle as a function of position. There are no dissipative forces or internal sources of energy.



What is the minimum total mechanical energy that the particle can have if you know that it has traveled over the entire region of X shown?

1. -8
2. 6
3. 10
4. It depends on direction of travel
5. Can't say - Potential Energy uncertain by a constant

8.01SC Physics I: Classical Mechanics