Survey

http://goo.gl/rrJhDy

Ch 7.4-5: Force & Potential Energy

PHYS 1210 - Prof. Jang-Condell

Goals for Chapter 7

- To use gravitational potential energy in vertical motion
- To use elastic potential energy for a body attached to a spring
- To solve problems involving conservative and nonconservative forces
- To determine the properties of a conservative force from the corresponding potential-energy function
- To use energy diagrams for conservative forces

Conservative and nonconservative forces

- A *conservative force* allows conversion between kinetic and potential energy. Gravity and the spring force are conservative.
- The work done between two points by any conservative force

  a) can be expressed in terms of a *potential energy function.*

  b) is reversible.

  c) is independent of the path between the two points.

  d) is zero if the starting and ending points are the same.
- A force (such as friction) that is not conservative is called a *nonconservative force*, or a *dissipative force.*

Energy Conservation

kinetic energy

potential energy

$$\Delta K + \Delta U + \Delta U_{\text{int}} = 0$$

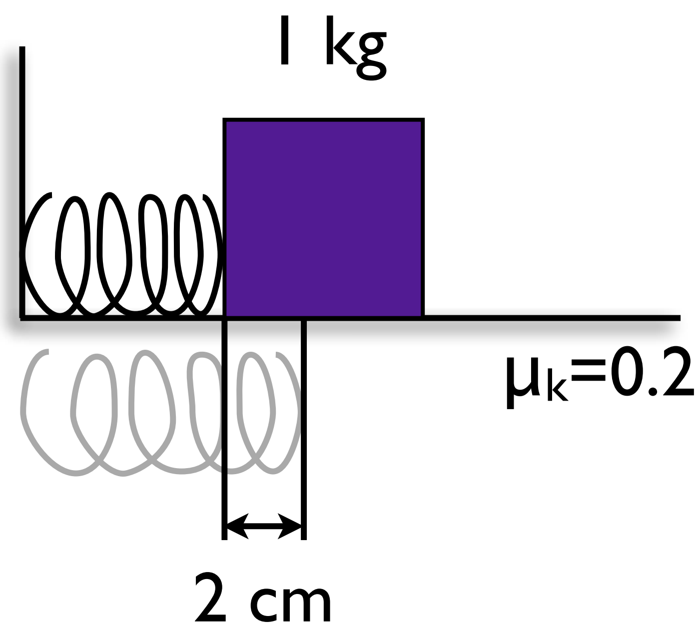
internal energy (ex: heat)

Example

The spring has $k=10^4$ N/m and is compressed by 2cm initially.

The coefficient of kinetic friction between the block and the surface is $\mu_k=0.2$.

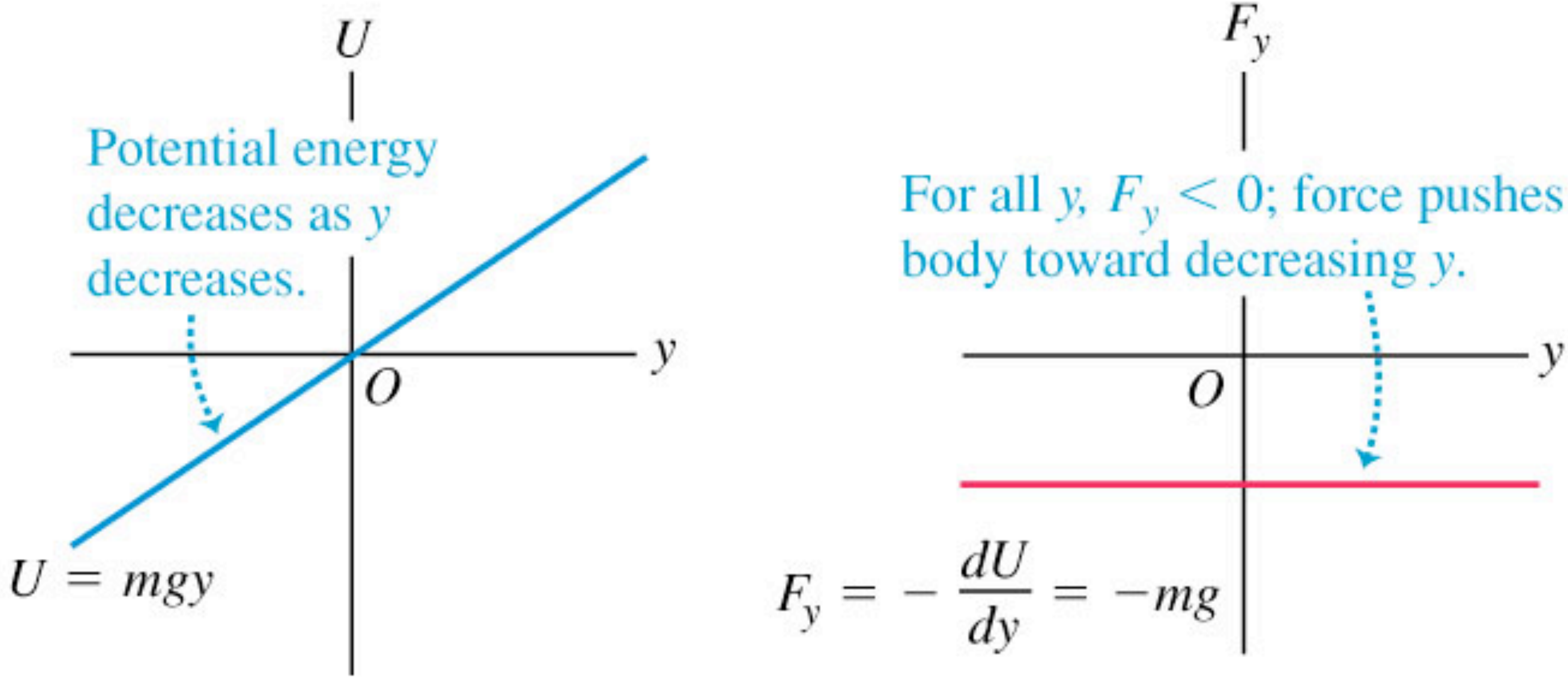
When the spring is released, what distance does the block travel before coming to a stop?



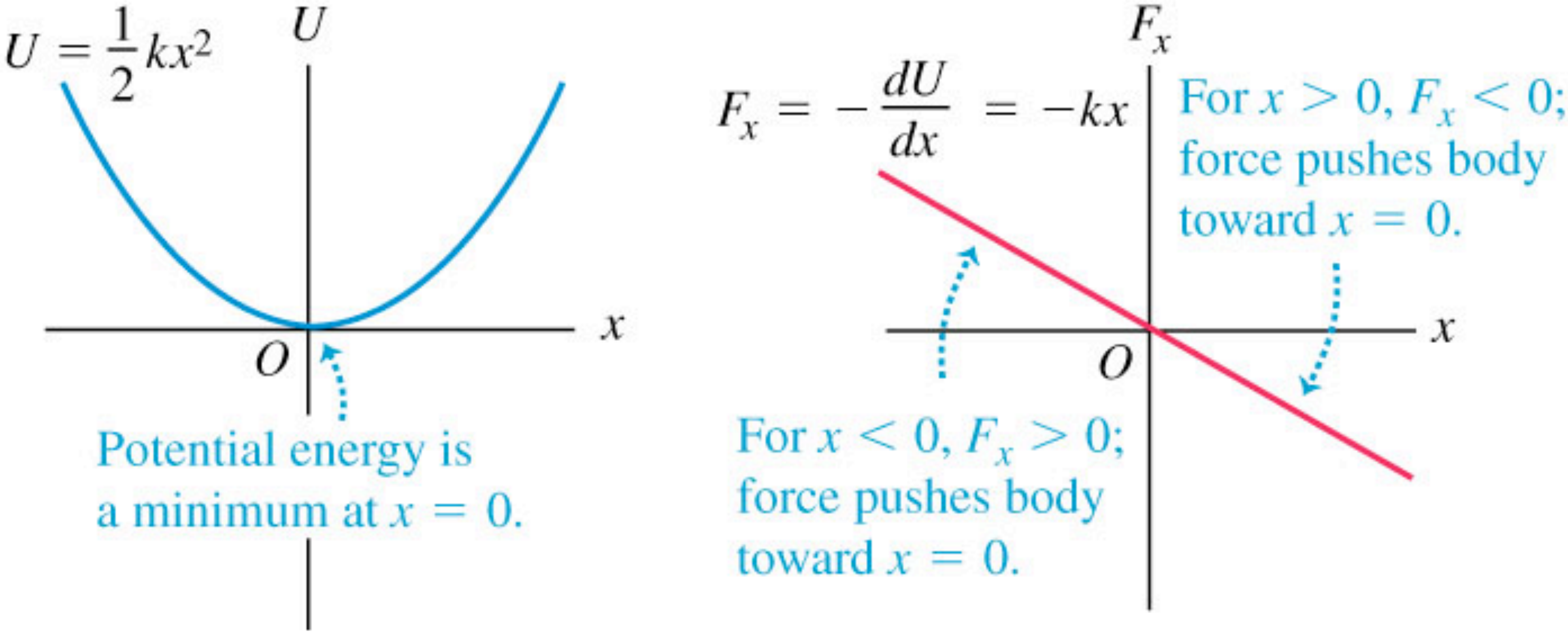
Force and Potential Energy

$$F = -\frac{dU(x)}{dx}$$

(b) Gravitational potential energy and force as functions of y

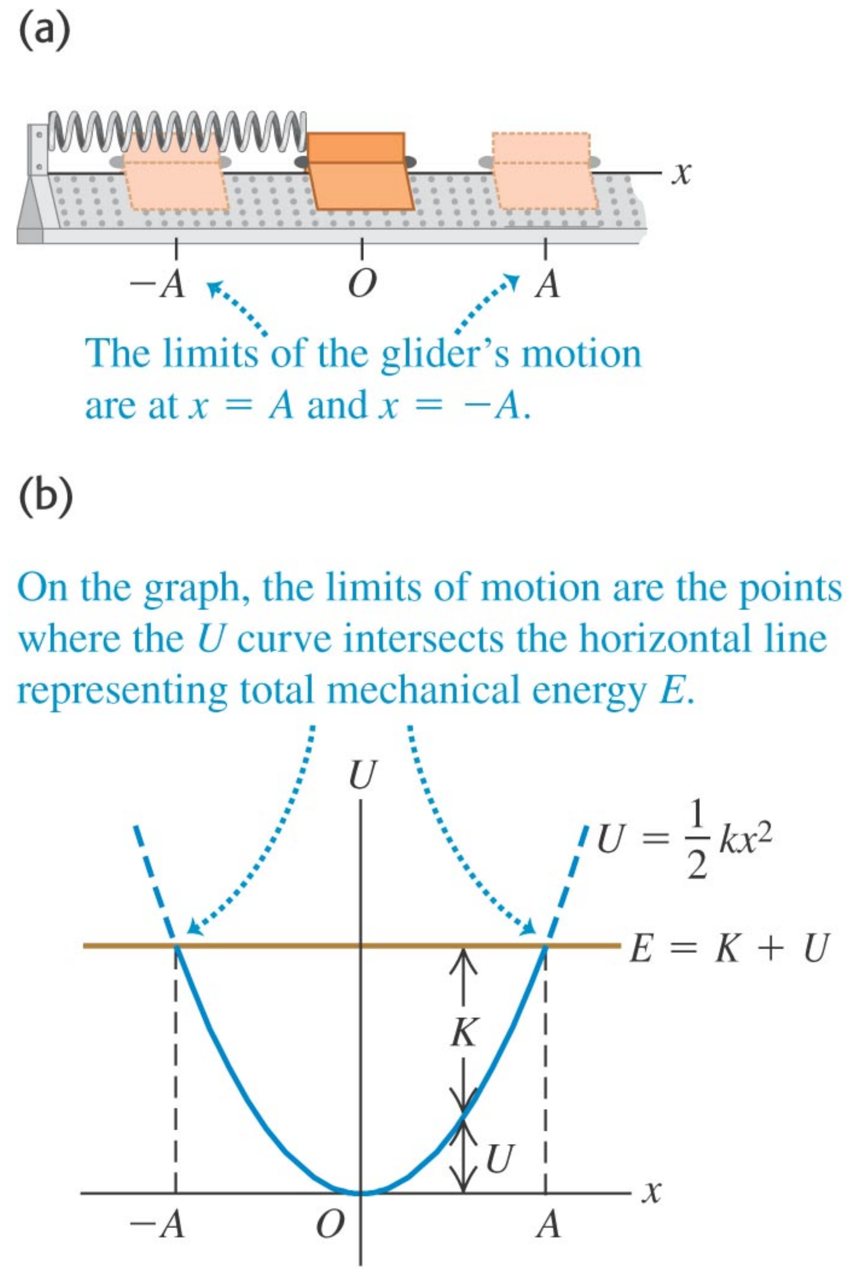


(a) Spring potential energy and force as functions of x



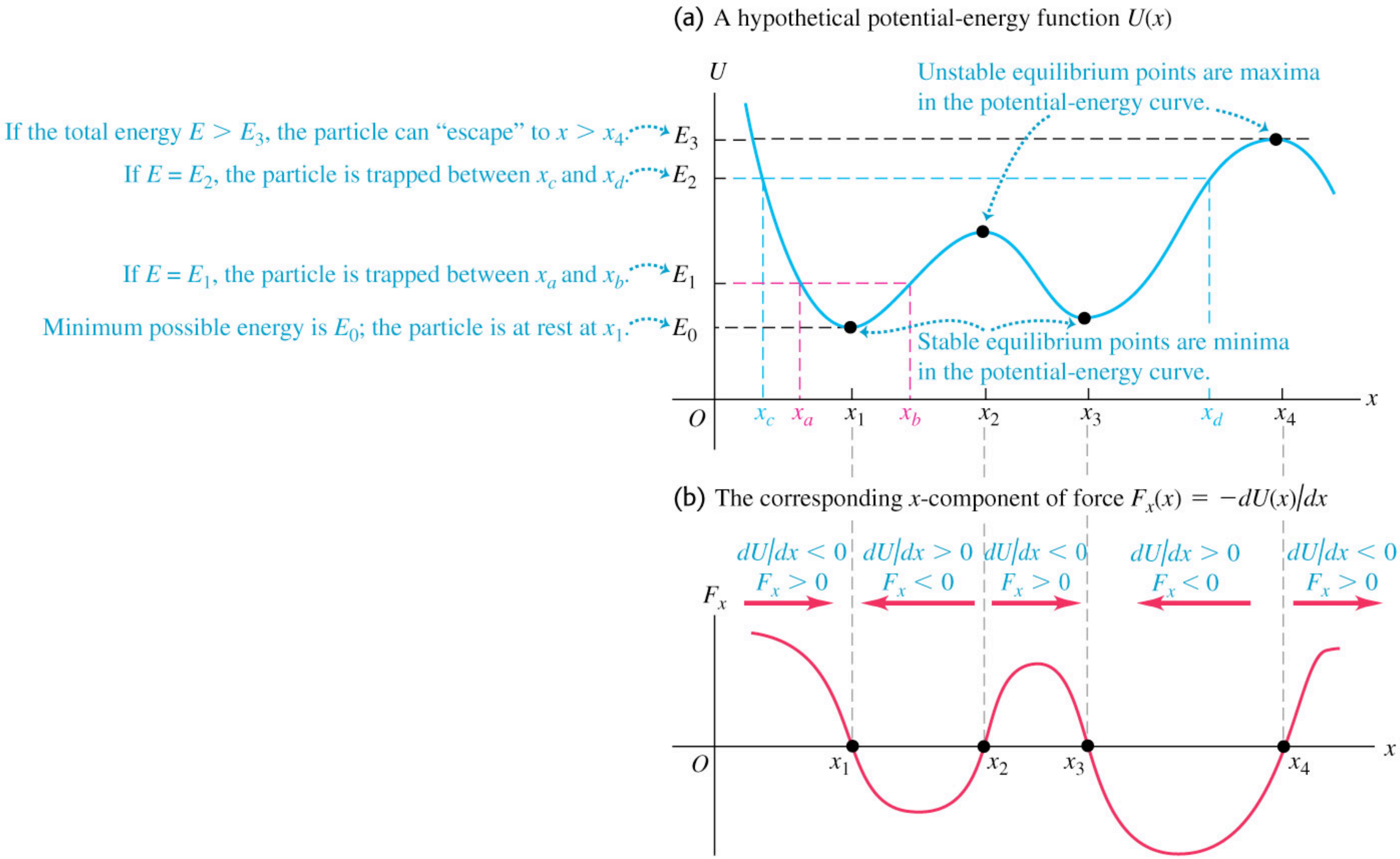
Energy diagrams

- An *energy diagram* is a graph that shows both the potential-energy function $U(x)$ and the total mechanical energy E.
- Figure 7.23 illustrates the energy diagram for a glider attached to a spring on an air track.



Force and a graph of its potential-energy function

- Figure 7.24 below helps relate a force to a graph of its corresponding potential-energy function.

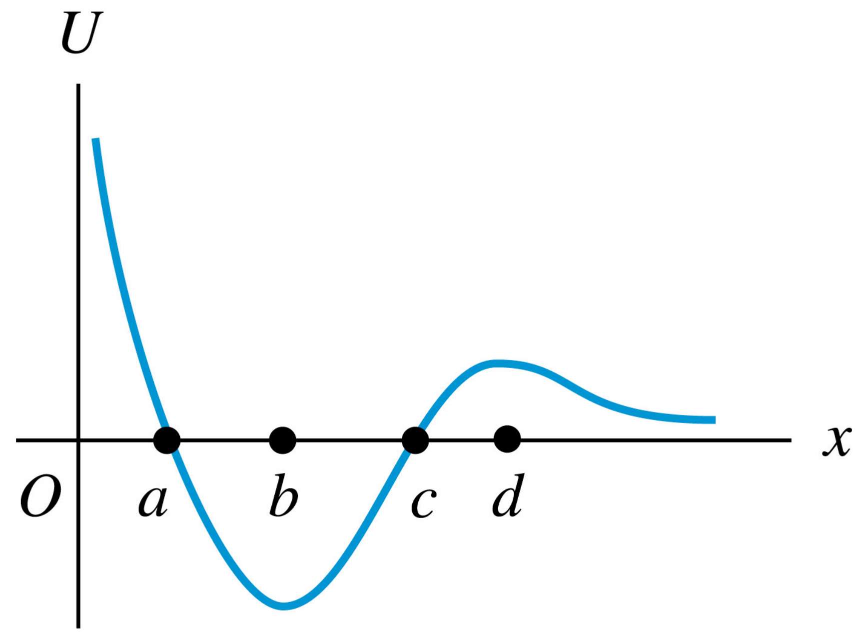


Unstable equilibrium

Q7.6

The graph shows the potential energy U for a particle that moves along the x-axis.

The particle is initially at $x = d$ and moves in the negative x-direction. At which of the labeled x-coordinates does the particle have the greatest *speed*?

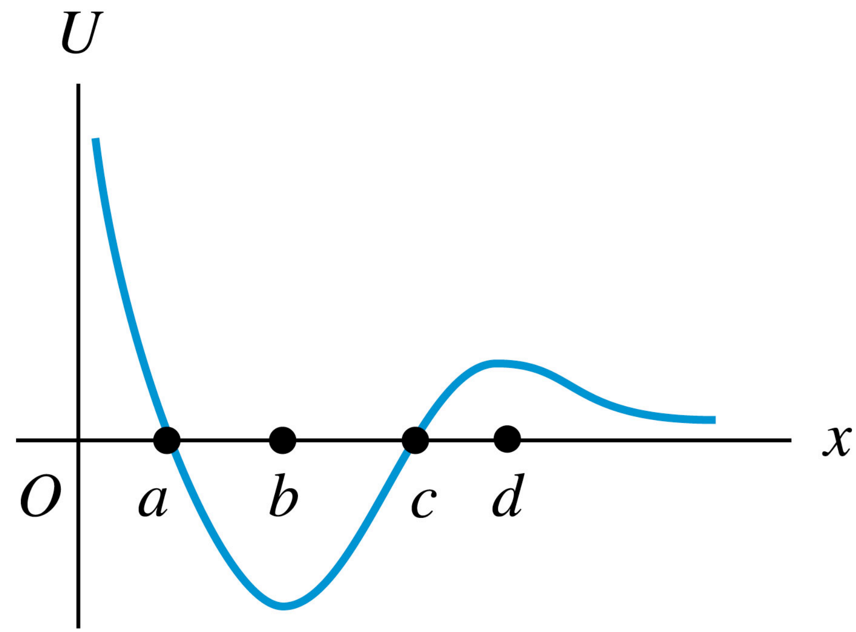


A. at $x = a$ B. at $x = b$ C. at $x = c$ D. at $x = d$

E. more than one of the above

Q7.8

The graph shows the potential energy U for a particle that moves along the x-axis. At which of the labeled x-coordinates is there *zero* force on the particle?



F. at $x = a$ and $x = c$

G. at $x = b$ only

H. at $x = d$ only

I. at $x = b$ and d

J. misleading question—there is a force at all values of x

Force and potential energy in two dimensions

- In two dimensions, the components of a conservative force can be obtained from its potential energy function using

$$F_x = -\partial U/dx \quad \text{and} \quad F_y = -\partial U/dy$$

- In general:

$$\vec{F} = -\nabla U$$