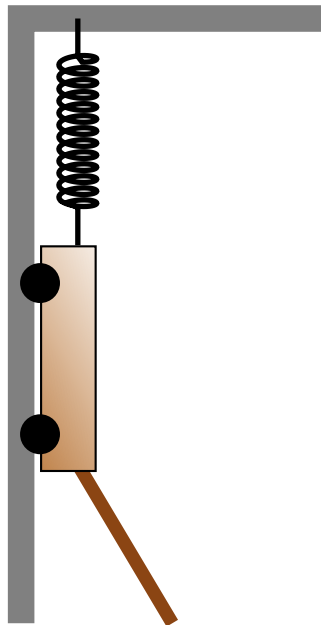


# Question 1

A cart is attached to a track by frictionless rails, which restrict the motion of the cart to the vertical direction. The cart is suspended from the ceiling by a spring.

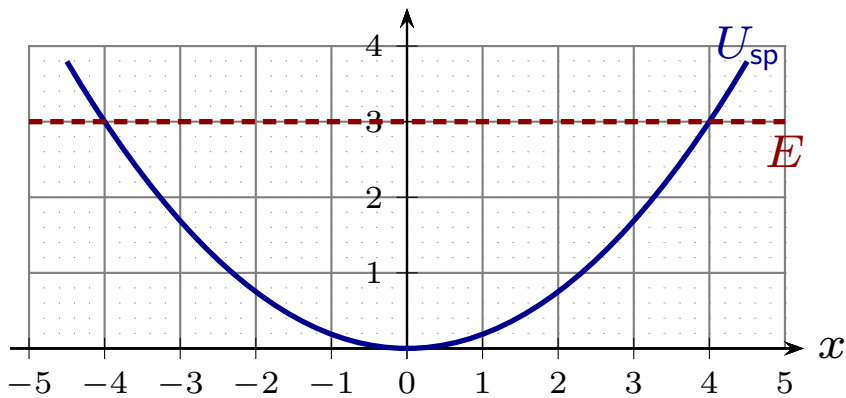


The cart is initially at rest. A rope then pulls the cart with a constant force at an angle from beneath and the cart moves down. Which of the following is true?

1.  $\Delta E = 0$
2.  $\Delta E = W_{\text{rope}}$
3.  $\Delta E = W_{\text{grav}}$
4.  $\Delta E + \Delta U_{\text{grav}} + \Delta U_{\text{spring}} = W_{\text{rope}}$
5.  $\Delta E + \Delta U_{\text{grav}} + \Delta U_{\text{spring}} = W_{\text{rope}} + W_{\text{grav}}$

## Question 2

A plot of potential energy for an object attached to a spring is indicated by the solid curve. The object's mechanical energy is indicated by the dashed curve. The horizontal axis indicates position in meters.

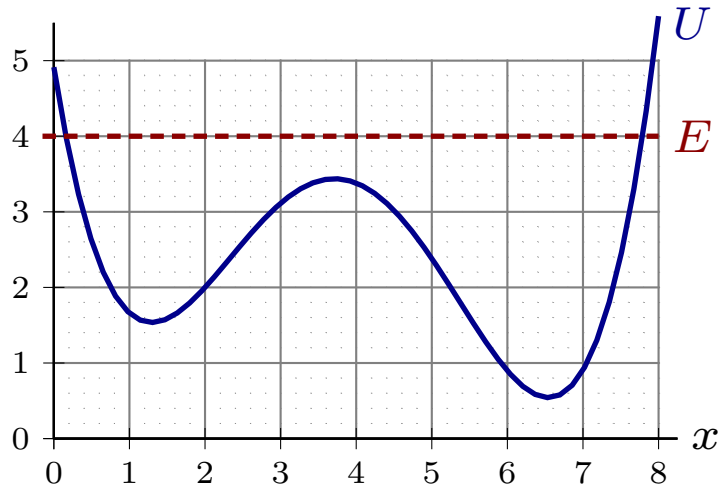


Which of the following is true when the object is at  $x = 4$  m?

1.  $K = 0$  and  $F_{sp} = 0$ .
2.  $K = 0$  and  $F_{sp} \neq 0$ .
3.  $K \neq 0$  and  $F_{sp} = 0$ .
4.  $K \neq 0$  and  $F_{sp} \neq 0$ .

## Question 3

A plot of potential energy (for a complicated interaction) is indicated by the solid curve. The particle's mechanical energy is indicated by the dashed curve. The horizontal axis indicates position in meters.

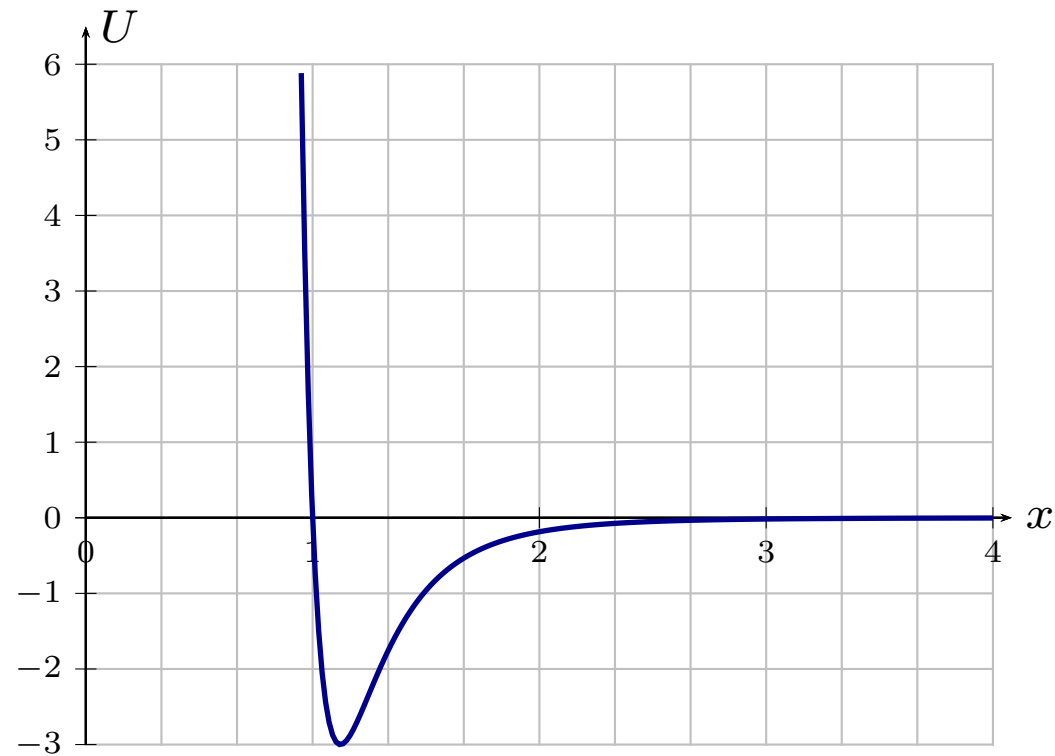


When does the particle attain its largest speed?

1. About 0.2 m
2. About 1.4 m
3. About 3.8 m
4. About 6.6 m
5. About 7.8 m

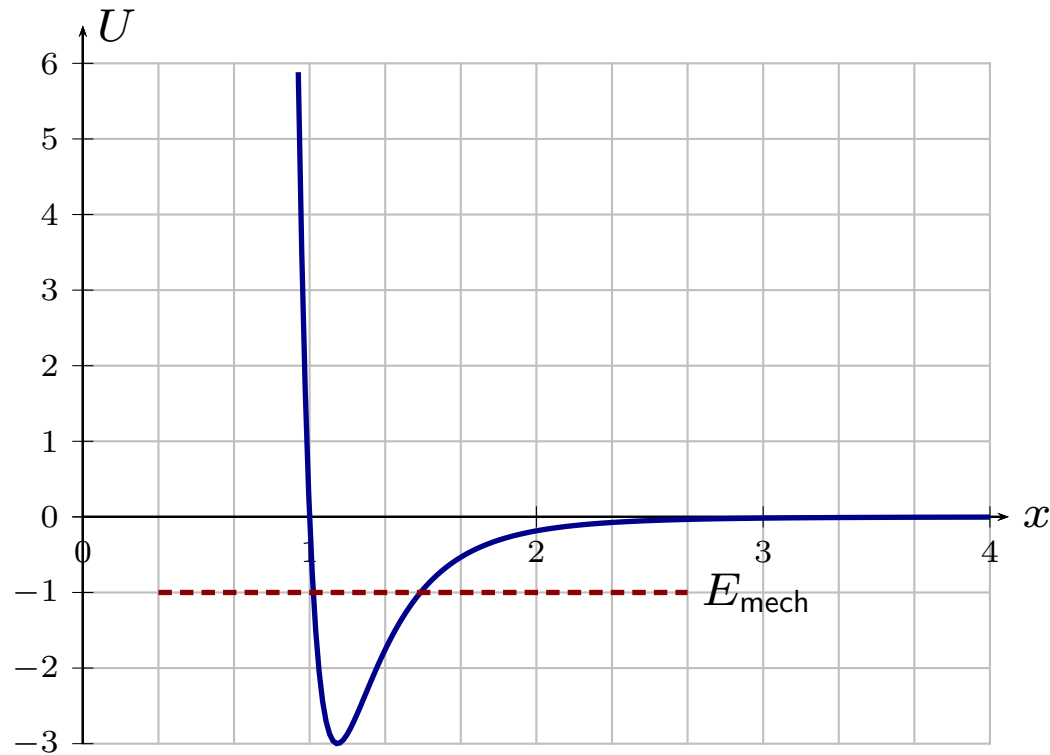
# Lennard-Jones Potential

Models interactions between two molecules in a gas.



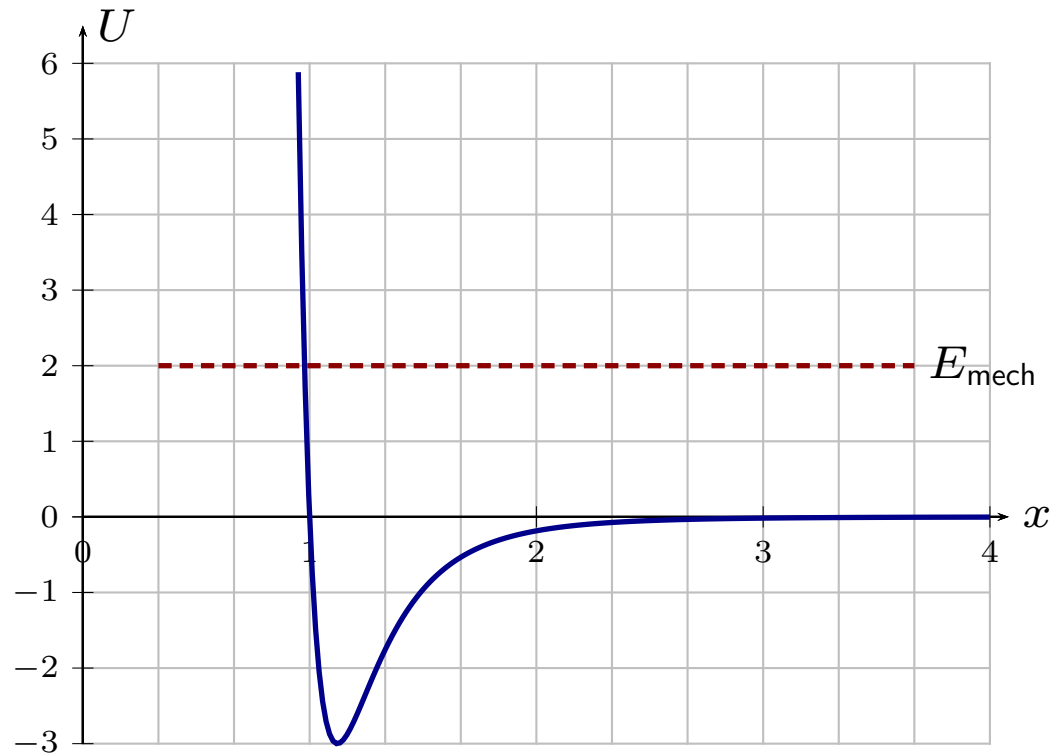
# Lennard-Jones Potential

Molecules are bound.



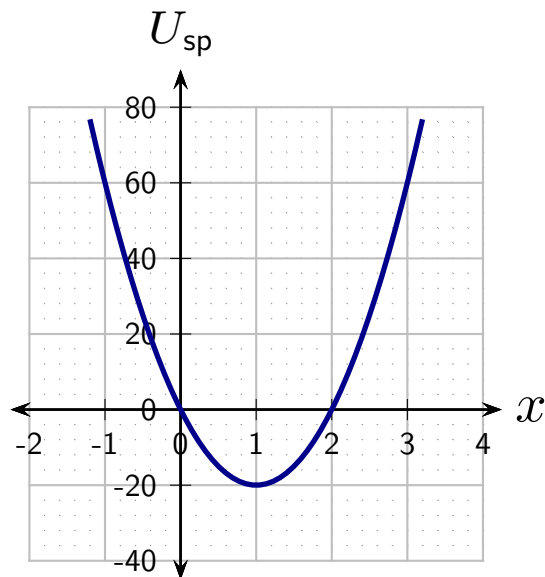
# Lennard-Jones Potential

Molecules are not bound.



## Question 4

A plot of potential energy for an object attached to a spring is indicated by the solid curve. The horizontal axis units are meters; vertical axis units are Joules.

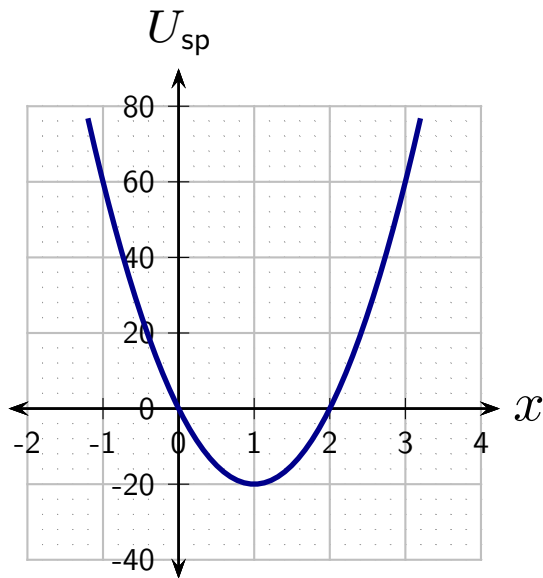


Suppose that  $E = 60$  J. Which of the following is the maximum kinetic energy?

1.  $-20$  J
2.  $40$  J
3.  $60$  J
4.  $80$  J
5.  $100$  J

## Question 5

A plot of potential energy for an object attached to a spring is indicated by the solid curve. The horizontal axis units are meters; vertical axis units are Joules.



Which of the following is true at the moment that the kinetic energy is a maximum?

1.  $F_x < 0$
2.  $F_x = 0$
3.  $F_x = 1$
4.  $F_x > 0$