

- 1 A mass-spring system makes 20 complete oscillations in 5 seconds. What is the period and frequency of the oscillations?**

2 A mass-spring system oscillates with a period of 6 seconds. How long will it take to complete 8 complete cycles?

3A simple pendulum oscillates with a period of 5 seconds. How many complete oscillations does it make in 15 seconds?

4A simple pendulum oscillates with a frequency of 25 Hz. What is the period?

**5A simple pendulum oscillates with a period of 4 s.
What is the frequency?**

6A mass-spring system makes 50 complete oscillations in 10 seconds. What is the period and frequency of the oscillations?

7A mass-spring system oscillates with a frequency of 20 Hz. What is the period?

8A simple pendulum oscillates with a period of 2 seconds. How many complete oscillations does it make in 30 seconds?

9A simple pendulum oscillates with a period of 7 seconds. How long will it take to complete 15 complete cycles?

10A mass-spring system oscillates with a period of 0.5 s. What is the frequency?

11 What is the mass which causes a spring of $k = 80$ N/m to stretch by 4 cm?

12A spring stretches 5 cm when a 1 kg mass is suspended from it. What is the spring constant?

13 What is the mass which causes a spring of $k = 100$ N/m to stretch by 10 cm?

14A spring stretches 7 cm when a 1.2 kg mass is suspended from it. What is the spring constant?

15 A mass of 1.4 kg is attached to a horizontal spring with a spring constant of 75 N/m. The spring is stretched from equilibrium position by 5 cm and released.

- a. What is the maximum elastic potential energy?**
- b. What is the maximum kinetic energy?**
- c. What is the maximum speed of the mass?**
- d. At which point the maximum speed will be reached?**

- 16 A mass of 2.7 kg is attached to a horizontal spring with a spring constant of 96 N/m. The spring is stretched from equilibrium position by 7 cm and released.**
- a. What is the maximum elastic potential energy?**
 - b. What is the maximum kinetic energy?**
 - c. What is the maximum speed of the mass?**
 - d. At which point the maximum speed will be reached?**

17 A mass of 3.6 kg oscillate on a horizontal spring with a spring constant of 160 N/m. When the mass passes the equilibrium point its speed is 5.2 m/s.

- a. What is the maximum kinetic energy?**
- b. What is the total energy?**
- c. What is the maximum elastic potential energy?**
- d. What is the maximum displacement of the mass?**
- e. Make a sketch of a mass-spring oscillating system and show maximum displacement, equilibrium point and the energies related to these points.**

18 A mass of 1.8 kg oscillate on a horizontal spring with a spring constant of 120 N/m. When the mass passes the equilibrium point its speed is 4.8 m/s.

- a. What is the maximum kinetic energy?**
- b. What is the total energy?**
- c. What is the maximum elastic potential energy?**
- d. What is the maximum displacement of the mass?**
- e. Make a sketch of a mass-spring oscillating system and show maximum displacement, equilibrium point and the energies related to these points.**

19 What is the period of a mass-spring oscillation system with a spring constant of 120 N/m and mass of 0.5 kg?

20 What is the spring constant of a mass-spring oscillating system making 10 complete oscillations in 5 seconds when a mass of 2 kg is suspended from the spring?

21 What is the mass suspended from a spring of 200 N/m making 20 complete cycles in 50 seconds?

22 What is the frequency of a mass-spring oscillation system with a spring constant of 125 N/m and mass of 3 kg?

23 What is the period of a mass-spring oscillation system with a spring constant of 250 N/m and mass of 5 kg?

24 What is the spring constant of a mass-spring oscillating system making 15 complete oscillations in 30 seconds when a mass of 0.2 kg is suspended from the spring?

25 What is the mass suspended from a spring of 150 N/m making 10 complete cycles in 30 seconds?

26 What is the frequency of a mass-spring oscillation system with a spring constant of 210 N/m and mass of 7 kg?

27A simple pendulum with a length of 2 m oscillates on the Earth's surface. What is the period of oscillations?

28 What is the length of a simple pendulum oscillating on Earth with a period of 0.5 s?

29A 2.2 m long simple pendulum oscillates with a period of 4.8 s on the surface of unknown planet. What is the surface gravity of the planet?

30A simple pendulum with a length of 2.6 m oscillates on the Earth's surface. What is the frequency of oscillations?

31A simple pendulum with a length of 1 m oscillates on the Moon's surface where acceleration due to gravity is 1.7m/s^2 . What is the period of oscillations?

32 What is the length of a simple pendulum oscillating on Earth with a period of 1.2 s?

33A 3.4 m long simple pendulum oscillates with a period of 2.4 s on the surface of unknown planet. What is the surface gravity of the planet?

34A simple pendulum with a length of 1.8 m oscillates on the Moon's surface where acceleration due to gravity is 1.7m/s^2 . What is the frequency of oscillations?

35 A mass of 0.5 kg oscillates on a simple pendulum with a length of 1.5 m that reaches a maximum height of 0.08 m when it is in SHM.

- a. What is the maximum gravitational potential energy?**
- b. What is the maximum kinetic energy?**
- c. What is the total energy of the system?**
- d. What is the maximum speed of the mass?**
- e. At which point the maximum speed is reached?**

36 A mass of 0.6 kg oscillates on a simple pendulum with a length of 0.9 m that reaches a maximum height of 0.04 m when it is in SHM.

- a. What is the maximum gravitational potential energy?**
- b. What is the maximum kinetic energy?**
- c. What is the total energy of the system?**
- d. What is the maximum speed of the mass?**
- e. At which point the maximum speed is reached?**

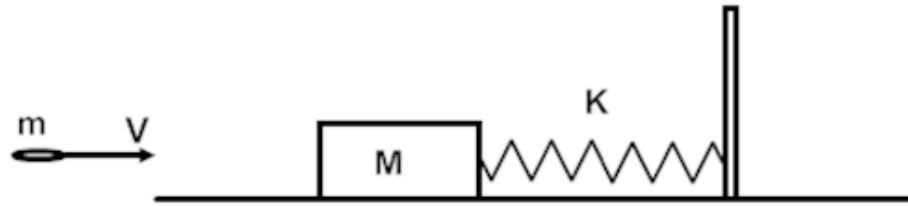
37 A mass of 0.6 kg oscillates at the end of a 2 m long string. When the mass passes the lowest point its speed is 0.9 m/s.

- a. What is the maximum kinetic energy of the system?**
- b. What is the maximum gravitational potential energy of the system?**
- c. What is the total energy of the system?**
- d. What is the maximum height the mass reaches during SHM?**
- e. Make a sketch of the simple pendulum and show the maximum displacement, equilibrium point and energies related to these points.**

38 A mass of 0.8 kg oscillates at the end of a 1.9 m long string. When the mass passes the lowest point its speed is 0.7 m/s.

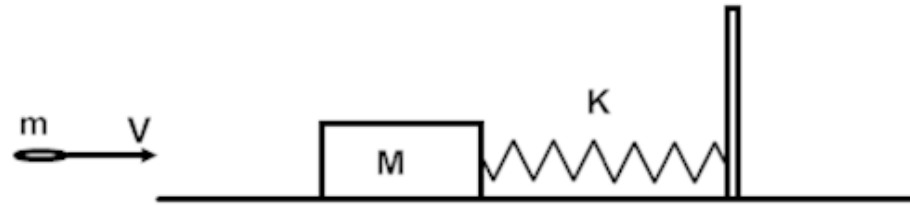
- a. What is the maximum kinetic energy of the system?**
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- e. Make a sketch of the simple pendulum and show the maximum displacement, equilibrium point and energies related to these points**

General Problems



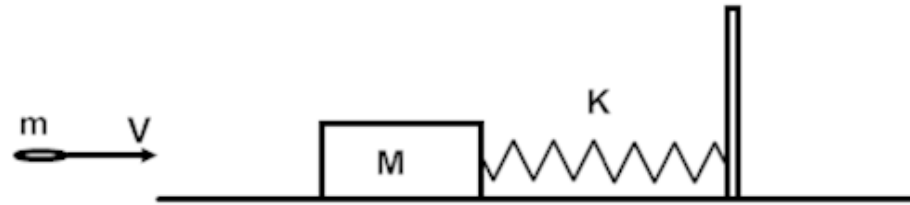
1. A bullet $m = 0.001$ kg moves with a speed of 500 m/s and strikes a block $M = 2$ kg at rest. After the collision the bullet becomes embedded into the block. The block is attached to the end of a spring $k = 120$ N/m.

- a. What is the initial kinetic energy of the bullet?**
- b. What is the speed of the bullet-block system after the collision?**
- c. What is the kinetic energy of the bullet-block system after the collision?**
- d. What is the maximum elastic potential energy when the block comes to rest?**
- e. What is the maximum compression of the spring?**
- f. What is the period of oscillations?**



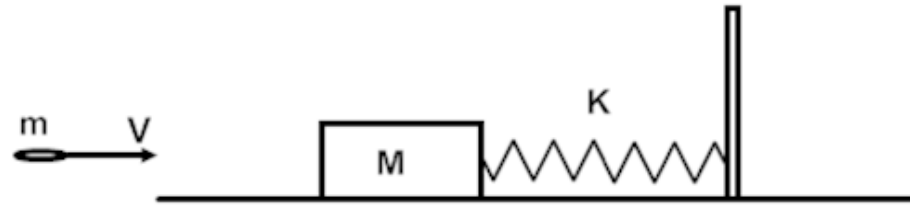
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a. What is the initial kinetic energy of the bullet?



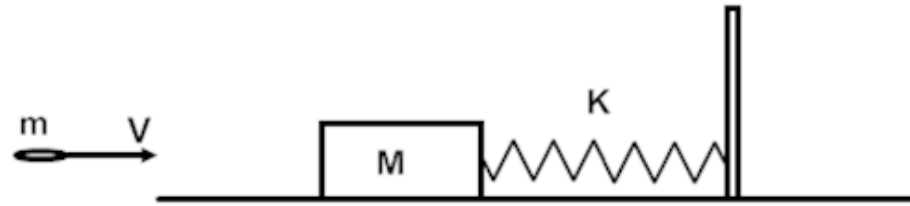
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b. What is the speed of the bullet-block system after the collision?



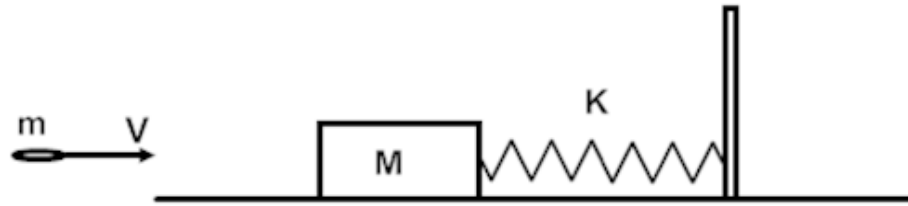
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c. What is the kinetic energy of the bullet-block system after the collision?



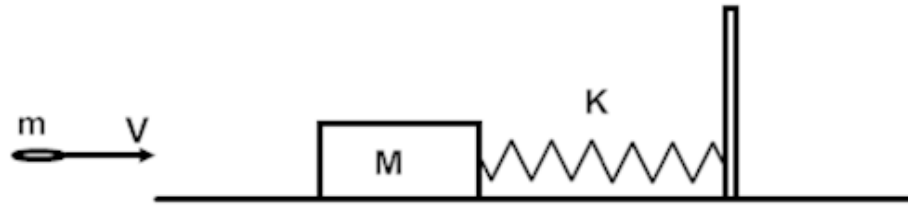
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d. What is the maximum elastic potential energy when the block comes to rest?



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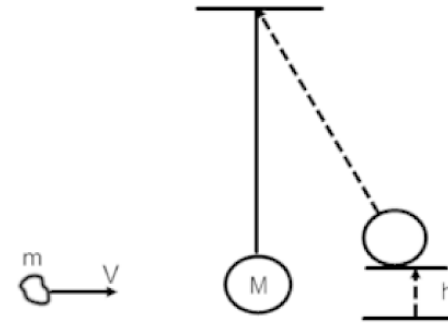
e. What is the maximum compression of the spring?



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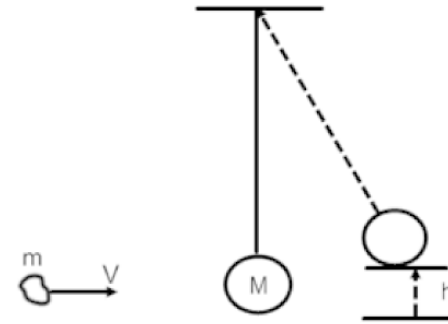
f. What is the period of oscillations?

2. A piece of clay $m = 0.04 \text{ kg}$ has a speed of 15 m/s as shown above. The clay strikes a pendulum bob $M = 0.5 \text{ kg}$ and sticks to it. The pendulum bob is attached to a string that is 0.5 meters long. As a result of the collision the pendulum swings to the right and the bob moves up by distance h .



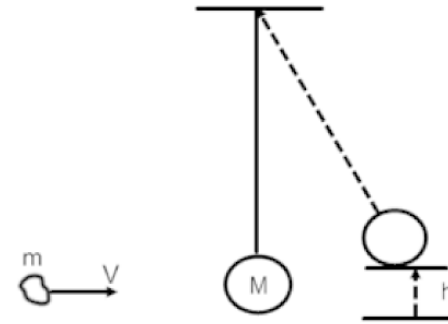
- What is the initial kinetic energy of the clay?
- What is the speed of the clay-bob system after the collision?
- What is the kinetic energy of the clay-bob system after the collision?
- What is the maximum gravitational potential energy of the clay-bob system?
- Find the maximum height of the bob after the collision.
- What is the period of oscillations?

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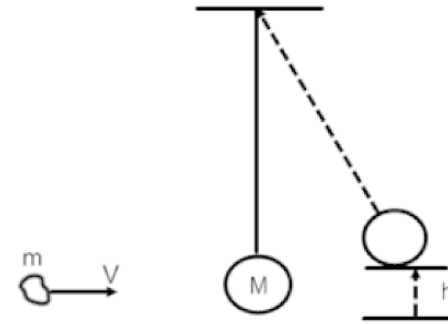
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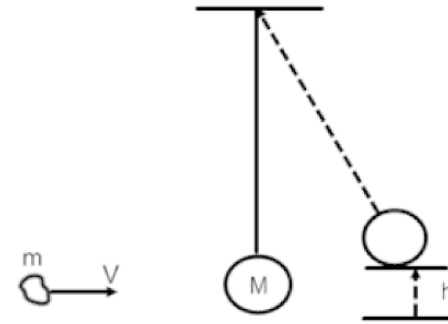
b. What is the speed of the clay-bob system after the collision?

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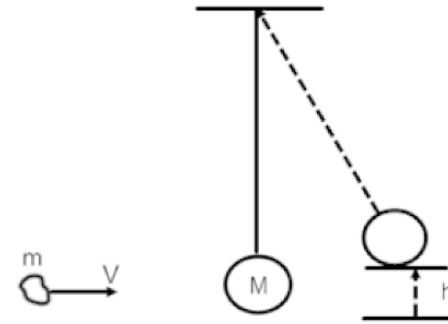
c. What is the kinetic energy of the clay-bob system after the collision?

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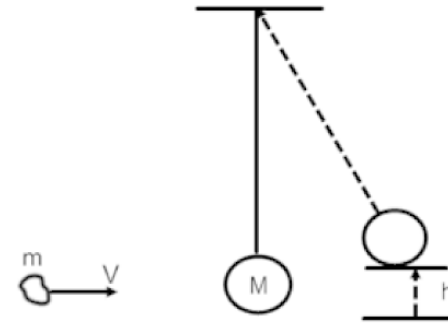
d. What is the maximum gravitational potential energy of the clay-bob system?

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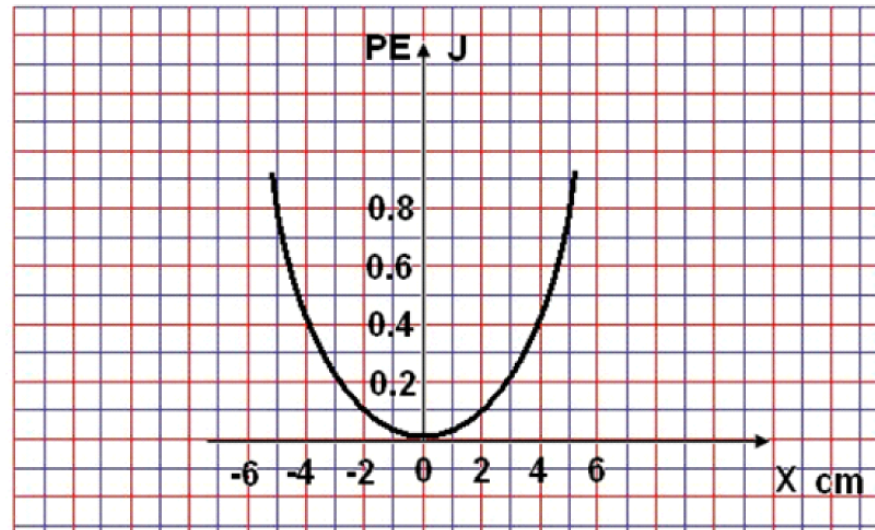
e. Find the maximum height of the bob after the collision.

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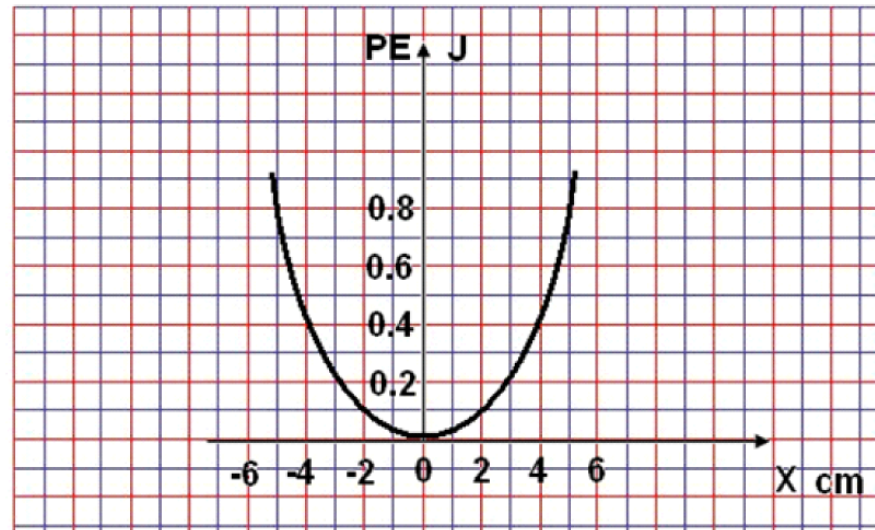
f. What is the period of oscillations?

3. A 0.5 mass is attached to a horizontal spring which undergoes SHM. The graph of EPE as a function of position show above. The total energy of the oscillating system is 0.8 J.



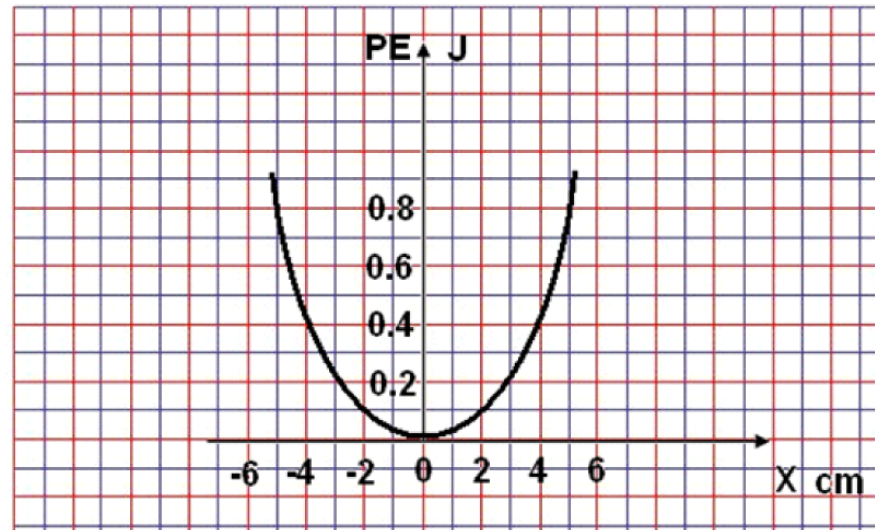
- Draw the graph of total energy as a function of position.
- Draw the graph of kinetic energy as a function of position.
- Draw the graph of kinetic energy as a function of position.
- What is the maximum displacement of the oscillating mass?
- What is the potential energy at the position of 2 cm?
- What is the kinetic energy at the position of 2 cm?
- Find the location of the oscillating mass when its potential energy is 0.7

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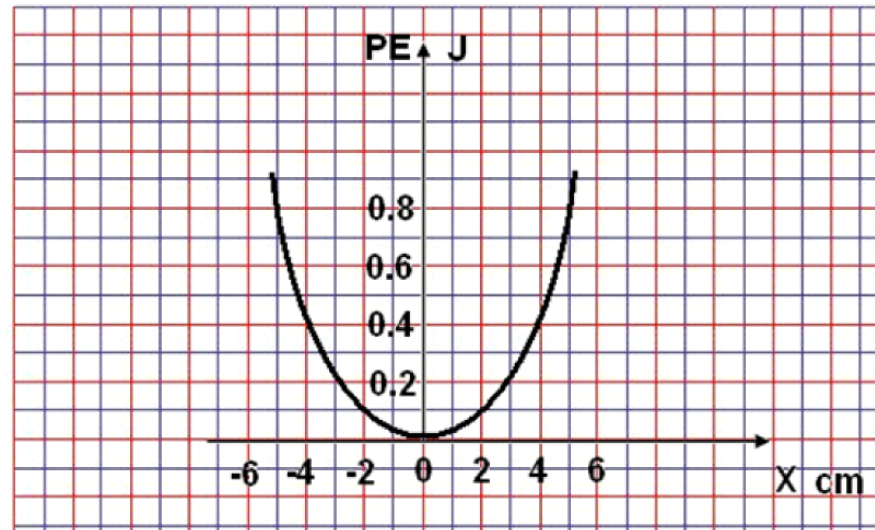
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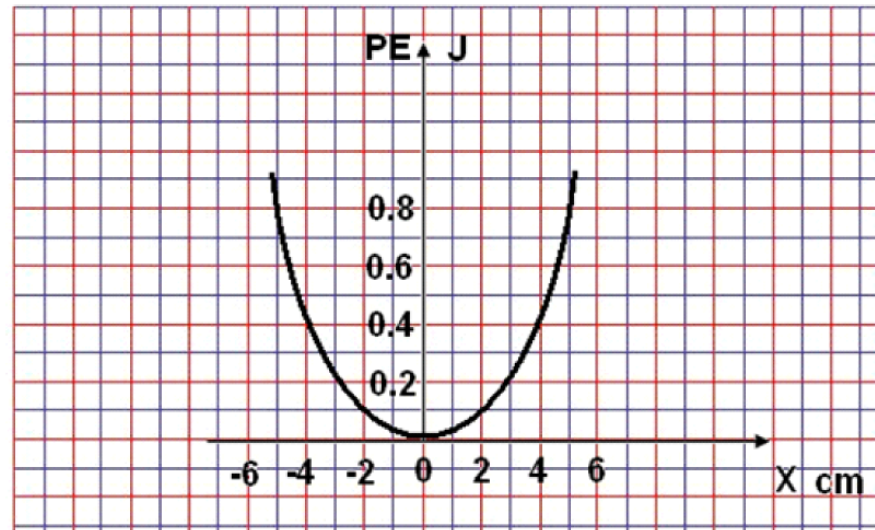
b. Draw the graph of kinetic energy as a function of position.

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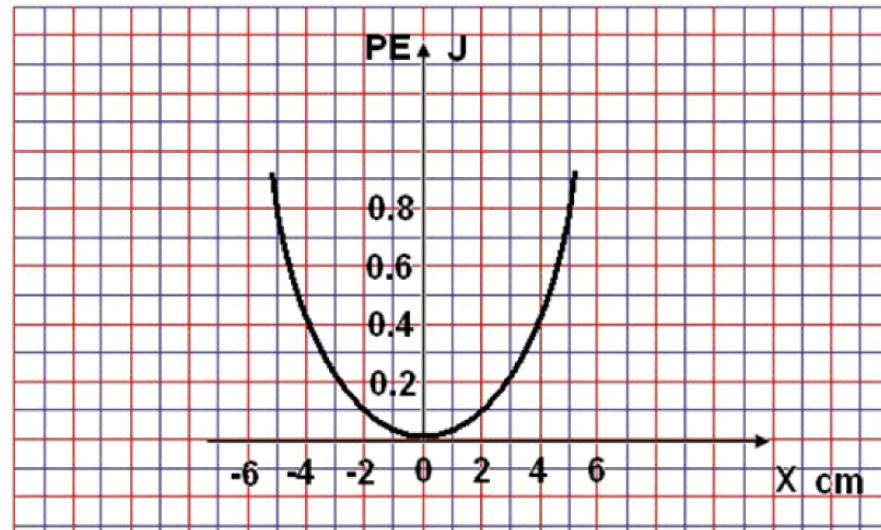
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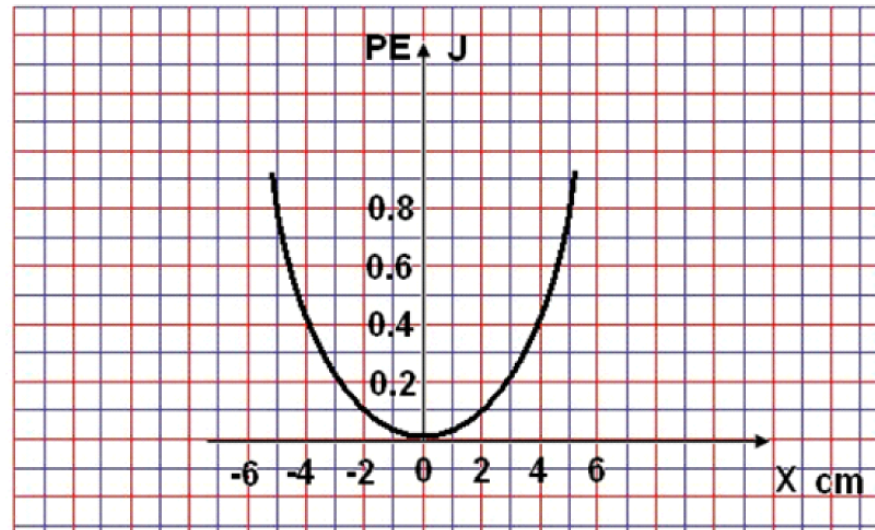
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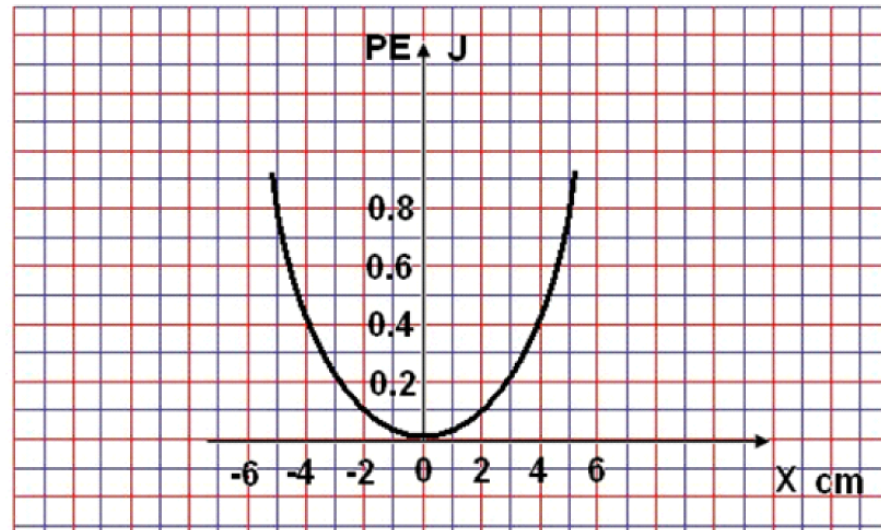
e. What is the potential energy at the position of 2 cm?

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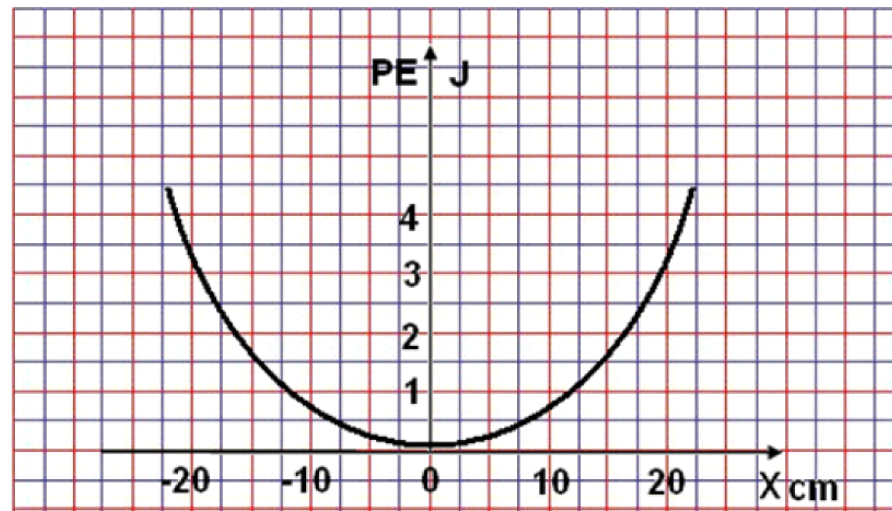
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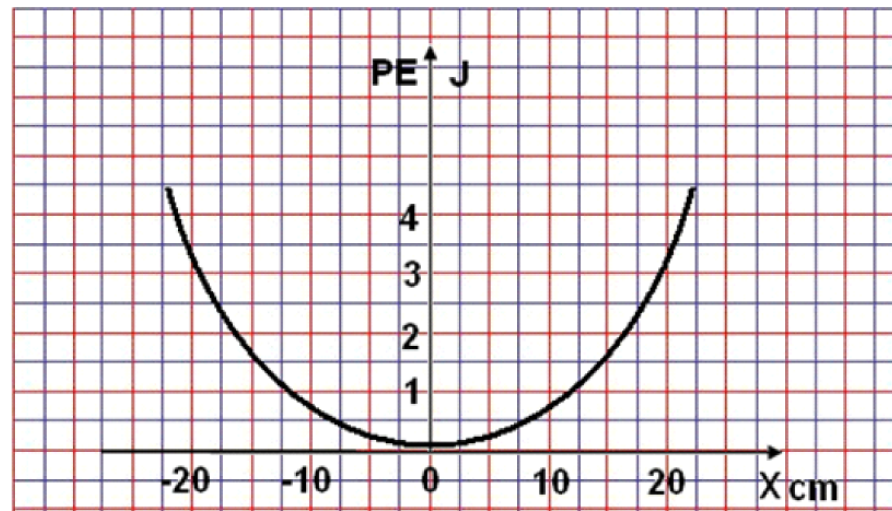
g. Find the location of the oscillating mass when its potential energy is 0.7

4. A 0.6 mass is attached to a horizontal spring which undergoes SHM. The graph of EPE as a function of position show above. The total energy of the oscillating system is 3 J.



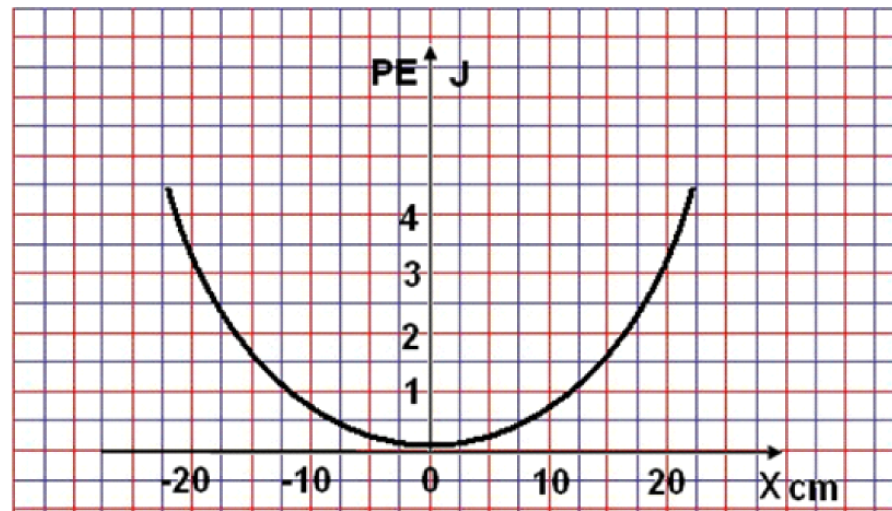
- Draw the graph of total energy as a function of position.
- Draw the graph of kinetic energy as a function of position.
- What is the maximum displacement of the oscillating mass?
- What is the potential energy at the position of 7.5 cm?
- What is the kinetic energy at the position of 7.5 cm?
- Find the location of the oscillating mass when its potential energy is 1.5
- What is the period of oscillations?

4. A 0.6 mass is attached to a horizontal spring which undergoes SHM. The graph of EPE as a function of position show above. The total energy of the oscillating system is 3 J.



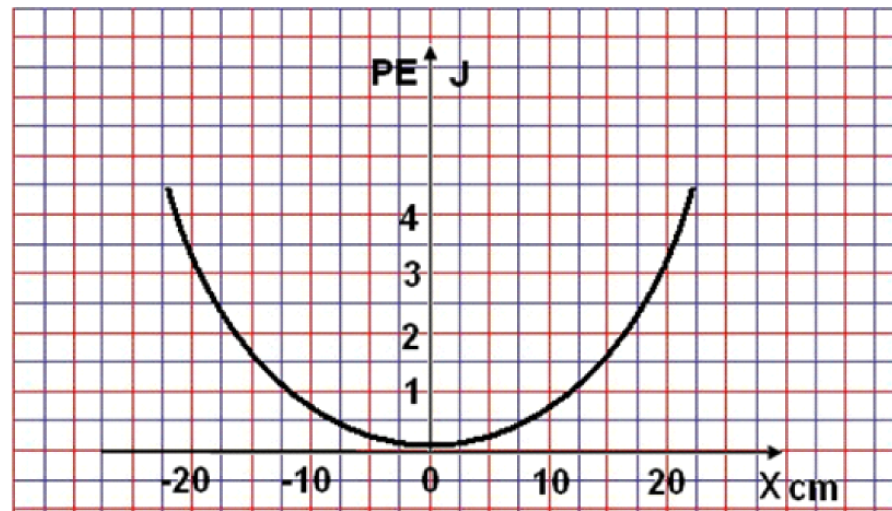
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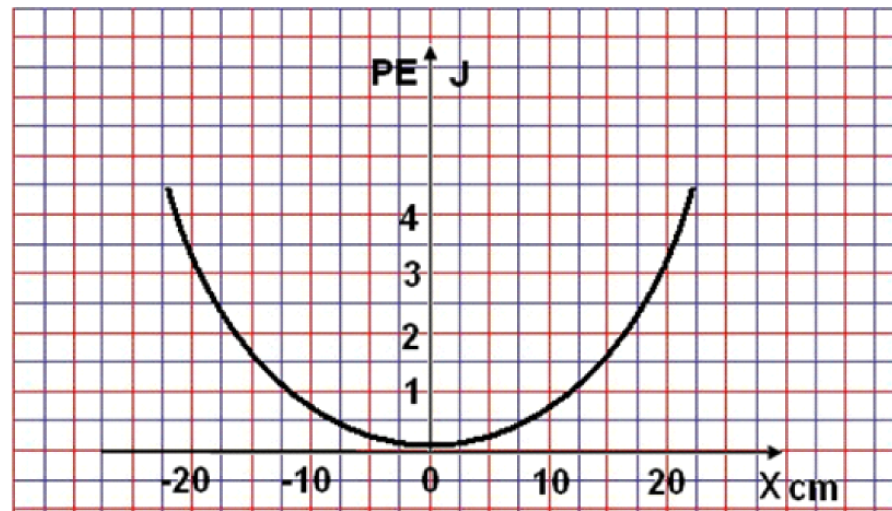
b. Draw the graph of kinetic energy as a function of position.

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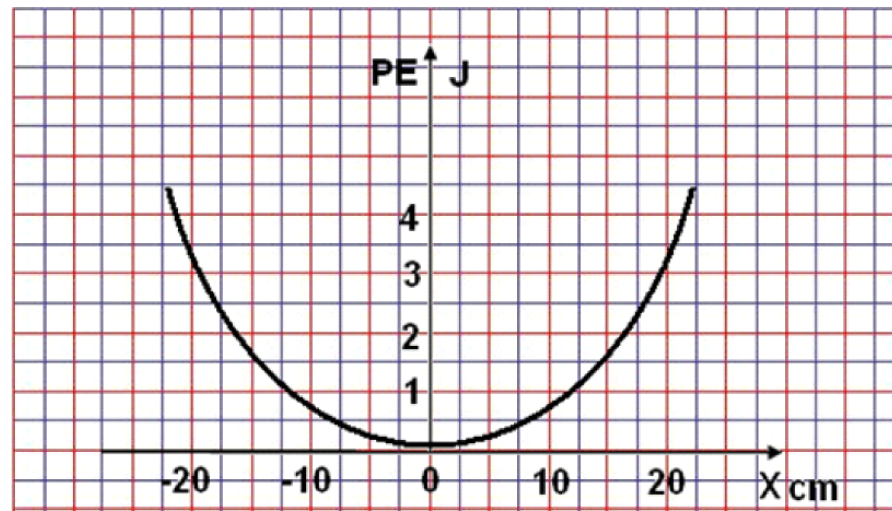
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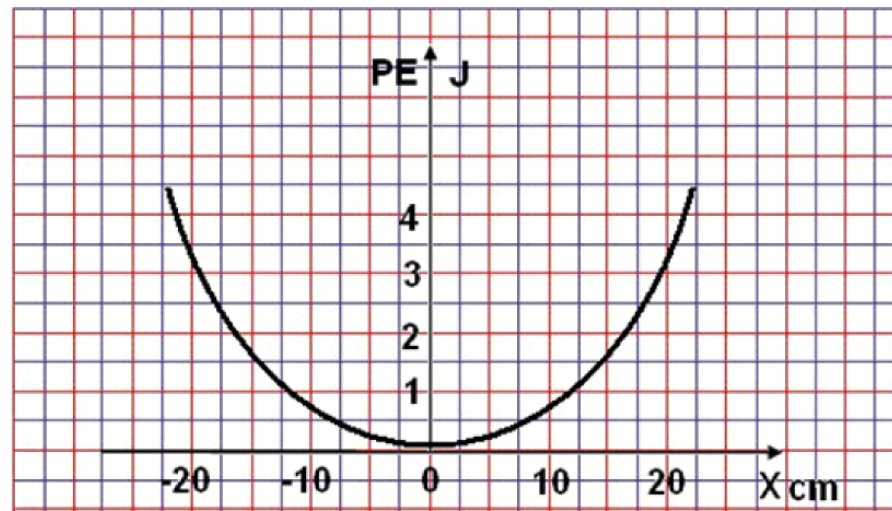
d. What is the potential energy at the position of 7.5 cm?

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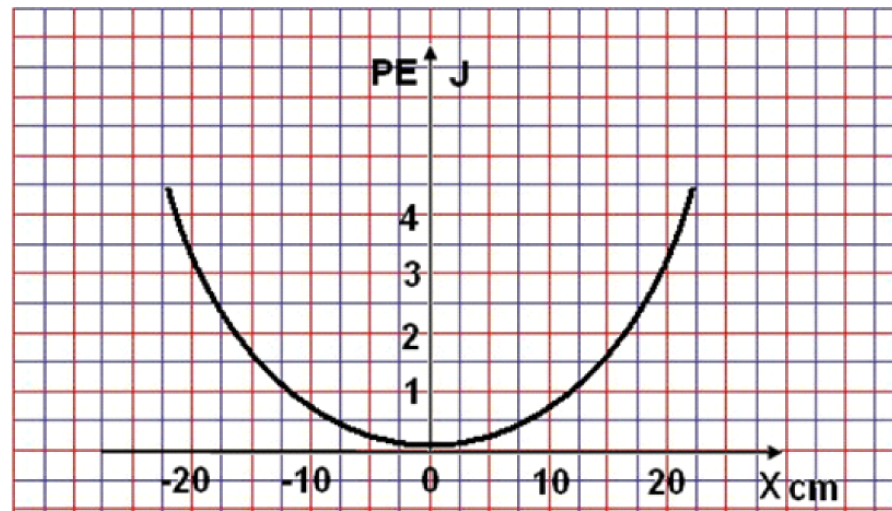
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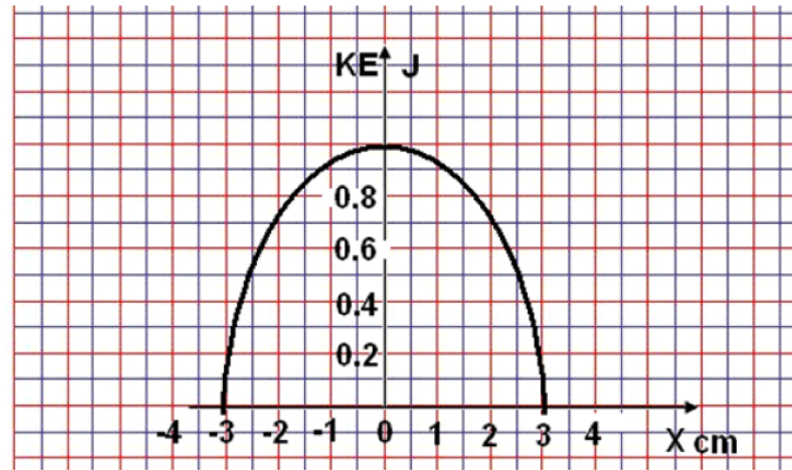
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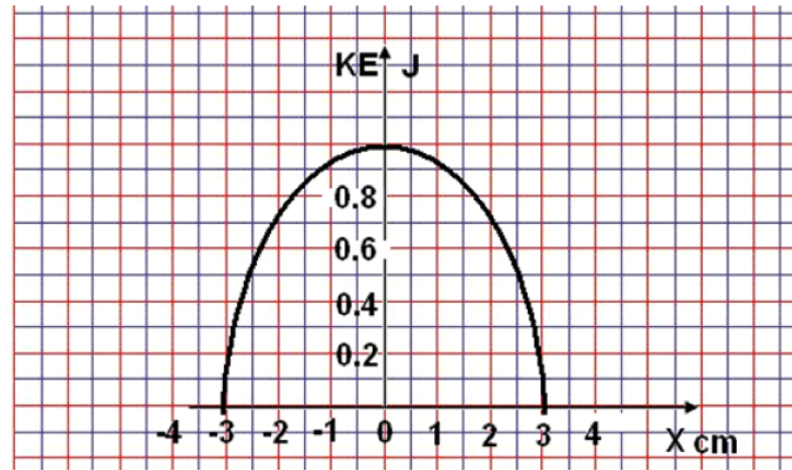
g. What is the period of oscillations?

5. A 0.4 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



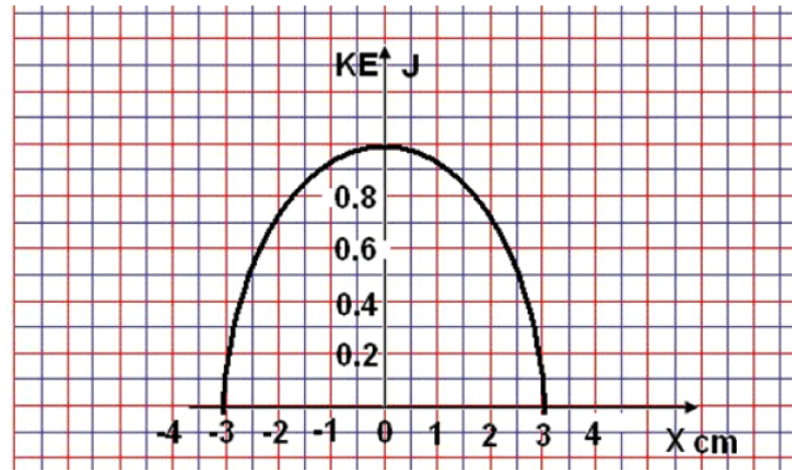
- Draw the graph of total energy as a function of position.
- Draw the graph of potential energy as a function of position.
- What is the maximum displacement of the oscillating mass?
- What is the potential energy at the position of 2 cm?
- What is the kinetic energy at the position of 2 cm?
- Find the location of the oscillating mass when its kinetic energy is 0.5
- What is the period of oscillations?

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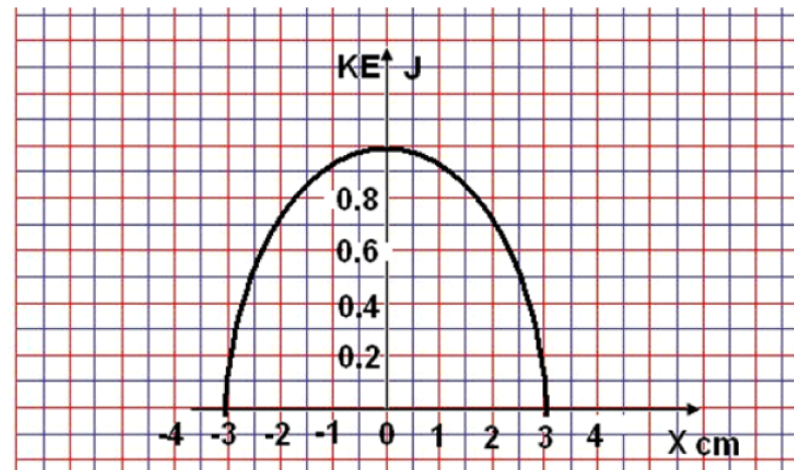
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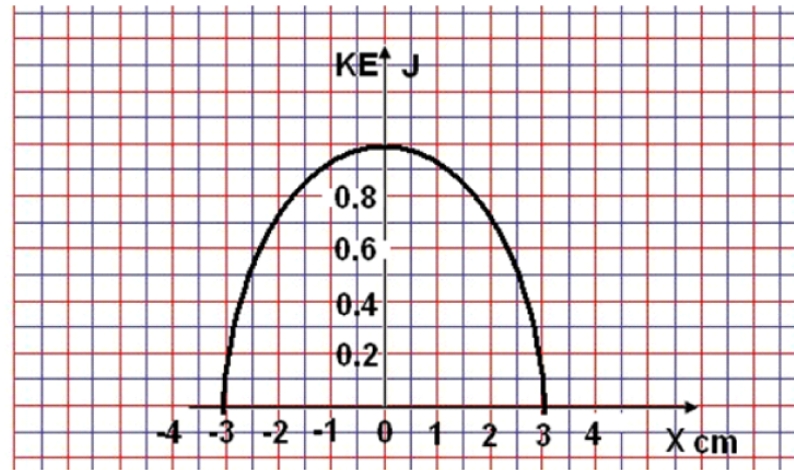
b. Draw the graph of potential energy as a function of position.

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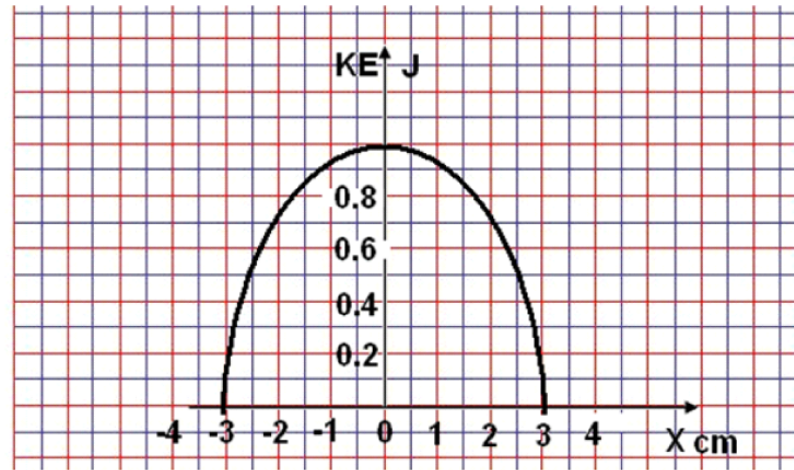
c. What is the maximum displacement of the oscillating mass?

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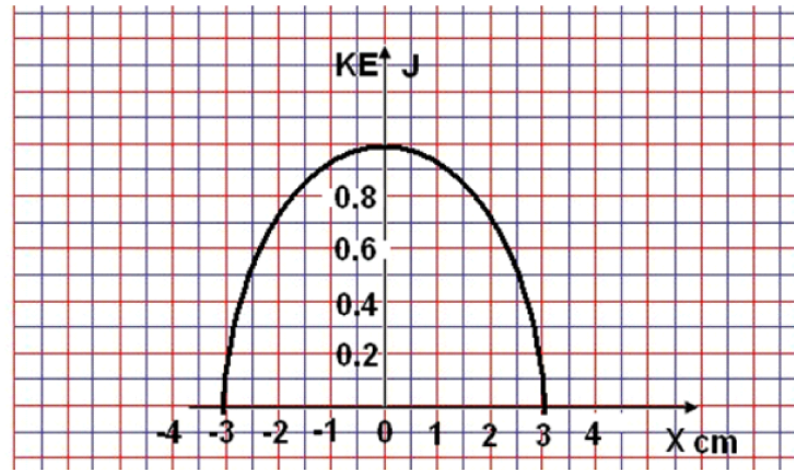
d. What is the potential energy at the position of 2 cm?

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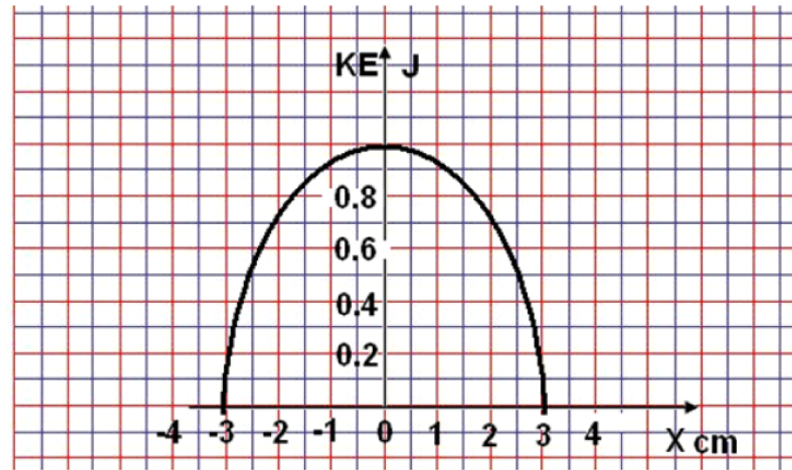
e. What is the kinetic energy at the position of 2 cm?

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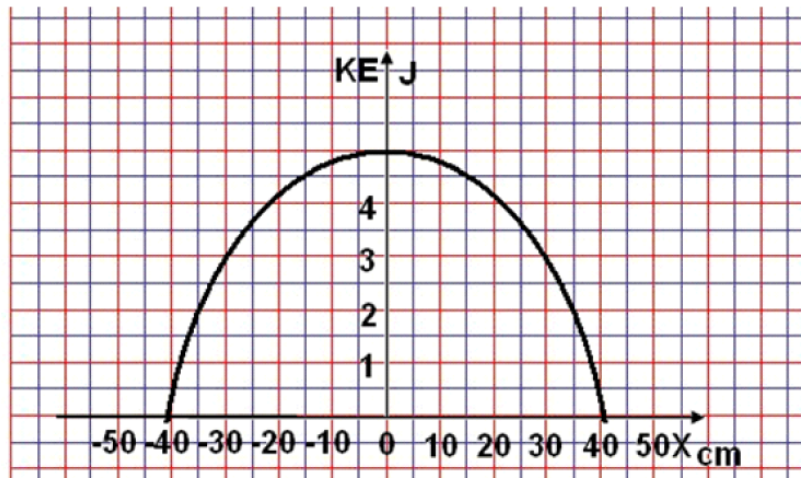
f. Find the location of the oscillating mass when its kinetic energy is 0.5

5. A 0.4 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



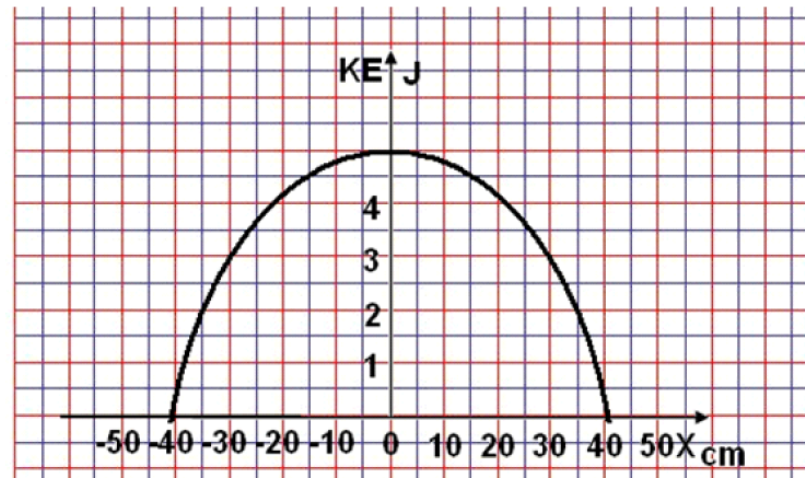
g. What is the period of oscillations?

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



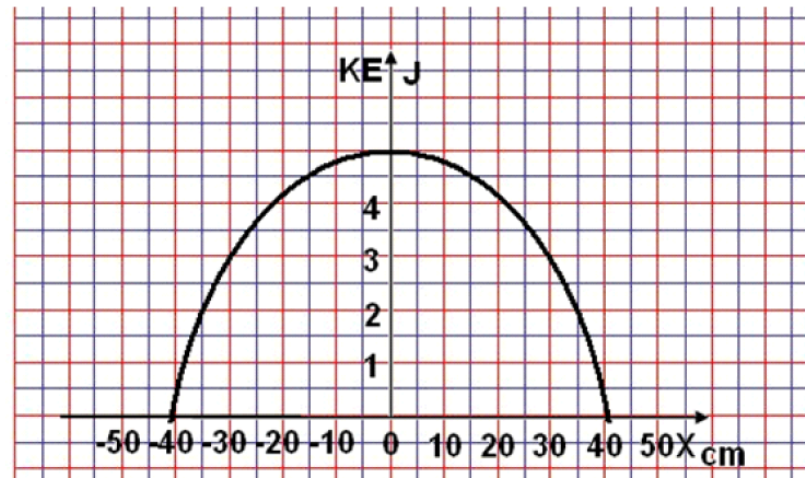
- Draw the graph of total energy as a function of position.
- Draw the graph of potential energy as a function of position.
- What is the maximum displacement of the oscillating mass?
- What is the potential energy at the position of 20 cm?
- What is the kinetic energy at the position of 20 cm?
- Find the location of the oscillating mass when its kinetic energy is 2
- What is the period of oscillations?

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



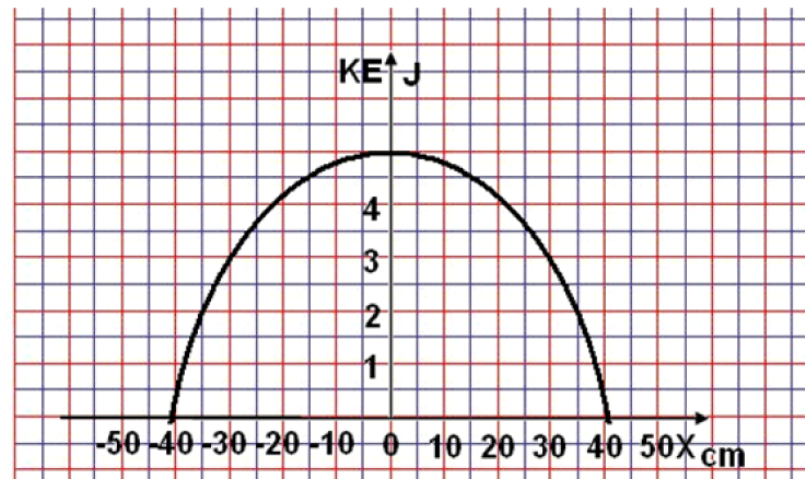
a. Draw the graph of total energy as a function of position.

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



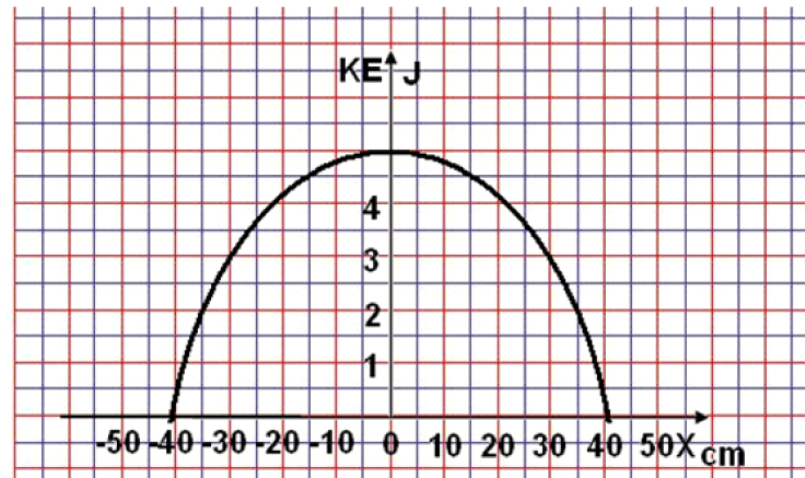
b. Draw the graph of potential energy as a function of position.

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



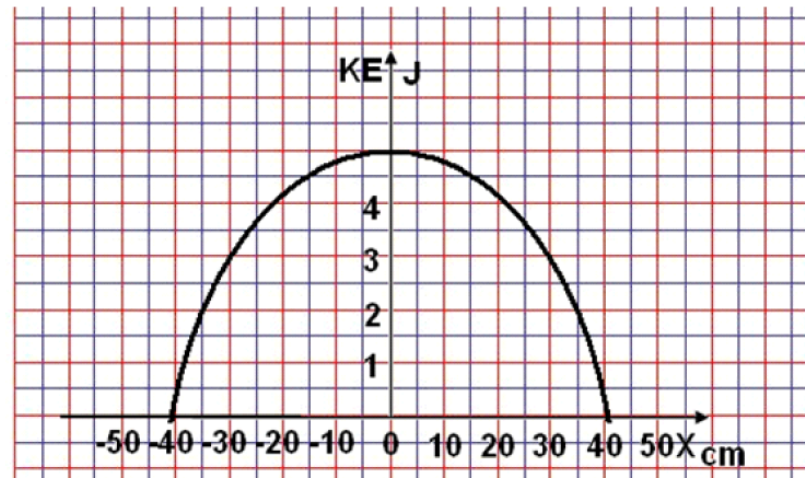
c. What is the maximum displacement of the oscillating mass?

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



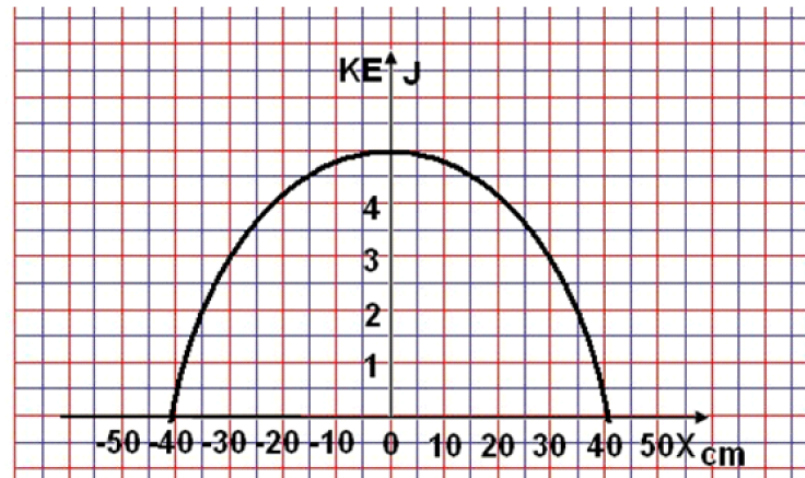
d. What is the potential energy at the position of 20 cm?

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



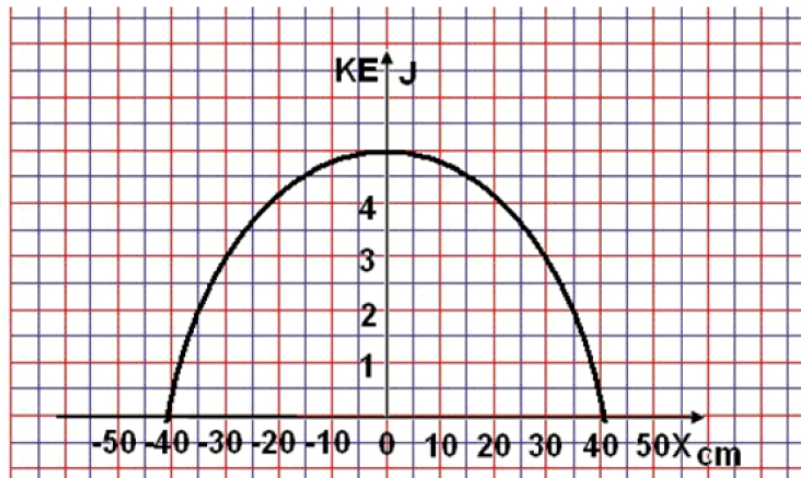
e. What is the kinetic energy at the position of 20 cm?

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



f. Find the location of the oscillating mass when its kinetic energy is 2

6. A 0.8 mass is attached to a horizontal spring which undergoes SHM. The graph of KE as a function of position show above.



g. What is the period of oscillations?