Simple Harmonic Motion
Concept Questions

Question 1 Which of the following functions $x(t)$ has a second derivative which is proportional to the negative of the function

$$\frac{d^2x}{dt^2} \propto -x\,?$$

1. $x(t) = \frac{1}{2}at^2$
2. $x(t) = Ae^{t/T}$
3. $x(t) = Ae^{-t/T}$
4. $x(t) = A\sin\left(\frac{2\pi}{T}t\right)$
5. $x(t) = A\cos\left(\frac{2\pi}{T}t\right)$
6. None of the above
7. Two of the above

Question 2: Simple Harmonic Motion

A block of mass m is attached to a spring with spring constant k is free to slide along a horizontal frictionless surface. At $t = 0$ the block-spring system is stretched an amount $x_0 > 0$ from the equilibrium position and is released from rest. What is the x -component of the velocity of the block when it first comes back to the equilibrium?

1. $v_x = -x_0 \dfrac{T}{4}$

2. $v_x = x_0 \dfrac{T}{4}$

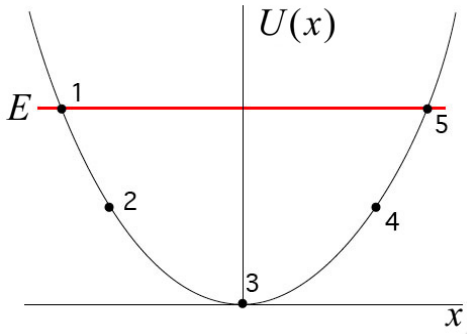
3. $v_x = -\sqrt{\dfrac{k}{m}} x_0$

4. $v_x = \sqrt{\dfrac{k}{m}} x_0$

5. None of the above.

Question 3

The potential energy function $U(x)$ for a particle with total mechanical energy E is shown below.



The position of the particle as a function of time is given by

$$x(t) = D\cos(\omega t) + D\sin(\omega t) \qquad (3.1)$$

.

where $D > 0$. The particle first reaches the position 3 when

1. $\omega t = 0$
2. $\omega t = \pi / 4$
3. $\omega t = \pi / 2$
4. $\omega t = 3\pi / 4$
5. $\omega t = \pi$
6. $\omega t = 5\pi / 4$
7. $\omega t = 3\pi / 2$
8. $\omega t = 7\pi / 4$

Question 4: SHO and the Pendulum

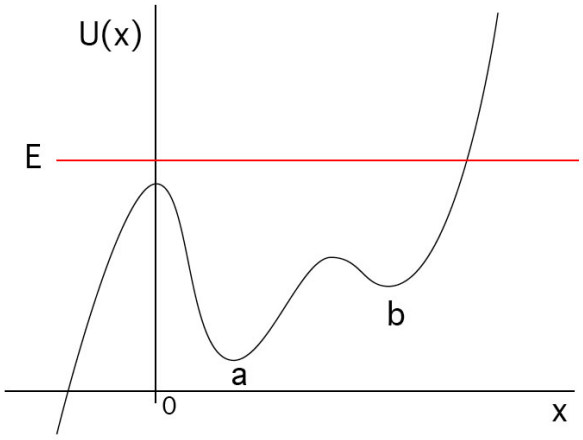
Suppose the point-like object of a simple pendulum is pulled out at by an angle $\theta_0 << 1$ rad. Is the angular speed of the point-like object equal to the angular frequency of the pendulum?

1. Yes.
2. No.
3. Only at bottom of the swing.
4. Not sure.

Question 5: Energy Diagram 1

A particle with total mechanical energy E has position $x > 0$ at $t = 0$

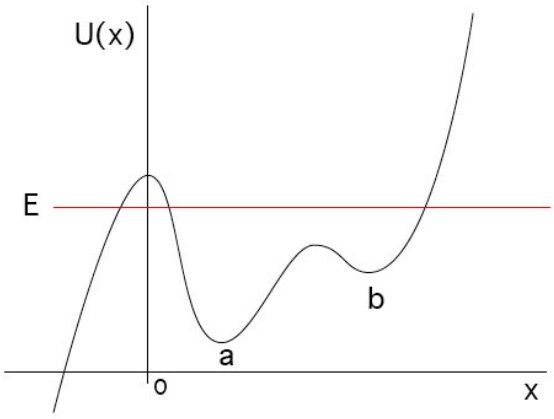
1. escapes to infinity in the – x-direction
2. approximates simple harmonic motion
3. oscillates around a
4. oscillates around b
5. periodically revisits a and b
6. not enough information
7. two of the above.



Question 6: Energy Diagram 2

A particle with total mechanical energy E has position $x > 0$ at $t = 0$

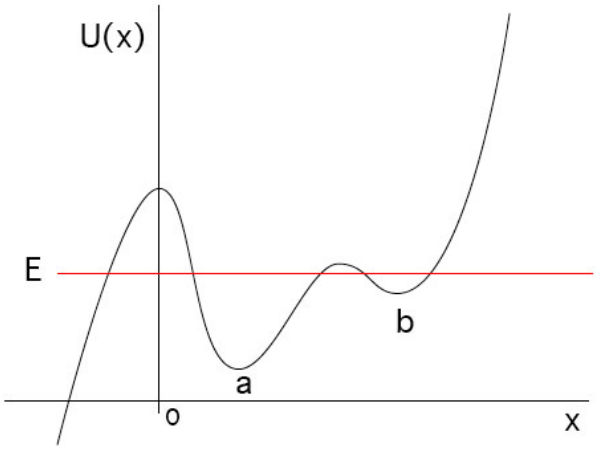
1. escapes to infinity in the – x-direction
2. approximates simple harmonic motion
3. oscillates around a
4. oscillates around b
5. periodically revisits a and b
6. not enough information
7. two of the above.



Question 7: Energy Diagram 3

A particle with total mechanical energy E has position $x > 0$ at $t = 0$

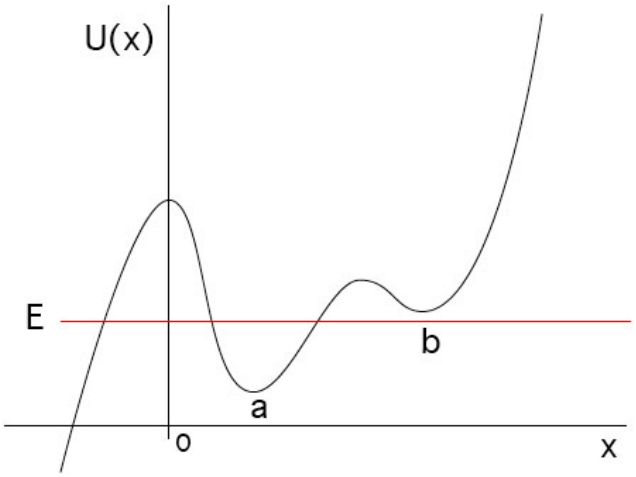
1. escapes to infinity in the – x-direction
2. approximates simple harmonic motion
3. oscillates around a
4. oscillates around b
5. periodically revisits a and b
6. not enough information
7. two of the above



Question 8: Energy Diagram 4

A particle with total mechanical energy E has position $x > 0$ at $t = 0$

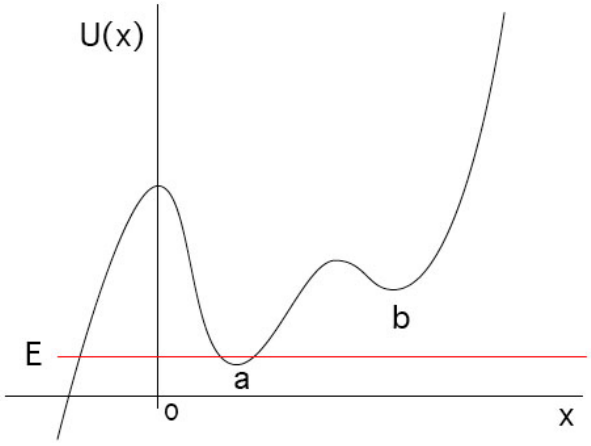
1. escapes to infinity in the – x-direction
2. approximates simple harmonic motion
3. oscillates around a
4. oscillates around b
5. periodically revisits a and b
6. not enough information
7. two of the above



Question 9: Energy Diagram 5

A particle with total mechanical energy E has position $x > 0$ at $t = 0$

1. escapes to infinity in the – x-direction
2. approximates simple harmonic motion
3. oscillates around a
4. oscillates around b
5. periodically revisits a and b
6. not enough information
7. two of the above



8.01SC Physics I: Classical Mechanics