

PH202 Recitation 8

SHM, Pendulums

Equations for SHM

$$E = K + U = \text{Const.}$$

$$v_{max} = \omega x_{max}$$

$$a_{max} = \omega^2 x_{max}$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$x(t) = \pm x_{max} \frac{\sin \text{ or } \cos}{\cos} (\omega t)$$

$$v(t) = \pm v_{max} \frac{\sin \text{ or } \cos}{\cos} (\omega t)$$

$$a(t) = \pm a_{max} \frac{\sin \text{ or } \cos}{\cos} (\omega t)$$

Energy (E), Velocity (V), Angular frequency (ω), Distance (x), Amplitude (A), Spring Constant (k),

Mass (m), Gravity (g), Length (l), Period (T)

Equations for Pendulums/Springs

$$v_{max} = \omega x_{max}$$

$$a_{max} = \omega^2 x_{max}$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

Springs:

$$\omega = \sqrt{\frac{k}{m}}$$

Pendulums:

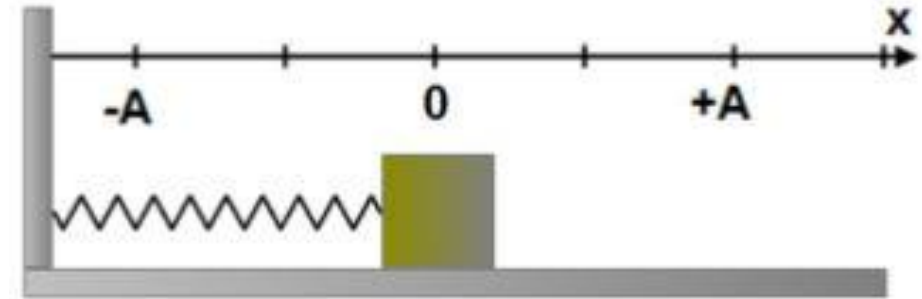
$$\omega = \sqrt{\frac{g}{l}}$$

Energy (E), Velocity (v), Angular frequency (ω), Distance (x), Amplitude (a), Spring Constant (k),

Mass (m), Gravity (g), Length (l), Period (T)

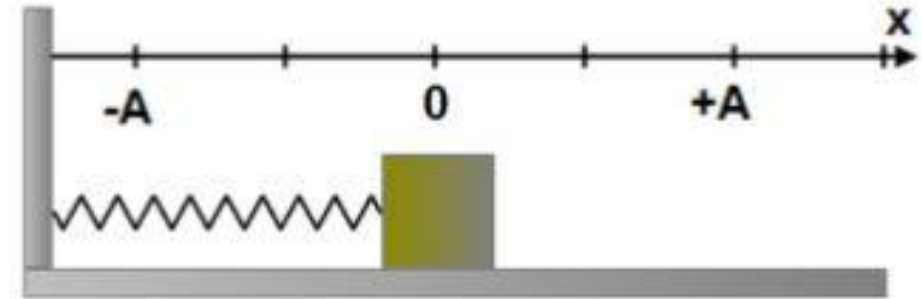
Discussion Question 1: 3 minutes

- A mass in the diagram to the right undergoes simple harmonic motion. Use this diagram for the following 4 questions.
- When the mass reaches point $x = +A$ its instantaneous velocity is?
 - A. Maximum and Positive
 - B. Maximum and Negative
 - C. Zero
 - D. Less than maximum and positive
 - E. Less than maximum and negative



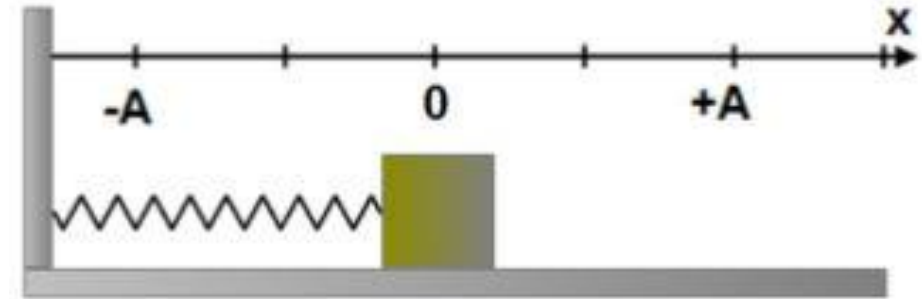
Discussion Question 2: 3 minutes

- When the mass reaches point $x = 0$ its instantaneous velocity is?
 - A. Maximum and can be positive or negative
 - B. Constant and doesn't depend on the location
 - C. Zero
 - D. Slightly less than maximum and positive
 - E. Slightly less than maximum and negative



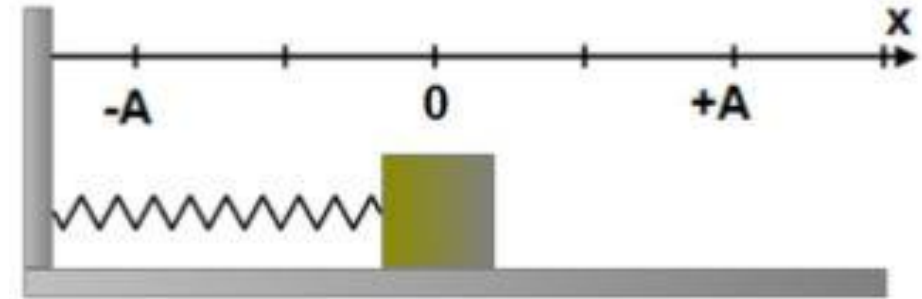
Discussion Question 3: 3 minutes

- When the mass reaches point $x = +A$ its instantaneous acceleration is?
 - A. Maximum and Positive
 - B. Maximum and Negative
 - C. Zero
 - D. Slightly less than maximum and positive
 - E. Slightly less than maximum and negative



Discussion Question 4: 3 minutes

- When the mass reaches point $x = 0$ its instantaneous acceleration is?
 - A. Maximum and Positive
 - B. Maximum and Negative
 - C. Zero
 - D. Slightly less than maximum and positive
 - E. Slightly less than maximum and negative



Problem 1: 5 minutes

- A. There is a simple harmonic oscillator made up of a mass on a spring. If the mass is 0.015kg and the period of oscillation is 0.5s , what is the spring constant of the spring?
- B. If the spring constant is doubled, how does the mass change in order to keep the frequency of oscillation constant?

Problem 2: 5 minutes

- A 0.500kg mass is attached to a spring and oscillates with a period of $T = 1.50\text{s}$. How much mass must be added to the system in order to change the period to 2s?

Problem 3: 7 minutes

- There is a pendulum made up of a rope and mass at the bottom. The rope has a length of 3m, the mass is 80kg, and the pendulum starts at a maximum angle of 30 degrees before being let go and entering oscillations. What is the tension in the rope at the bottom of the swing?