ADVANCED PHYSICS CLUB

JANUARY 19, 2020

Today's meeting

Today we continued to talk about collision problems. We solved homework problems from the last meeting.

We started to talk about oscillations using $F = ma$ exam problems as examples. Generally one can find the frequency, and period of small oscillations using either equations of motion

$$\ddot{x} = -\omega^2 x, \tag{1}$$

or energy conservation equaiton

$$E = \frac{M}{2}\left(\dot{x}^2 + \omega^2 x^2\right). \tag{2}$$

If one can bring equations of motion for a given system to either form (1) or (2), one can immediately find the angular frequency ω or period $T = 2\pi/\omega$ or frequency $f = 1/T$ of oscillations.

For example, for the harmonic oscillator mass+spring we have

$$\ddot{x} = -\frac{k}{m}x,$$
$$E = \frac{m}{2}\left(\dot{x}^2 + \frac{k}{m}x^2\right),$$
$$\omega = \sqrt{\frac{k}{m}}, \qquad T = \frac{1}{f} = 2\pi\sqrt{\frac{m}{k}}.$$

For pendulum

$$\ddot{\phi} = -\frac{g}{L}\sin\phi \approx -\frac{g}{L}\phi,$$
$$E = \frac{mL^2}{2}\left(\dot{\phi}^2 + \frac{2g}{L}(1-\cos\phi)\right) \approx \frac{mL^2}{2}\left(\dot{\phi}^2 + \frac{g}{L}\phi^2\right),$$
$$\omega = \sqrt{\frac{g}{L}}, \qquad T = \frac{1}{f} = 2\pi\sqrt{\frac{L}{g}}.$$

We solved the problems 12,13,19,23,25 of $F = ma$ 2015
`https://aapt.org/physicsteam/2015/upload/exam1-2015-1-8.pdf`

Homework problems

1. Solve problems 7, 14, 15 of $F = ma$ 2016
`https://www.aapt.org/physicsteam/2016/upload/exam1-2016-3-1-2.pdf`

2. Solve problems 11, 12, 14, 24 of $F = ma$ 2018A
`https://www.aapt.org/physicsteam/2019/upload/Fma-2018-A.pdf`

IMPORTANT

The next club meeting is on January 26, 2020. We will start discussing PhysicsBowl exam. Good luck to everybody taking F=ma exam this week!