Pembahasan Latihan Soal FFKG Minggu Kedua

Soal

1. Sebuah ayunan sederhana ditempatkan di bawah sebuah lift. Jika lift dalam keadaan diam, periode ayunan 2 sekon. Jika percepatan gravitasi bumi 10 m/s2. Pada saat lift bergerak ke atas dengan percepatan 30 m/s2, tentukan periode ayunannya!

2. Sebuah kotak dengan massa 500 g dikaitkan pada pegas dan ditarik sejauh 20 cm ke kanan dan dilepaskan.

   Osilasi yang terjadi diukur dan didapati memiliki periode 0,80 s. Tentukan:

   a. Posisi dari kotak ketika kotak memiliki kecepatan 1.0 m/s

   b. Hitung Spring Constant (k)

3. Sebuah keranjang dikaitkan pada pegas, ditarik sejauh 20.0 cm ke kanan dan dilepaskan saat t = 0 s. Setelah diamati, tercipta 15 osilasi pada detik 10.0 s.

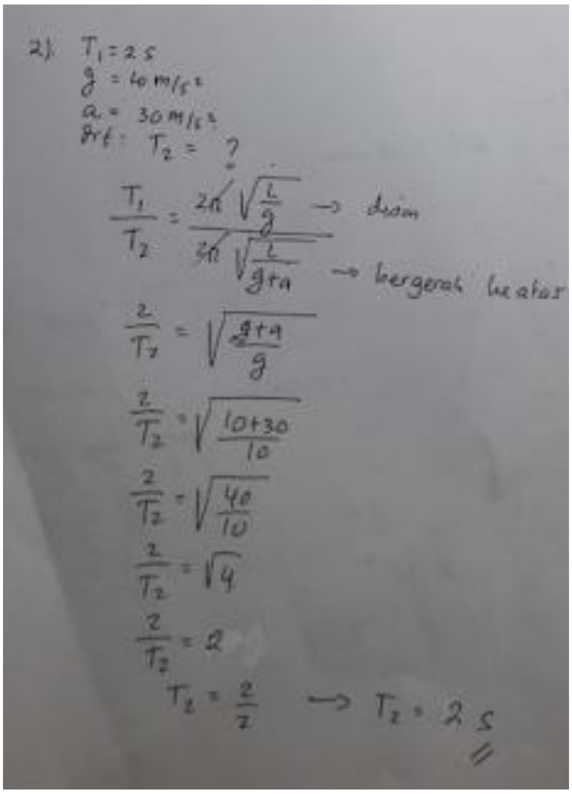
   Tentukan:

   a. Periode dari osilasi yang tercipta

   b. Kecepatan maksimum dari keranjang

Jawaban

1.



2.

EXAMPLE 14.5 **Using conservation of energy**

A 500 g block on a spring is pulled a distance of 20 cm and released. The subsequent oscillations are measured to have a period of 0.80 s.

a. At what position or positions is the block's speed 1.0 m/s?
b. What is the spring constant?

MODEL The motion is SHM. Energy is conserved.

SOLVE a. The block starts from the point of maximum displacement, where $E = U = \frac{1}{2}kA^2$. At a later time, when the position is x and the speed is v, energy conservation requires

$$\frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2$$

Solving for x, we find

$$x = \sqrt{A^2 - \frac{mv^2}{k}} = \sqrt{A^2 - \left(\frac{v}{\omega}\right)^2}$$

where we used $k/m = \omega^2$ from Equation 14.24. The angular frequency is easily found from the period: $\omega = 2\pi/T = 7.85$ rad/s. Thus

$$x = \sqrt{(0.20\text{ m})^2 - \left(\frac{1.0\text{ m/s}}{7.85\text{ rad/s}}\right)^2} = \pm 0.15\text{ m} = \pm 15\text{ cm}$$

There are two positions because the block has this speed on either side of equilibrium.

b. Although part a did not require that we know the spring constant, it is straightforward to find from Equation 14.24:

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$k = \frac{4\pi^2 m}{T^2} = \frac{4\pi^2\,(0.50\text{ kg})}{(0.80\text{ s})^2} = 31\text{ N/m}$$

3.

EXAMPLE 14.2 **A system in simple harmonic motion**

An air-track glider is attached to a spring, pulled 20.0 cm to the right, and released at $t = 0$ s. It makes 15 oscillations in 10.0 s.

a. What is the period of oscillation?
b. What is the object's maximum speed?
c. What are the position and velocity at $t = 0.800$ s?

MODEL An object oscillating on a spring is in SHM.

SOLVE a. The oscillation frequency is

$$f = \frac{15\text{ oscillations}}{10.0\text{ s}} = 1.50\text{ oscillations/s} = 1.50\text{ Hz}$$

Thus the period is $T = 1/f = 0.667$ s.

b. The oscillation amplitude is $A = 0.200$ m. Thus

$$v_{max} = \frac{2\pi A}{T} = \frac{2\pi(0.200\text{ m})}{0.667\text{ s}} = 1.88\text{ m/s}$$

c. The object starts at $x = +A$ at $t = 0$ s. This is exactly the oscillation described by Equations 14.2 and 14.6. The position at $t = 0.800$ s is

$$x = A\cos\left(\frac{2\pi t}{T}\right) = (0.200\text{ m})\cos\left(\frac{2\pi(0.800\text{ s})}{0.667\text{ s}}\right)$$

$$= (0.200\text{ m})\cos(7.54\text{ rad}) = 0.0625\text{ m} = 6.25\text{ cm}$$

The velocity at this instant of time is

$$v_x = -v_{max}\sin\left(\frac{2\pi t}{T}\right) = -(1.88\text{ m/s})\sin\left(\frac{2\pi(0.800\text{ s})}{0.667\text{ s}}\right)$$

$$= -(1.88\text{ m/s})\sin(7.54\text{ rad}) = -1.79\text{ m/s} = -179\text{ cm/s}$$

At $t = 0.800$ s, which is slightly more than one period, the object is 6.25 cm to the right of equilibrium and moving to the *left* at 179 cm/s. Notice the use of radians in the calculations.