Pre lab springs

Science, Physics

Springs and Oscillators From the theory section of the lab we have two ways to determine the angular frequency ω of oscillations of the mass m: ω= 2π/ T and ω=√kd/m+mo

a. Both ways to determine angular frequency ω must give the same value. Equate the above equations and solve for T2.

ω=√kd/m+mo

Kd is the spring constant between the initial stretch and the final stretch (x-xo)

K varies with the level of stretch of the spring, thus, Kd= δF/δx

F= mg

200g*9. 8

0. 2*9. 8= 1. 96N

Let the stretch be from 0 cm to 10 cm making the stretch, x= 10cm= 0. 1m

Kd= 1. 96N/0. 1m

= 19. 6N/m

Considering the range of masses from 200g to 600g, m+mo= 200+600

800g= 0. 8kg

Thus, Kd/m+mo= 19. 6/0. 8= 24. 5

ω=√24. 5= 4. 95

ω= 2π/T

But ω= 4. 95, thus, 4. 95= 2π/T

4. 95T= 2π

T= (2*3. 142)/4. 95

T= 1. 269

T2= 1. 61

The result in part (a) should look like the standard equation for a straight line, y= mx+ b, if the variable for the x-axis is taken to be the mass m. This means if we plot T2 vs. m we would see a straight line.

b. Compare the standard form of the equation for a straight line and the result for part (a) and determine the theoretical value for the slope in terms of constants and the dynamical spring constant k d. In terms of the slope (and other constants), what is the value of the dynamical spring constant k d?

From the above calculation, T2= K d/ m + mo

Meaning that T2 (m+ mo) = K d

When rearranged,

T2= K d m +mo

The standard equation of a straight line is y= mx +c. The theoretical y-intercept in the standards equation of a straight line compares (corresponds) to the determined value of T2. The slope (constant) is normally represented by the value of m in the standards equation of a straight line and in this case corresponds to K d.

The dynamical spring constant (Kd) is the spring constant between the initial stretch and the final stretch (x-xo)

K varies with the level of stretch of the spring, thus, Kd= δF/δx

F= mg

200g*9. 8

0. 2*9. 8= 1. 96N

Let the stretch be from 0 cm to 10 cm making the stretch, x= 10cm= 0. 1m

Kd= 1. 96N/0. 1m

= 19. 6N/m

c. Again, compare the standard form of the equation for a straight line and the result for part (a), what should the theoretical value for the y-intercept be in terms of constants and the dynamical spring constant k d and m0 the effective mass of the spring? In terms of the y-intercept (and other known values), what is the value of the effective mass of the spring m0?

As argued above, the standard equation of a straight line is y= mx +c. This equation implies that y is the same as c since it is the value where the line cuts the y-axis. C is the intercept on the y-axis.

In comparison, if T2 compares to y, and T2= 1. 61, then it means that the straight line of the graph of T2 against m cuts the x-axis at 1. 61. This value depends on the constant K d, since the spring constant results from the resultant forces applied on the spring, the restoring force and the mass, mo applied on the spring.

The effective mass, mo, corresponds to c, such that in order to determine the value of the effective mass, the value 2. 418 is very important.

The spring equation, T= 2π√(m0/Kd), implies that mo=(KdT2)/(4π2)

(19. 6*1. 61)/(4*9. 872) = 0. 8kg