Problem:

If an object on a horizontal, frictionless surface is attached to a spring, displaced, and then released, it will oscillate. If it is displaced 0.120 m from its equilibrium position and released with zero initial speed, then after 0.800 s its displacement is found to be 0.120 m on the opposite side, and it has passed the equilibrium position once during this interval.

Find (a) the amplitude; (b) the period; (c) the frequency.

Solution:

According to the problem set, initial displacement A=0.120 m was made and then object was released with zero initial speed. That means that all the initial energy given to the oscillator was defined by this displacement (initial kinetic energy was zero) and it's value was maximum at the moment t=0. So the amplitude equals to the initial displacement A = 0.120 m.

In time $t_0 = 0.800\ s$ the position of the object was diametrically opposite to initial, so the displacement (from the equilibrium point) was the same A. This means that speed of object at that moment was also zero (full energy is constant and, at the moment t_0 , equal to the potential energy of springs at this position). As after time t_0 object passed equilibrium point only once, this time equals to half of the period:

$$t_0 = \frac{T}{2} => T = 2t_0 = 1.600\ s$$

Thus, frequency equals to:

$$\nu = \frac{1}{T} = 0.625\ Hz$$

Answer: A = 0.120 m; $\nu = 0.625\ Hz$; $T = 1.600\ s$.