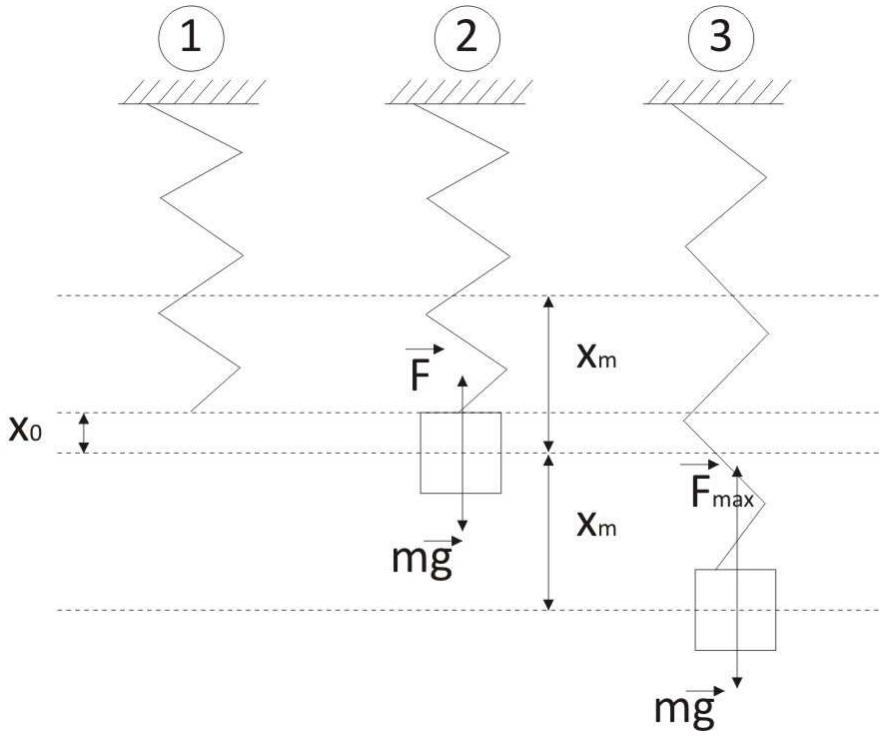
A block of mass 0.5 kg hanging from a vertical spring executes simple harmonic motion of amplitude 0.1 m and time period 0.314 s. Find the maximum force exerted by the spring on the block.

Solution.

$$m = 0.5kg, x_m = 0.1m, T = 0.314s;$$

$$F_{max} - ?$$



1) Only spring.
2) A block hanging from a vertical spring at rest.
3) A block hanging from a vertical spring executes simple harmonic motion.

The time period of the simple harmonic motion:

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

The stiffness of the spring:

$$k = \frac{4\pi^2 m}{T^2}.$$

Hooke's law (modul):

$$F = kx_0;$$

$$F = mg;$$

$$mg = kx_0;$$

$$x_0 = \frac{mg}{k};$$

From diagram the maximum force:

$$F_{max} = k(x_0 + x_m);$$

$$F_{max} = k\left(\frac{mg}{k} + x_m\right);$$

$$F_{max} = mg + kx_m.$$

$$F_{max} = mg + \frac{4\pi^2 m}{T^2} x_m.$$

$$F_{max} = 0.5 \cdot 9.8 + \frac{4 \cdot 3.14^2 \cdot 0.5}{0.314^2} 0.1 = 24.9(N).$$

Answer: $F_{max} 24.9N$.