Q- A block attached to a spring with unknown spring constant oscillates with a period of 3.0 s.
(a) What is the period if the mass is doubled?
(b) What is the period if the mass is halved?
(c) What is the period if the amplitude is doubled?
(d) What is the period if the spring constant is doubled?

The period of oscillation of a mass 'm' attached with a spring of spring constant K is given by

$$T = 2\pi\sqrt{\frac{m}{K}} \quad \text{(see text)}$$

As the time period of the block is 3.0 s, we have

$$T = 2\pi\sqrt{\frac{m}{K}} = 3.0\,s$$

(a) What is the period if the mass is doubled?

Now if the mass of the block is doubled means the new block is having mass 2m then the new period will be

$$T_1 = 2\pi\sqrt{\frac{2*m}{K}} = (\sqrt{2})*2\pi\sqrt{\frac{m}{K}} = (\sqrt{2})*T = (\sqrt{2})*3 = 4.24s$$

(b) What is the period if the mass is halved?

Now if the mass of the block is halved means the new block is having mass m/2 then the new period will be

$$T_2 = 2\pi\sqrt{\frac{(m/2)}{K}} = \left(\frac{1}{\sqrt{2}}\right)*2\pi\sqrt{\frac{m}{K}} = \frac{1}{\sqrt{2}}*T = \frac{1}{\sqrt{2}}*3 = 2.12s$$

(c) What is the period if the amplitude is doubled?

As the time period of the oscillations does not depend on the amplitude of oscillations, the time period T_3 of the oscillation will remains the same i.e. 3.0 s

(d) What is the period if the spring constant is doubled?
Now if the spring constant is doubled means the new spring is having constant 2K then the new period will be

$$T_4 = 2\pi\sqrt{\frac{m}{2*K}} = \left(\frac{1}{\sqrt{2}}\right)*2\pi\sqrt{\frac{m}{K}} = \frac{1}{\sqrt{2}}*T = \frac{1}{\sqrt{2}}*3.0 = 2.12s$$