Problem 6

Write down everything given everything assumed, and everything we need to find

Given: mass = 6000 kg k1=1600 N/m k2=3400 N/m after the first spring compresses 30.0 cm the second spring starts to compress xtotal = 50.0 cm vf=0

Assumptions: no friction

Find: vi

Seeing as we are only concerned with the magnitude of vi and not its vectors lets use the work-energy theorem. We only have kinetic energy and spring/elastic/mechanical potential energy

Let’s make 2 pictures. One with initial conditions and one with final conditions

50.0 cm

6000 kg

3400 N/m

1600 N/m

Vi

1600 N/m

3400 N/m

6000 kg

|  |  |
| --- | --- |
|  | Condition |
| Initial | Final |
| Type of energy | KE (1/2 mv2) | ½ (6000 kg) (vi)2 | 0 |
| MPE (1/2 kx2) spring 1 | 0 | ½ (1600 N/m)(.500 m)2 |
| MPE (1/2 kx2) spring 2 | 0 | ½ (3400 N/m)(.200 m)2 |
| Total energy | 268 J | 268 J |

Because this is a closed system, the total energy must remain constant. It is important to know that because the second spring starts to compress after the first spring compresses 30.0 cm we have a different displacements for the two springs. It will be 50.0 cm for spring 1 and (50.0 cm – 30.0 cm) for spring 2. Now let’s make a table and sum the energy done by the springs to find total energy.

We now know that ½ (6000 kg)(vi)2 = 268 J. By rearranging terms we have vi=√(2(268 J)/(6000 kg)) = .299 m/s.