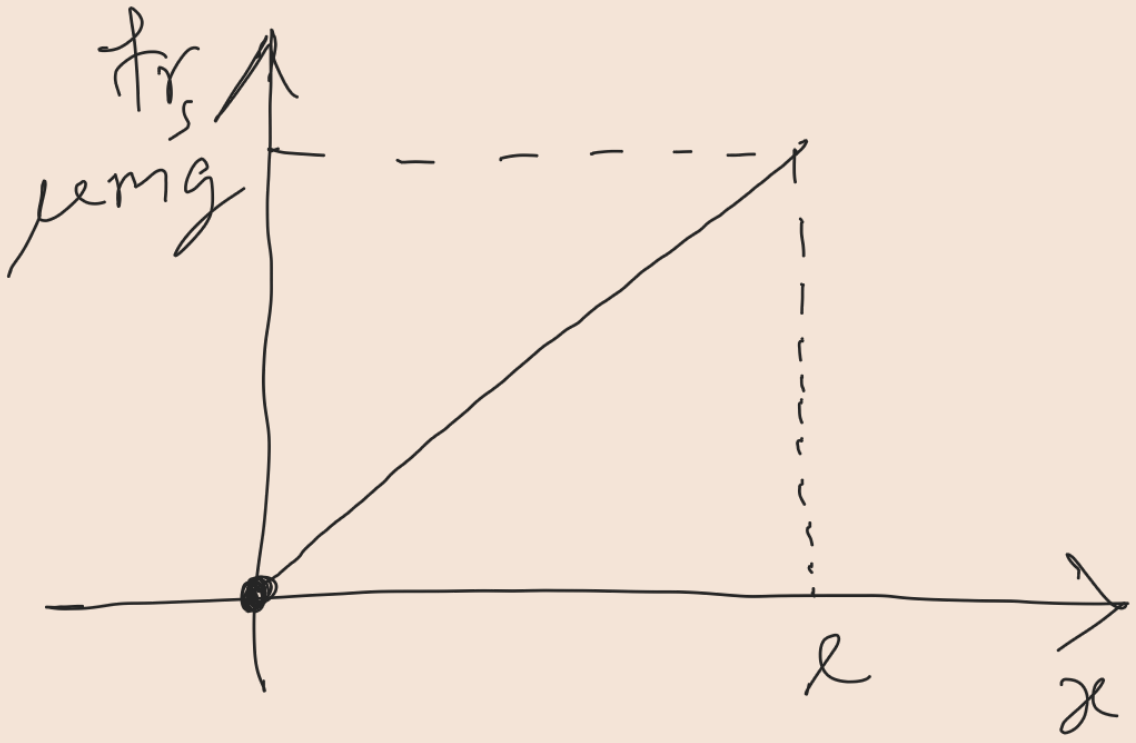
In this question, 'x' & 'k' are floating. Rest all are fixed parameters.

Now, as long as block of mass 'm' is above M it must not slip. That means friction force must be static & proportional to 'x'. Let the max friction act at the instant when compression is 'l'.

Then, graph of friction versus displacement of block 'm' must look

like



So, work done by friction upto this instant on 'm' is $\frac{1}{2}(\mu mg\ell)$. This has to be $\geq \frac{1}{2}mu^2$. So, if $\frac{1}{2}\mu mg\ell < \frac{1}{2}mu^2$ or $u > \sqrt{\mu g\ell}$, then block 'm' MUST slide off.

Now let $u = \sqrt{\mu g l}$. Then, block 'm' just stops when spring is compressed by 'l'.

$$\frac{kl}{M+m} = \mu g, \text{ So}$$

$$\boxed{k = \frac{(M+m)\mu g}{l}} \quad \text{if}$$

Now, let $u < \sqrt{\mu g l}$.

This means, static friction on block of mass 'm' doesn't reach its max value. So,

$$\frac{1}{2} k l^2 > \frac{1}{2}(M+m) u^2$$

$$k > \frac{(M+m) u^2}{l^2}.$$

Now,

$$\frac{1}{2} k x^2 = \frac{1}{2}(M+m) u^2$$

$$x = \sqrt{\frac{(M+m)}{k}}\, u.$$ At

this 'x', upper block must slip.

$$\frac{k\left(\sqrt{\frac{M+m}{k}}\,(u)\right)}{(M+m)} < \mu g$$

$$\left(\sqrt{\frac{k}{M+m}}\right) < \frac{\mu g}{u}$$

$$k^2 < \frac{(\mu^2 g^2)(M+m)}{u^2}$$

Once again, most imp part of the question is here we are manipulating both 'k' & 'u' simultaneously. Both must satisfy specific values / ranges to make phenomena possible.

What happens if $k > \text{large}$.

By manipulating value of 'k', we may be able to stop lower block, even before 'L'.

But in ANY case, it will be impossible for upper block to stop as frictional work cant destroy its K.E.