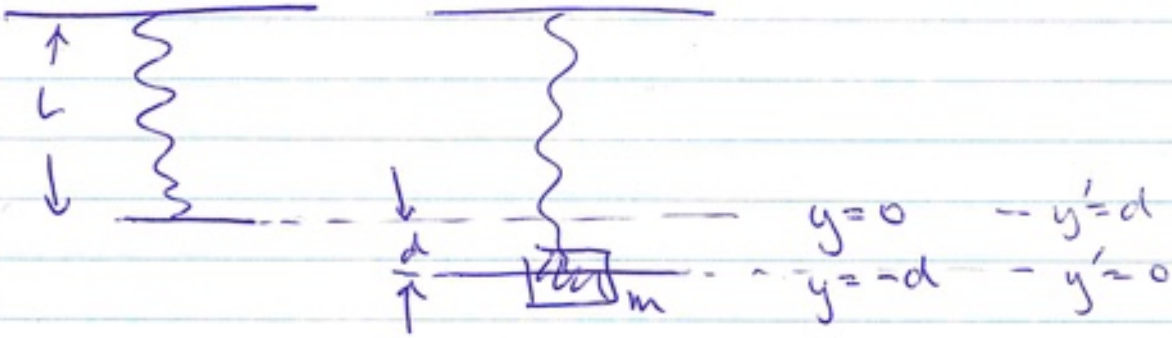
Hanging Weight.



(a) $\uparrow F_s$ Net force vanishes at equilibrium.

$\downarrow F_g = mg$

$$F_s - mg = 0$$

$$F_s = -ky = +kd$$

$$\therefore \; kd - mg = 0$$

$$\therefore \; d = \frac{mg}{k}.$$

$y = -d$ is new equilibrium position.

$$= -\frac{mg}{k}$$

New eq$^{\underline{m}}$ length is $L' = L + d = L + \frac{mg}{k}$

(b) Displace from new eq$^{\underline{n}}$ position.

~~what is force~~?

Net force is $\quad F_s = -ky$
$\qquad\qquad\qquad F_g = -mg$

$$F_{net} = \cancel{+ky - mg}\ F_s + F_g$$
$$= -ky - mg$$
$$= -k\left(y + \frac{mg}{k}\right)$$
$$= -k(y + d)$$

Define $y' \equiv y + d$ $\qquad$ $y' = 0$ when $y = -d$ (eq$^{\underline{m}}$).

$$\boxed{F_{net} = -ky'}$$ Hooke's Law

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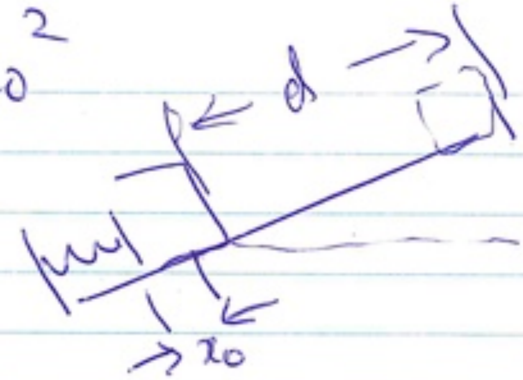
(i) $U_s = \frac{1}{2} k x_0^2$

$K_i = 0$



(ii) $K_f = 0$

$\Rightarrow U_s = U_g$

$U_g = mg\,\Delta y = mg(d \sin\theta)$

$\frac{1}{2} k x_0^2 = mg\, d \sin\theta$

$\therefore d = \dfrac{k x_0^2}{2mg\sin\theta} = \underline{4\,m}$