Conservation of Mechanical Energy

$$E_{total} = E'_{total}$$

(BEFORE) (AFTER)

$$E_k + E_g + E_e = E'_k + E'_g + E'_e$$

This will apply when there is no friction or air resistance

If $E_{total} \neq E'_{total}$, then there was negative work done by a non-conservative force like friction and air resistance.

RECALL the work energy theorem:

$$W = \Delta E_{total}$$

(Conservation Of Total Energy)

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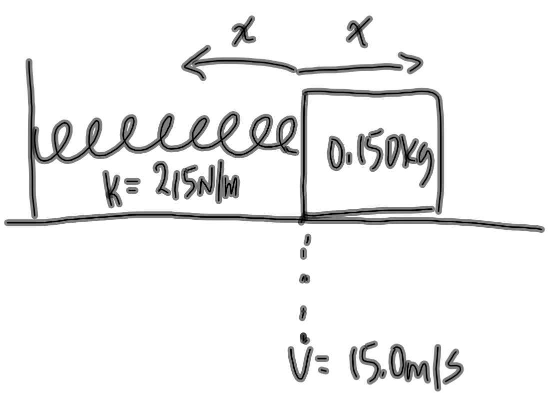
$m = 0.150\,kg$

$k = 215\,N/m$

$V_{max} = 15.0\,m/s$

$x = ??$



$E_{total} = E'_{total}$

(equilibrium) (max stretch/comp)

$E_k + E_e = E'_k + E'_e$ ($E_e = 0$, $E'_k = 0$)

$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$x^2 = \frac{mv^2}{k}$

$x^2 = \frac{(0.150\,kg)(15.0\,m/s)^2}{215\,N/m}$

$x = \pm 0.396\,m$

a) The amplitude is 39.6 cm.

b) $W = \Delta E_e$

$W = E_{e_2} - E_{e1}$ ($E_{e1} = 0$)

$W = \frac{1}{2}kx^2$

$W = \frac{1}{2}(215\,N/m)(0.396\,m)^2$

$\boxed{W \doteq 16.9\,J}$

§7.3 Conservation of Momentum

Recall Newton's 3rd Law:

$$\vec{F}_A = -\vec{F}_B$$

$$\vec{F}_A \Delta t = -\vec{F}_B \Delta t$$

$$\vec{J}_A = -\vec{J}_B$$

$$\Delta \vec{P}_A = -\Delta \vec{P}_B$$ (Law of Conservation of Momentum)

$$\vec{P}_{A_2} - \vec{P}_{A_1} = -(\vec{P}_{B_2} - \vec{P}_{B_1})$$

$$\vec{P}_{A_2} - \vec{P}_{A_1} = -\vec{P}_{B_2} + \vec{P}_{B_1}$$

$$-\vec{P}_{A_1} - \vec{P}_{B_1} = -\vec{P}_{A_2} - \vec{P}_{B_2}$$

$$\vec{P}_{A_1} + \vec{P}_{B_1} = \vec{P}_{A_2} + \vec{P}_{B_2}$$

$$\boxed{\vec{P}_{total} = \vec{P}\,'_{total}}$$ ← Law of Conservation of Momentum.

* Isolated system ⇒ no friction

Remember: $\boxed{\vec{p} = m\vec{v}}$

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+ ⇒ the original direction car A.

	BEFORE		AFTER
	A	B	A+B
m	1.75×10^4 kg	2.00×10^4 kg	3.75×10^4 kg
v	+5.45 m/s	0	v
p	95375 kg·m/s	0	$(3.75\times10^4\ kg)v$

p_{total} (before) p'_{total} (after)

$$\vec{p}_{total} = \vec{p}\,'_{total}$$

$$95375\ kg\cdot m/s + 0 = (3.75\times10^4\ kg)v$$

$$95375\ kg\cdot m/s = (3.75\times10^4\ kg)v$$

$$v = \frac{95375\ kg\cdot m/s}{3.75\times10^4\ kg}$$

$$v = +2.54\ m/s$$

$\vec{v} = 2.54\ m/s$ [in the original dir of car A]

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(+ ⇒ forward)

	BEFORE: you + canoe	AFTER: you	AFTER: canoe
m	180 kg	65 kg	115 kg
v	0	+0.75 m/s	v
p	0	+48.75 kg·m/s	(115 kg) v

$\vec{p}_{total}$ (before) ; $\vec{p}\,'_{total}$ (after)

$$\vec{p}_{total} = \vec{p}\,'_{total}$$

$$0 = +48.75\,kg\cdot m/s + (115\,kg)v$$

$$-48.75\,kg\cdot m/s = (115\,kg)v$$

$$v = -0.42\,m/s$$

$$\vec{v} = 0.42\,m/s\ [backwards]$$

TO DO:

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