Conservation of Energy

$E_{total} = E'_{total}$
(before) (after)

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

* as long as there are no non-conservative forces (like air resistance or friction) acting on the object.

* Non-conservatives do negative work on the object and will decrease the objects total mechanical energy

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

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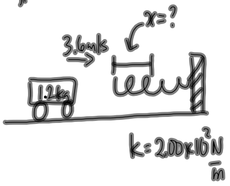
14. b) $W = \Delta E_e$

$W = E_{e_2} - \cancel{E_{e_1}}$ 0 ← wasn't stretched

$W = \frac{1}{2}kx_2^2$

↑ answer from (a)

9.



a) $x = ?$
b) $v = ?$ when $x = 0.10m$
c) $a = ?$

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

$\underbrace{\cancel{E_e}}_{0} + E_k = E'_e + \underbrace{\cancel{E'_k}}_{0}$

before compressed — max. compressed.

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

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

$x^2 = \frac{(1.2kg)(3.6m/s)^2}{2.00\times10^2 N/m}$

$\boxed{x \doteq 0.28m}$

↑ negative ⇒ compression

b) $E_{total} = E'_{total}$
(before compressed) (partially compressed)

$\cancel{E_e}^{\,0} + E_k = E'_e + E'_k$

$\frac{1}{2}mv_1^2 = \frac{1}{2}kx^2 + \frac{1}{2}mv_2^2$

$(1.2kg)(3.6m/s)^2 = (2.00\times10^2 \frac{N}{m})(0.10m)^2 + (1.2kg)v_2^2$

$15.552 J = 2.0 J + (1.2kg)v_2^2$

$13.552 J = (1.2kg)v_2^2$

$v_2^2 = 11.29\bar{3}\ \frac{m^2}{s^2}$

$\boxed{v_2 \doteq 3.4 m/s}$

c) $a = ?$ $F_{net} = ma$ $(F_e = kx$ Hooke's .

Conservation of Momentum in Collisions

Recall Newton's Third Law:

* Neglecting friction!

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

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

$$\Delta \vec{p}_A = -\Delta \vec{p}_B$$

(the loss in momentum of one object is equal to the gain in momentum of the other object)

$$m_A \Delta \vec{v}_A = -m_B \Delta \vec{v}_B$$

$$m_A(\vec{v}_A' - \vec{v}_A) = -m_B(\vec{v}_B' - \vec{v}_B)$$

$$m_A\vec{v}_A' - m_A\vec{v}_A = -m_B\vec{v}_B' + m_B\vec{v}_B$$

$$-\left(-m_A\vec{v}_A - m_B\vec{v}_B = -m_A\vec{v}_A' - m_B\vec{v}_B'\right)$$

$$m_A\vec{v}_A + m_B\vec{v}_B = m_A\vec{v}_A' + m_B\vec{v}_B'$$

$$\vec{p}_A + \vec{p}_B = \vec{p}_A' + \vec{p}_B'$$

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

The total momentum before is equal to the total momentum after in ANY collision neglecting friction!

Law of Conservation of momentum

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+ car 1

	BEFORE car 1	BEFORE car 2	AFTER car (1+2)
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	$(3.75\times10^4\text{ kg})\,v$

$p = mv$

$\underbrace{\text{car 1} + \text{car 2}}_{\vec{p}_{total}}$ $\underbrace{\text{car (1+2)}}_{\vec{p}\,'_{total}}$

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

$$95375\text{ kg·m/s} + 0 = (3.75\times10^4\text{ kg})v$$

$$v = +2.54\text{ m/s}$$

write final answer in vector form.... needs a direction!

$\vec{v} = 2.54$ m/s [in the original direction of car 1]

Recoil

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+ [forward]

	Before	After	
	You + canoe	You	canoe
m	180kg	65kg	115kg
v	0	+0.75m/s	v
p	0	48.75 kg·m/s	(115kg)v
	$\vec{P}_{total}$	$\vec{P}'_{total}$	

According to the Law of Conservation of Momentum:

$$\vec{P}_{total} = \vec{P}'_{total}$$

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

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

$$v = -0.424\,m/s$$

velocity of canoe. $\longrightarrow$ $\vec{V} = 0.424\,m/s$ [backwards]

$\Rightarrow$ RECOIL

TO DO:

① PP|315

② PP|317

$$\vec{P}_{total} = \vec{P}'_{total}$$

$$\vec{P}_{you+canoe} = \vec{P}_{you} + \vec{P}_{canoe}$$