Q# 12, 22 + P# 13, 14, 16, 19

Q #12

impulse = momentum

$J = \Delta P$

★ Newton's 3rd law

action/reaction pairs

$J_{x_1} = J_{x_2}$

$\Delta P_1 = (P_f)_1 - (P_i)_1$

$\Delta P = (P_f)_2 (P_i)_1$

Q #22

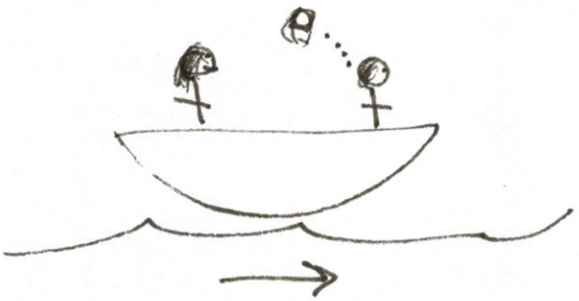
(A)

t_i - 3.0 s

t_f - 3.2 s

v_i - 0 m/s

sack travels in the opposite direction (= - P)



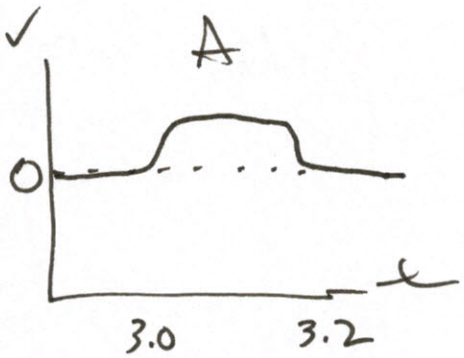
isolated system

$$P_{x_i} = \emptyset$$

$$-P = P$$

sack in air — canoe

✓ A



#13

before 0.100kg	after
m_1 - ~~100g~~ small	m_1 - 0.100kg
v_1 - 1.20m/s	v_1 - -0.850m/s
m_2 - 1.0 kg large	m_2 - 1.0 kg
v_2 - 0 m/s	v_2 - ?

$$(P_x)_i = (P_x)_f$$

$$(P_{1x})_i + (P_{2x})_i = (P_{1x})_f + (P_{2x})_f$$

$$(m_1 v_{1x})_i + (m_2 v_{2x})_i = (m v_{1x})_f + (m_2 v_{2x})_f$$

$$(v_{2x})_f = \frac{(m_1 v_{1x})_i + (m_2 v_{2x})_i - (m_1 v_{1x})_f}{m_2}$$

$$\frac{(0.100\text{kg})(1.20\text{ m/s}) - (0.100\text{kg})(-0.850\text{ m/s})}{1.0\text{ kg}}$$

$$\frac{0.205}{1.0}$$

$$v_2 = 0.205\text{ m/s}$$

P
#14

m_1 - ~~100~~ 70 kg
man + rifle

m_2 bullet - ~~10~~ 0.01 kg

v_2 - 500 m/s

$v_{1\,man}$ - ?

isolated system (no external force - ice)

$$(P_x)_i = (P_x)_f$$

$$(P_{1x})_f + (P_{2x})_f = (P_{1x})_i + (P_{2x})_i$$

$$(m_1 v_1)_f + (m_2 v_2)_f = (m_1 v_1)_i + (m_2 v_2)_i = \emptyset$$

$$(v_1)_f = -\left(\frac{m_2}{m_1}\right)(v_2)_f =$$

$$= -\left(\frac{0.01\,kg}{70\,kg}\right)(500\,m/s)$$

$$= -0.0001429\,(500)$$

$$(v_1)_f = -0.071\,m/s$$

P

#16

before	after
$m_1 - 5.3\,kg$	$m_1 - 5.3\,kg$
$m_2 - 2.3\,kg$	$m_2 - 2.3\,kg$
$V_{1+2} - 0\,m/s$	$V_1 - ?$
	$V_2 - 6.0\,m/s$

$$(V_{1x})f = -\left(\frac{m_2}{m_1}\right)(V_{2x})f$$

$$= \left(\frac{2.3\,kg}{5.3\,kg}\right)(6.0\,m/s)$$

$$= .4339\,(6.0)$$

$$(V_{1x})f = 2.6\,m/s$$

P
#19

$m_1 - 55\ kg$

$m_2 - 42\ g$ → $0.042\ kg$

$(V_2)_f - 620\ m/s$

$(V_1)_i - 0\ m/s$

$$(m_1v_1)_f + (m_2v_2)_f = (m_1v_1)_i + (m_2v_2)_i = \emptyset$$

$$(V_1)_f = -\left(\frac{m_2}{m_1}\right)(V_2)_f$$

$$= -\left(\frac{0.042\ kg}{55\ kg}\right)(620\ m/s)$$

$$= -0.0007636\ (620)$$

$$(V_1)_f = -0.47\ m/s$$