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SA.

Physics 122

~~Assignment:~~ **U1–S3 & 4: Relative Velocity and Collisions/Explosions (November 2016)**

Name - Key Date - Thurs., Nov. 3/16.

Part 1 – Multiple Choice (Value – 5)

Print the letter of the best answer on the line provided.

C 1. Snail A is travelling at 0.003 m/s [W] toward Snail B travelling at 0.001 m/s [W]. What is the velocity of Snail A relative to Snail B?

A) 0.002 m/s [E]
B) 0.004 m/s [E]
C) 0.002 m/s [W]
D) 0.004 m/s [W]

$\vec{v}_{AB} = \vec{v}_{AG} + \vec{v}_{GB}$

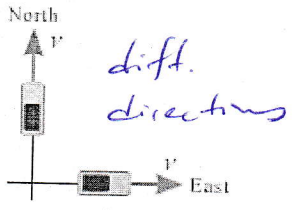
$\vec{v}_{AB} = \vec{v}_{AG} - \vec{v}_{BG} = -0.003 - (-0.001)$

A 2. Two identical cars are traveling at the same speed. One is heading due east and the other due north, as the drawing shows. Which statement is true regarding the kinetic energies and momenta of the cars?

A) They have the same kinetic energies, but different momenta.
B) They have the same kinetic energies and the same momenta.
C) They have different kinetic energies and different momenta.
D) They have different kinetic energies, but the same momenta.

$\vec{p} = m\vec{v}$

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



diff. directions

B 3. Momentum is conserved in an inelastic collision. Which of the following statements is true about kinetic energy in an inelastic collision?

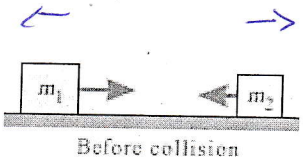
A) kinetic energy is also conserved
B) kinetic energy is transformed into other types of energy
C) kinetic energy is gained

$\Delta E_K \neq 0$

C 4. The two objects shown in the drawing are initially moving in opposite directions. They are on a horizontal frictionless surface, so the net external force acting on them is zero. The objects collide and move apart after the collision. The table shows five possible sets of initial and final momenta for the objects. Which is the only set that could occur?

$\vec{p}_{before} = \vec{p}_{after}$

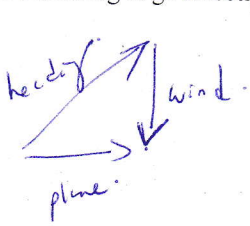
	Initial Momenta (Before Collision)		Final Momenta (After Collision)	
	Object 1	Object 2	Object 1	Object 2
A)	+16 kg·m/s	-16 kg·m/s	+8 kg·m/s	+12 kg·m/s
B)	+16 kg·m/s	-6 kg·m/s	+4 kg·m/s	+10 kg·m/s
C)	+12 kg·m/s	-2 kg·m/s	-4 kg·m/s	+14 kg·m/s
D)	+12 kg·m/s	-28 kg·m/s	-8 kg·m/s	-10 kg·m/s
E)	+6 kg·m/s	-14 kg·m/s	-6 kg·m/s	+14 kg·m/s



Before collision

C 5. A pilot wants to travel east in an airplane with an air speed of 350 km/h. The wind is blowing from the north at 20 km/h. What should be the plane's heading to go directly east?

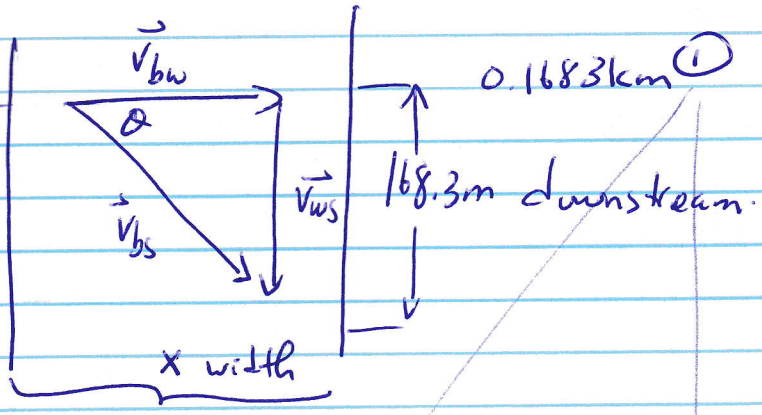
A) directly east
B) east of south
C) north of east
D) south of east



Part 2 – Problems

1.

a)



②

$\vec{v}_{bw} = 2.0\,km/h, E$

$\vec{v}_{ws} = 3.9\,km/h, S$

⑤

b) $v = \frac{d}{t}$

$t = \frac{d}{v}$ ②

$t = \frac{0.1683}{3.9}$

$t = 0.0432\,h$

$v = \frac{d}{t}$

$d = vt$ ②

$d = (2.0)(0.0432)$

$d = 0.0864\,km$ or $86.4\,m$

c) $v_{bs} = \sqrt{(2.0)^2 + (3.9)^2}$

$v_{bs} = 4.4\,km/h$

$\tan\theta = \frac{3.9}{2.0}$

$\theta = 63°$

③

$\vec{v}_{bs} = 4.4\,km/h, 63° S\,of\,E$

① ① ①

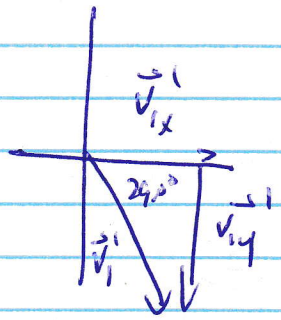
27° E of S.

/10

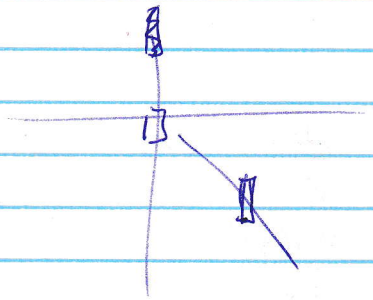
2. $m_1 = 11.0\,kg$ ↓
$\vec{v}_1 = -7.40\,m/s$
$\vec{v}_{1x} = 0$
$\vec{v}_{1y} = -7.40\,m/s$ ②

$m_2 = 8.90\,kg$
$\vec{v}_2 = 0$
$\vec{v}_{2x} = 0$
$\vec{v}_{2y} = 0$ ②

$\vec{v}_1' = 3.75\,m/s,\ 29.0°$ SqE



$\vec{v}_2' \rightarrow \vec{v}_{2x}$?
$\vec{v}_2' \searrow \vec{v}_{2y}$?



$\vec{v}_{1x}' = +3.75\cos 29.0°$
$\vec{v}_{1y}' = \ominus 3.75 \sin 29.0°$ ②

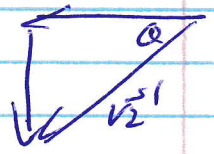
x/ $\cancel{m_1\vec{v}_{1x}} + \cancel{m_2\vec{v}_{2x}} = m_1\vec{v}_{1x}' + m_2\vec{v}_{2x}'$

$0 = m_1\vec{v}_{1x}' + m_2\vec{v}_{2x}'$

$\cancel{m_2}\vec{v}_{2x}' = \dfrac{-m_1\vec{v}_{1x}'}{m_2}$ ①

$\vec{v}_{2x}' = \dfrac{-(11.0)(3.75\cos 29.0°)}{8.90}$ ①

$\vec{v}_{2x}' = -4.054\,m/s$ ⑫



y/ $m_1\vec{v}_{1y} + \cancel{m_2\vec{v}_{2y}} = m_1\vec{v}_{1y}' + m_2\vec{v}_{2y}'$

$m_2\vec{v}_{2y}' = m_1\vec{v}_{1y} - m_1\vec{v}_{1y}'$

$\vec{v}_{2y}' = \dfrac{m_1\vec{v}_{1y} - m_1\vec{v}_{1y}'}{m_2}$ ①

$\vec{v}_{2y}' = \dfrac{(11.0)(-7.40) - (11.0)(-3.75\sin 29.0°)}{8.90}$

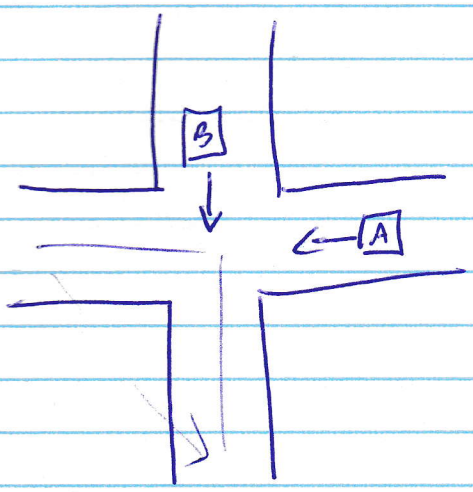
$\vec{v}_{2y}' = \cancel{-8.442\,m/s}$ ①
$-6.899\,m/s$

$v_2' = 8.00\,m/s$
$\theta = 59.6°$

$\vec{v}_2' = 8.00\,m/s,\ 59.6°$ SqW.

②

3.

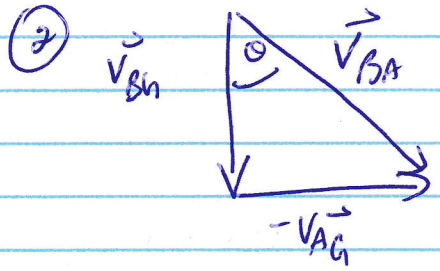


$\vec{V}_{AG} = -38\ m/s$

$\vec{V}_{BG} = -49\ m/s$

$\vec{V}_{BA} = \vec{V}_{BG} + \vec{V}_{GA}$

$\vec{V}_{BA} = \vec{V}_{BG} - \vec{V}_{AG}$ (5/2)



(2)

$V_{BA} = \sqrt{(38)^2 + (49)^2}$

$V_{BA} = 62\ m/s$

$\tan\theta = \frac{38}{49}$

$\theta = 38°$

$\vec{V}_{BA}' = 62\ m/s,\ 38°$ E of S (1) (1)

or

$52°$ S of E (1)

4. $m_1 = 5.20\ kg$ $\quad m_2$ ☐ $\quad$ ☐ m_1 $\leftarrow$

$\vec{v}_1 = -9.40\ m/s$ (1) $\quad ? \leftarrow$ ☐ $\quad$ ☐ m_1 $\rightarrow$

$m_2 = 8.60\ kg$

$\vec{v}_2 = 0$ (1)

$\vec{v}_1' = +1.80\ m/s$

(5)

$m_1\vec{v}_1 + \cancel{m_2\vec{v}_2} = m_1\vec{v}_1' + m_2\vec{v}_2'$ (1)

$\vec{v}_2' = \frac{m_1\vec{v}_1 - m_1\vec{v}_1'}{m_2}$ (1)

$\vec{v}_2' = \frac{(5.20)(-9.40) - (5.20)(1.80)}{8.60}$

$\vec{v}_2' = -6.77\ m/s$ (1)

(3)

b) $\Delta E_k = \frac{1}{2}m_1(v_1')^2 + \frac{1}{2}m_2(v_2')^2 - \frac{1}{2}m_1(v_1)^2 - \cancel{\frac{1}{2}m_2 v_2^2}$

$\Delta E = \frac{1}{2}(5.20)(1.80)^2 + \frac{1}{2}(8.60)(6.77)^2 - \frac{1}{2}(5.20)(9.40)^2$ (1)

$\Delta E_k = -24.2\ J$ (1) inelastic. (1)