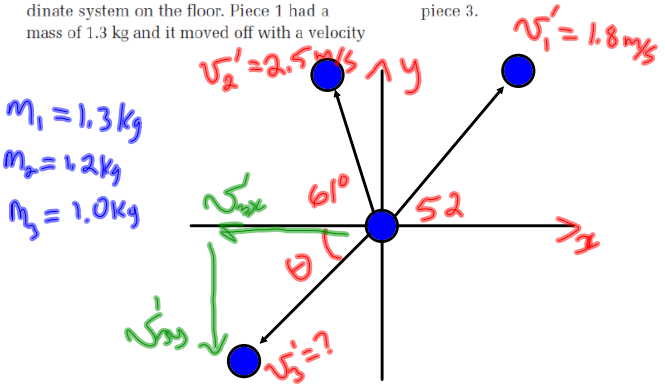
PRACTICE PROBLEMS MHR Pg 513

38. You accidentally dropped a 3.5 kg glass platter. Before it hit the floor, the motion was entirely in the vertical direction. When it hit the floor, it broke into three pieces and they all moved out in the plane of the floor. Imagine a coordinate system on the floor. Piece 1 had a mass of 1.3 kg and it moved off with a velocity of 1.8 m/s at an angle of 52° counterclockwise from the positive *x* axis. Piece 2 with a mass of 1.2 kg moved off with a velocity of 2.5 m/s at an angle of 61° clockwise from the negative *x* axis. Find the mass and the velocity of piece 3.



x-dir

$$0 = m_1 v_{1x}' + m_2 v_{2x}' + m_3 v_{3x}'$$

$v_{1x}' = 1.8\cos 52 = 1.11$ m/s $v_{1y}' = 1.8\sin 52 = 1.42$

$v_{2x}' = -2.5\cos 61 = -1.21$ m/s $v_{2y}' = 2.5\sin 61 = 2.19$

$$0 = (1.3)(1.11) + (1.2)(-1.21) + (1)(v_{3x}')$$

$$0 = 1.443 - 1.452 + v_{3x}'$$

$$0.009 = v_{3x}'$$

y-dir

$$0 = m_1 v_{1y}' + m_2 v_{2y}' + m_3 v_{3y}'$$

$$0 = (1.3)(1.42) + (1.2)(2.19) + (1) v_{3y}'$$

$$0 = 1.846 + 2.628 + v_{3y}'$$

$$-4.47 \text{ m/s} = v_{3y}'$$

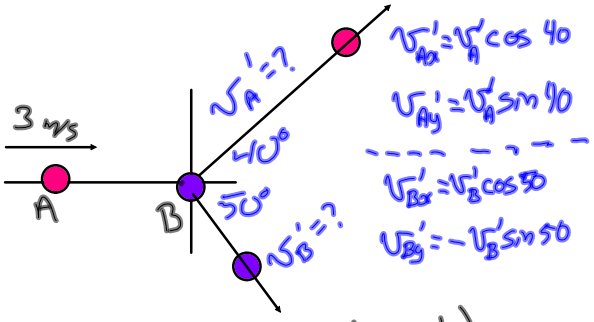
$$v_3' = \sqrt{(v_{3x}')^2 + (v_{3y}')^2}$$

$$v_3' = \sqrt{(0.009)^2 + (4.47)^2} = 4.47 \text{ m/s}$$

$$\theta = \tan^{-1}\left|\frac{4.47}{0.009}\right| = 90°$$

$v_3' = 4.47$ m/s down y-axis

Example: A 6.0 kg object, A, moving at a velocity of 3.0 m/s east collides with a 6.0 kg object, B, at rest. After the collision, A moves off in a direction 40.0° to the left of its original direction. B moves off in a direction 50.0° to the right of A's original direction. What is the magnitude of the velocity of each object after the collision? ($v_A' = 2.3$ m/s, $v_B' = 1.9$ m/s)



x-dir (mass divide out)

$v_{Ax} = v_{Ax}' + v_{Bx}'$

$3 = v_{Ax}' + v_{Bx}'$

$3 = v_A' \cos 40 + v_B' \cos 50$

$3 = 0.766 v_A' + 0.643 v_B'$ ①

y-dir

$v_{Ay} = v_{Ay}' + v_{By}'$

$0 = v_A' \sin 40 + (-v_B' \sin 40)$

$0 = 0.643 v_A' - 0.766 v_B'$ ②

Solve ② v_A'

$\frac{0.766 v_B'}{0.643} = v_A' \rightarrow 1.19 v_B' = v_A'$ sub into ①

① $3 = 0.766(1.19 v_B') + 0.643 v_B'$

$3 = 0.913 v_B' + 0.643 v_B'$

$3.0 = 1.56 v_B'$

$1.93 \text{ m/s} = v_B'$ → sub in ②

② $1.19 v_B' = v_A'$

$1.19(1.93) = v_A'$

$2.29 \text{ m/s} = v_A'$