after explosion

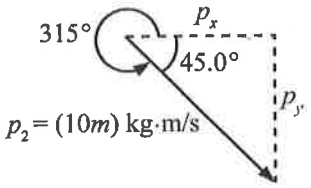
①	②	③
$m_1 = m$	$m_2 = m$	$m_3 = m$
$\vec{v}_1 = 15$ m/s east	$\vec{v}_2 = 10$ m/s 45° S of E	$\vec{v}_3 = ?$
$\vec{p}_1 = (15m)$ m/s east	$\vec{p}_2 = (10m)$ m/s 45° S of E	$\vec{p}_3 = ?$

$\vec{p}_{\text{sys(after)}} = \vec{p}_{\text{sys(before)}}$
$\vec{p}_1 + \vec{p}_2 + \vec{p}_3 = 0$

Find the horizontal and vertical components of $\vec{p}_1$

$\vec{p}_{1x} = (15m)$m/s east
$\vec{p}_{1y} = 0$

Find the horizontal and vertical components of $\vec{p}_2$
45.0° S of E = 315° heading counter clockwise from positive x-axis



$\vec{p}_{2x} = p_2 \cos\theta$
$= ((10m)\text{ m/s})(\cos 315°)$
$= (7.07m)$ m/s

$\vec{p}_{2y} = p_2 \sin\theta$
$= ((10m)\text{ m/s})(\sin 315°)$
$= -(7.07m)$ m/s

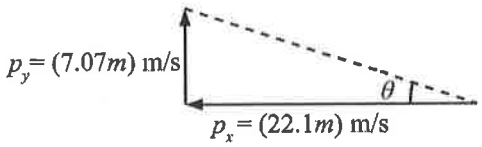
$\sum \vec{p}_x = (15m)\text{ m/s} + (7.07m)\text{ m/s}$
$= (22.1m)$ m/s

$\sum \vec{p}_y = 0 + ((-7.07m)\text{ m/s})$
$= (-7.07m)$ m/s

$\sum p_x$ should be zero,
x component of $\vec{p}_3 = (-22.1\text{ m})$ m/s

$\sum p_y$ should be zero,
$\therefore$ y component of $\vec{p}_3 = (7.07\text{ m})$ m/s

Now add x and y component of $\vec{p}_3$



$p_{3(R)} = \sqrt{(p_{3x})^2 + (p_{3y})^2}$
$= \sqrt{((22.1m)\text{ m/s})^2 + ((7.07m)\text{ m/s})^2}$
$= (23.2m)$ m/s

$\tan\theta = \dfrac{p_{3y}}{p_{3x}}$
$= \dfrac{(7.07m)\text{ m/s}}{(22.1m)\text{ m/s}}$
$\theta = 17.8°$ N of W
$\vec{p}_3 = \vec{p}_{3R} = (23.2m)$ m/s 17.8° N of W

$\vec{v}_3 = \dfrac{\vec{p}_3}{m}$
$= \dfrac{(23.2m)\text{ m/s } 17.8°\text{ N of W}}{m}$
$= 23.2$ m/s 17.8° N of W

Practice Test

ANSWERS AND SOLUTIONS

1. $E_k = \frac{1}{2}mv^2$
Since both the mass and the velocity remain constant, the kinetic energy remains constant.

$E_p = mgh$
Since the height (h) increases, the gravitational potential energy increases.

$p = mv$
Like kinetic energy, since both the mass and the velocity remain constant, the momentum remains constant.

D is the answer.

2. Momentum is conserved in <u>all</u> collisions and explosions.

D is the answer.