pg ~~190~~ 228

① before

1.4×10^3 kg ← 37 km/h

$\vec{P}_1 = 51800$ kg km/h

2×10^3 kg ↑ 35 km/h

$\vec{P}_2 = 70000$ kg km/h

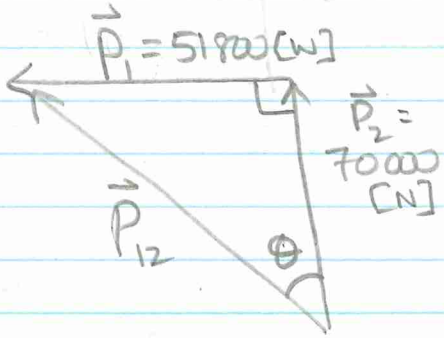
after

3.4×10^3 kg

V = ?

$\vec{P}'_{12}$

since looking for V, not $\vec{P}$, we can leave units as km/h



$\tan\theta = \frac{51800}{70000}$

$\theta = 36.5°$

pythag:

$\vec{P}_{12} = \sqrt{51800^2 + 70000^2}$

$= 87081.8$ kg km/h

$\vec{V}_{12} = \frac{\vec{P}_{12}}{m_{12}} = \frac{87081.8 \text{ kg km/h}}{3.4\times10^3 \text{ kg}}$

$= 25.6$ km/h

$\vec{V}_{12} = 26$ km/h [37° W of N] ✓

② $\vec{P}_2$ $(8\text{kg})(35\text{m/s}) = 28$ kgm/s

$\vec{P}_1$ $(6.2\text{kg})(3\text{m/s}) = 18.6$ kgm/s

$\vec{P}_{12}$, θ

$V_{12} = ?$

pythag

$\vec{P}_{12} = \sqrt{28^2 + 18.6^2}$

$= 33.615$

$= 34$ kgm/s

$\tan\theta = \frac{28}{18.6}$

$\theta = 56°$

$\vec{V}_{12} = \frac{33.615}{(8+6.2)\text{kg}}$

$= 2.4$ m/s

$\vec{V}_{12} = 2.4$ m/s [56° W of N] ✓

③ $\vec{P}_1 = (4\times10^4\text{ kg})(8\text{ m/s}) = 3.2\times10^5$

$\vec{P}_2 = 3\times10^4\text{ kg} \times 5\text{ m/s} = 1.5\times10^5$

$\vec{P}_{12} = (7\times10^4\text{ kg})(V_{12})$

$V_{12} = ?$

$P_{12} = \sqrt{(1.5\times10^5)^2 + (3.2\times10^5)^2}$

$= 353411.9\text{ kg m/s}$

$V_{12} = \dfrac{353411.9}{(7\times10^4\text{ kg})}$

$= 5.0\text{ m/s}$

$\tan\theta = \dfrac{1.5\times10^5}{3.2\times10^5}$

$\theta = 25°$

$\vec{V}_{12} = 5.0\text{ m/s}\ [25°\text{ S of W}]$ ✓

④ 50kg, V → (Resultant) 60kg, 0 m/s ≠ 50kg → , 60kg ↓ (error in key)

a) V=?

50kg $(V_1) = \vec{P}_1$

38°, 50°, 92°

$\vec{P}_2'$: 60kg × 6.3 m/s = 378 kg m/s

$\vec{P}_1'$: 50kg × 6 m/s = 300 kg m/s

180 − 38 − 50 = 92°

$\vec{P}_1^2 = 378^2 + 300^2 - 2(378)(300)\cos92°$

$\vec{P}_1 = 490.71\text{ kg m/s}$

$V_1 = \dfrac{490.71}{50\text{ kg}}$

(text key 9.82 m/s →) $= 9.81\text{ m/s}\ [E]$ ✓

b) elastic or inelastic? (direction doesn't matter in energy since scalar)

$E_{K\text{before}} \stackrel{?}{=} E_{K\text{after}}$

$\frac{1}{2}(50)(9.81)^2 \stackrel{?}{=} \frac{1}{2}(60)(6.3)^2 + \frac{1}{2}(50)(6)^2$

$2408 \neq 2090.7$ ∴ inelastic ✓

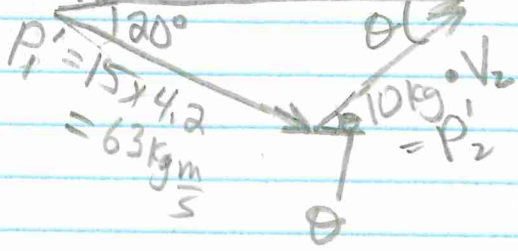
(E_K not conserved)

c) "Lost" E_K converted into heat, sound, etc. ✓

⑤ $15\text{kg} \xrightarrow{7\text{m/s [E]}}$ + 10kg 0m/s $\Rightarrow$ $15\text{kg} \searrow 4.2\text{m/s}$ + $10\text{kg} \nearrow V_2 = ?$

a) $p_1 = 15 \times 7 = 105 \text{ kg}\frac{\text{m}}{\text{s}}$

$p_1' = 15 \times 4.2 = 63 \text{ kg}\frac{\text{m}}{\text{s}}$



$p_2' = \sqrt{105^2 + 63^2 - 2(105)(63)\cos 20°}$

$= 50.6149 \text{ kg}\frac{\text{m}}{\text{s}}$

$V_2 = \frac{50.6149}{10\text{kg}} = 5.06149 \text{ m/s}$

$= 5.1 \text{ m/s}$

$\frac{\sin\theta}{63} = \frac{\sin 20}{50.6149}$

$\theta = 25.2°$

$\vec{V}_2 = 5.1\frac{\text{m}}{\text{s}}$ [25° N of E] ✓

b) elastic or inelastic? (direction doesn't matter with energy since scalar)

$\frac{1}{2}(15)(7)^2 \stackrel{?}{=} \frac{1}{2}(15)(4.2)^2 + \frac{1}{2}(10)(5.1)^2$

$367.5 \quad 132.3 \quad 130.05$

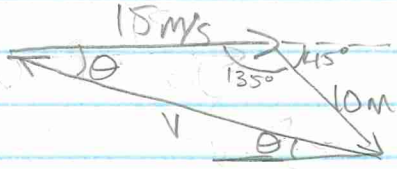
$367.5 \neq 262.4$

Kinetic energy not conserved so <u>inelastic</u> ✓

c) E_K mostly converted to E_{Th}, sound, etc

(6) before $\vec{p} = 0$
3 equal masses

after



equilibrium Δ (adds to zero)

since equal masses, can use $\vec{v}$ only, don't need $\vec{p}$

$$V = \sqrt{10^2 + 15^2 - 2(10)(15)\cos 135^\circ}$$
$$= 23.1761$$
$$= 23.2 \text{ m/s}$$

$$\frac{\sin\theta}{10} = \frac{\sin 135}{23.1761}$$

$$\theta = 17.8^\circ$$

$$\vec{V} = 23.2\frac{m}{s}\ [17.8^\circ \text{ N of W}] \checkmark$$