Homework 12 solutions

1) Conservation of momentum

momentum before = momentum after

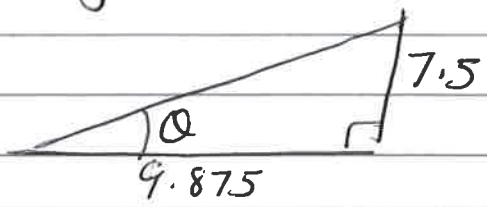
$1200 \times 18\underline{i} + 2000(5\underline{i} + 12\underline{j}) = 3200\underline{v}$ ✓ ✓

$31600\underline{i} + 24000\underline{j} = 3200\underline{v}$

$\underline{v} = 9.875\underline{i} + 7.5\underline{j}$ ✓

$|\underline{v}| = \sqrt{9.875^2 + 7.5^2}$

$= 12.4 ms^{-1}$ ✓



$\tan\theta = \frac{7.5}{9.875}$

$\theta = 37.2°$ to the x-axis. ✓

2) Particle P

$u = 0$

$t = 4$ secs

$a = F/m$

$a = 3/2$ ✓

$v = u + at$

$v = 0 + 3/2 \times 4$

$v = 6 ms^{-1}$ ✓

momentum before = momentum after

$2 \times 6 + m \times 0 = (2+m) \times 3.75$ ✓

$12 = 7.5 + 3.75m$

$m = 1.2 kg$ ✓

3) momentum before = momentum after

$1\times(-2\underline{i}+4\underline{j})+2\underline{v}=3\times(\underline{i}+4\underline{j})$ ✓

$-2\underline{i}+4\underline{j}+2\underline{v}=3\underline{i}+12\underline{j}$

$2\underline{v}=5\underline{i}+8\underline{j}$

$\underline{v}=(\frac{5}{2}\underline{i}+4\underline{j})\,ms^{-1}$ ✓

$|\underline{v}|=\sqrt{(\frac{5}{2})^2+4^2}$

$=\underline{4.72ms^{-1}}$ ✓

4) Impulse = change in momentum

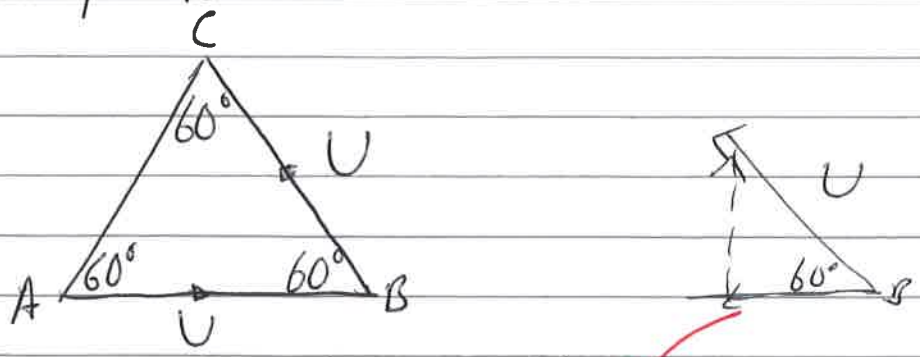
$I=\int F\,dt$

$I=\int_0^1 100\cos(\frac{1}{2}\pi)t\,dt$ ✓

$I=\left[\frac{100}{\frac{1}{2}\pi}\sin(\frac{1}{2}\pi)t\right]_0^1$ ✓

$\underline{I=63.7Ns}$ ✓

6) one possible solution



A→B momentum $= mU\underline{i}$ ✓

B→C momentum $= m(-U\cos 60\,\underline{i}) + m(U\sin 60\,\underline{j})$

$= -\frac{1}{2}mU\underline{i} + \frac{\sqrt{3}}{2}mU\underline{j}$ ✓

Impulse = change in momentum

$= -\frac{1}{2}mU\underline{i} + \frac{\sqrt{3}}{2}mU\underline{j} - mU\underline{i}$ ✓

$= -\frac{3}{2}mU\underline{i} + \frac{\sqrt{3}}{2}mU\underline{j}$

$|I| = \sqrt{\left(\frac{3}{2}mU\right)^2 + \left(\frac{\sqrt{3}}{2}mU\right)^2}$ ✓

$= \sqrt{\frac{9}{4}m^2U^2 + \frac{3}{4}m^2U^2}$

$= \sqrt{3m^2U^2}$

$= \underline{\sqrt{3}\,mU\ Ns}$ ✓

5) $I = \int F\,dt$

$$I = \int_0^6 (4t\underline{i} - 2\underline{j})\,dt$$ ✓

$$I = \left[2t^2\underline{i} - 2t\underline{j}\right]_0^6$$

$I = (72\underline{i} - 12\underline{j})$ Ns ✓

$I = mv - mu$

$72\underline{i} - 12\underline{j} = 3v - 3(3\underline{i} + \underline{j})$ ✓

$72\underline{i} - 12\underline{j} = 3v - 9\underline{i} - 3\underline{j}$

$3v = 81\underline{i} - 9\underline{j}$

$v = (27\underline{i} - 3\underline{j})$ ms^{-1} ✓

speed $= |\underline{v}| = \sqrt{27^2 + 3^2} = 27.2$ ms^{-1} ✓