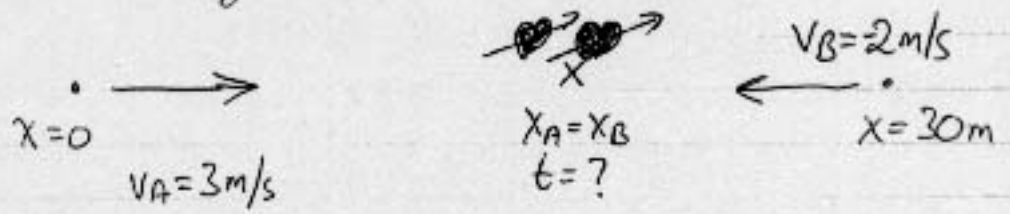
Physics 1A Quiz 1 Solutions

1. Distance from A's starting point is x

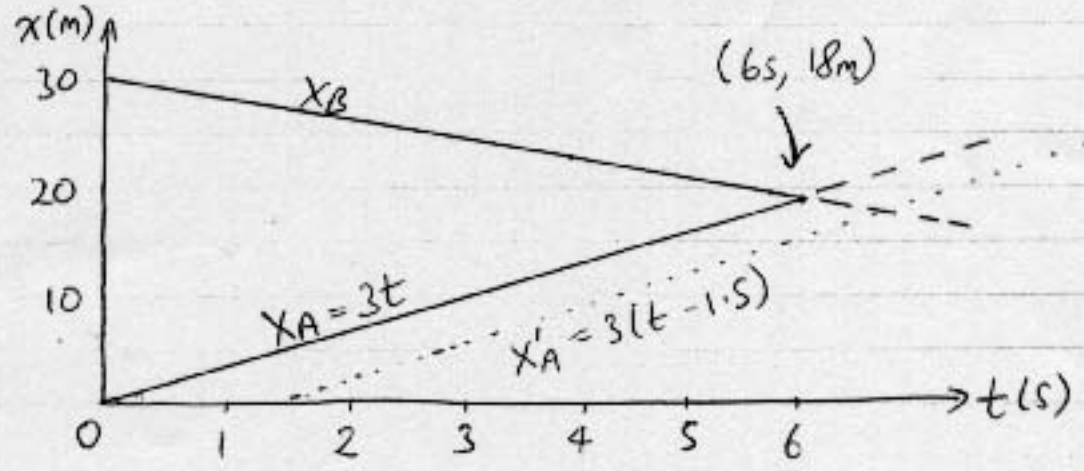
In general $x = x(0) + vt$



a) Actor A: $v_A = +3m/s$, $x_A(0) = 0$ so $x_A = 0 + 3t$
B: $v_B = -2m/s$, $x_B(0) = 30$ $x_B = 30 - 2t$

b) At collision $x_A = x_B$, i.e. $3t = 30 - 2t$
So $5t = 30$ or $t = 30/5 = \underline{6s}$
Substitute back $\Rightarrow x_A = x_B = \underline{18m}$.
So A runs 18 m (from $x_A = 0$ to $x_A = 18$)
and B " 12m (" $x_B = 30$ to $x_B = 18$)

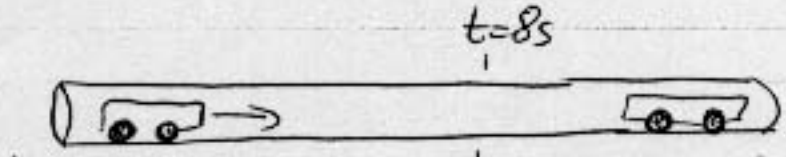
c)



d) If A is delayed by 1.5s, such that $x'_A = 0$ when $t = 1.5$
$\Rightarrow$ $x'_A = v_A(t - 1.5) = 3(t - 1.5)$

So $x'_A = x_B$ when $3(t-1.5) = 30 - 2t$
$\Rightarrow$ $\underline{t = 6.9s}$,
and $x_A = x_B = \underline{16.2m}$

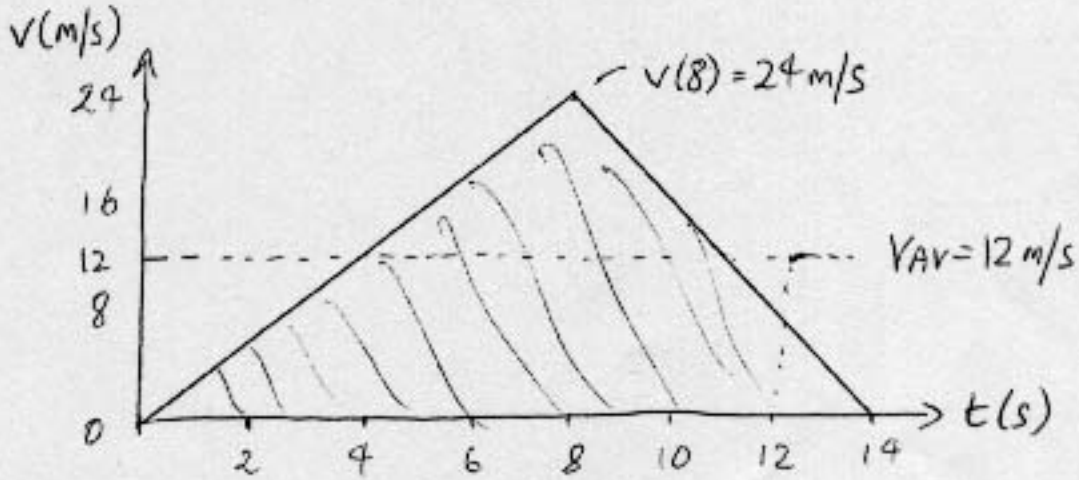
2.



a) Trip ends when $v=0$, i.e. $24-4(t-8)=0$

$\Rightarrow t = \frac{24+32}{4} = 14s.$

b)



c(i) Integration method: displacement $x = \int_0^8 3t\,dt + \int_8^{14} 24-4(t-8)\,dt$

$= \left[\frac{1}{2}.3t^2\right]_0^8 + \left[56t - 2t^2\right]_8^{14}$

$= 96 + 72 = \underline{168m}$

OR distance = area under triangle = ½ base × height

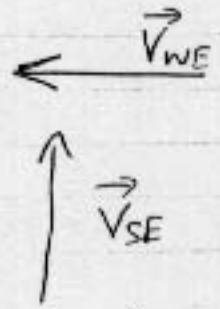
(base = 14s, height = 24m/s)

$= \frac{1}{2} \times 14 \times 24 = \underline{168m}$

(ii) AVERAGE speed $v_{AV} = \frac{\text{total distance}}{\text{total time}} = \frac{168m}{14s} = \underline{12\,m/s}$

3. Given $V_{WE} = 40$ km/h, west

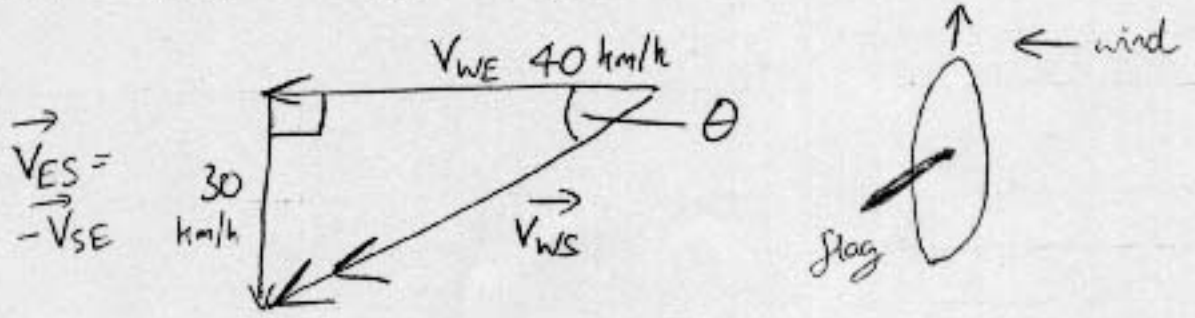
$V_{SE} = 30$ km/h, north



Need to find: $\vec{V}_{WS}$, wind velocity relative to ship

$\vec{V}_{WS} = \vec{V}_{WE} + \vec{V}_{ES}$, and $\vec{V}_{ES} = -\vec{V}_{SE}$

So $\vec{V}_{WS} = V_{WE} - \vec{V}_{SE}$

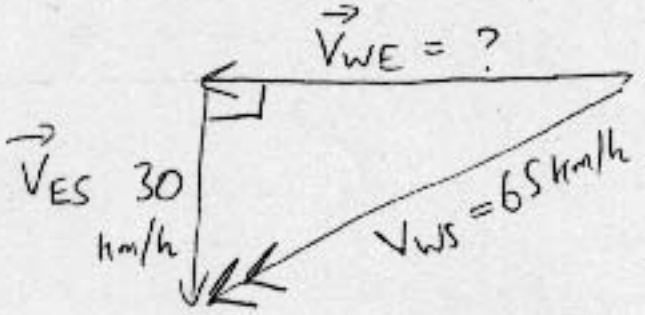


a) Magnitude of $\vec{V}_{WS}$ measured on deck is $V_{WS} = \sqrt{40^2+30^2}$

$= 50$ km/h

b) Direction of $\vec{V}_{WS}$ blowing flags is $\theta = \tan^{-1}(\frac{30}{40}) = 36.9°$ S of W

c)



Measure new speed on deck $V_{WS} = 65$ km/h

So real speed $V_{WE} = \sqrt{65^2 - 30^2}$ $= 57.7$ km/h

(and new flag direction $= \sin^{-1}(\frac{30}{65}) = 27.5°$)