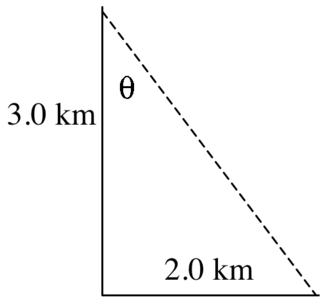
Chapter 2.1

Q1 $v = \frac{3000.0}{5.00}\frac{\text{km}}{\text{hr}} = \frac{3000.0\times 10^3}{5.00\times 60\times 60}\ \text{m s}^{-1} = 167\ \text{m s}^{-1}$.

Q2 Distance traveled in first 1.5 h is $s = vt = 70\times 1.5 = 105\ \text{km}$. Remaining distance is 15 km and must be covered in 1.0 hr so average speed must be $v = \frac{15}{1.0}\frac{\text{km}}{\text{hr}} = 15\ \text{km hr}^{-1}$.

Q3 (a) A distance of 5.0 km is covered in 3.0 h so the average speed is $v = \frac{5.0}{3.0}\frac{\text{km}}{\text{hr}} = 1.7\ \text{km hr}^{-1}$. (b) The magnitude of the displacement is $\sqrt{2.0^2 + 3.0^2} = 3.61\ \text{km}$. The magnitude of the average velocity is then $v = \frac{3.61}{3.0}\frac{\text{km}}{\text{hr}} = 1.2\ \text{km hr}^{-1}$. The direction is determined by the angle θ which is $\tan^{-1}\frac{2}{3} = 34^\circ$.



Q4 The velocity is initially constant and negative so displacement graph will be a straight line with negative slope. The velocity is then constant and positive so displacement graph is a straight line with positive slope. See answers ion textbook.

Q5 (a) The area under the graph is the change in displacement. At $t = 8$ s the area is 80 m and so the displacement is 88 m. (b) The area from $t = 0$ to $t = 12$ s is $80 - 20 = 60$ m and so the displacement is 68 m. (c) The distance traveled is 80 + 20 = 100 m and so the average speed is $v = \frac{100}{12}\ \text{m s}^{-1} = 8.3\ \text{m s}^{-1}$. The change in displacement is 60 m and so the average velocity is $v = \frac{60}{12}\ \text{m s}^{-1} = 5.0\ \text{m s}^{-1}$.

Q6 The relative speed of the cyclists is $v = 35\ \text{km hr}^{-1}$. They will then meet in a time of $v = \frac{70}{35} = 2.0\,\text{hr}$. (a) The common displacement is $s = 15\times 2.0 = 30\ \text{km}$. (b) The fly will travel a distance of $s = 30\times 2.0 = 60\ \text{km}$.

Q7 (a) $d = vt$ (b) $\vec{r} = \vec{d}_1 + ... + \vec{d}_N$, where $|\vec{d}_i| = d$. Then $r^2 = \vec{r} \bullet \vec{r} = (\vec{d}_1 + ... + \vec{d}_N) \bullet (\vec{d}_1 + ... + \vec{d}_N) = \sum_{i=1}^{N} d^2 + \sum_{i \neq j=1}^{N} d^2 \cos\theta_{ij}$, where θ_{ij} is the angle between vectors $\vec{d}_i, \vec{d}_j$. On the average $\sum_{i \neq j=1}^{N} d^2 \cos\theta_{ij} = d^2 \sum_{i \neq j=1}^{N} \cos\theta_{ij} = 0$ since the angles are random. Thus $r^2 = \sum_{i=1}^{N} d^2 = Nd^2$ and so $r = d\sqrt{N}$.

Q8 (a) $\vec{v}_{B|A} = \vec{v}_B - \vec{v}_A = -50 - 80 = -130 \text{ km hr}^{-1}$. (b) $\vec{v}_{A|B} = \vec{v}_A - \vec{v}_B = 80 - (-50) = +130 \text{ km hr}^{-1}$.

Q9 (a) $\vec{v}_{B|A} = 1.0 = \vec{v}_B - \vec{v}_A = \vec{v}_B - (-3.0) \Rightarrow \vec{v}_B = -2.0 \text{ m s}^{-1}$. (b) $\vec{v}_{C|A} = -2.0 = \vec{v}_C - \vec{v}_A = \vec{v}_C - (-3.0) \Rightarrow \vec{v}_C = -5.0 \text{ m s}^{-1}$.

Q10 $\vec{v}_{B|A} = \vec{v}_B - \vec{v}_A = 4.0 - (-4.0) = +8.0 \text{ m s}^{-1}$.

Q11 We must find the slopes of the graphs. (a) $v = \frac{10-0}{11-5.0} \text{ m s}^{-1} = 1.7 \text{ m s}^{-1}$ (b) $v = \frac{0-30}{4.8-0} \text{ m s}^{-1} = -6.2 \text{ m s}^{-1}$.

Q12 (a) The distance traveled is 80 m. The average speed is then $v = \frac{80}{20} \text{ m s}^{-1} = 4.0 \text{ m s}^{-1}$.
(b) The displacement is zero and so the average velocity is zero.