Solutions

2.1 Magnitude $\sqrt{9+16} = 5\ \mathrm{m\,s^{-1}}$. The direction $(3, -4)$ is south-east; $\tan^{-1}(3/4) = 36.9°$ east of south, so the bearing is $180 - 37 = 143°$.

2.2 Resultant $6\mathbf{i} - 2\mathbf{j}$: magnitude $\sqrt{36+4} = 2\sqrt{10} \approx 6.3$ N, direction $\tan^{-1}(2/6) = 18.4°$ south of east.

2.3 Velocity $= \dfrac{(12\mathbf{i}+7\mathbf{j}) - (3\mathbf{i}-2\mathbf{j})}{3} = 3\mathbf{i} + 3\mathbf{j}$; $\mathbf{r}(t) = (3\mathbf{i} - 2\mathbf{j}) + (t-1)(3\mathbf{i}+3\mathbf{j}) = 3t\mathbf{i} + (3t-5)\mathbf{j}$.

2.4 Perpendicular $\Longleftrightarrow$ dot product zero: $3\lambda - 8 = 0$, so $\lambda = \frac{8}{3}$.

3.1 (a) $\dfrac{(10\mathbf{i}+4\mathbf{j}) - (-5\mathbf{i}+16\mathbf{j})}{3} = \dfrac{15\mathbf{i}-12\mathbf{j}}{3} = (5\mathbf{i}-4\mathbf{j})\ \mathrm{m\,s^{-1}}$. (b) $\mathbf{r} = (-5\mathbf{i}+16\mathbf{j}) + (t-2)(5\mathbf{i}-4\mathbf{j}) = (5t-15)\mathbf{i} + (24-4t)\mathbf{j}$. (c) At $t = 5$: A is at $10\mathbf{i}+4\mathbf{j}$; B is at $-5\mathbf{i}+7\mathbf{j}+5(2\mathbf{i}-3\mathbf{j}) = 5\mathbf{i} - 8\mathbf{j}$; so $\overrightarrow{AB} = -5\mathbf{i} - 12\mathbf{j}$, magnitude 13, direction $\tan^{-1}(5/12) = 22.6°$ west of due south: bearing 203°.

3.2 (a) Position $(2, -1)$: south-east quadrant, $\tan^{-1}(2/1) = 63.4°$ east of south, bearing $180 - 63 = 117°$. (b) Position $(2+3t)\mathbf{i} + (-1+4t)\mathbf{j}$: due east when the $\mathbf{j}$-component is zero, $t = 0.25$ h; position $2.75\mathbf{i}$, so the ship is 2.75 km due east of the origin.

Local review guidance: difference quotient with the correct time interval; position vectors generalised from one instant; bearings measured clockwise from north in the correct quadrant. This is authored classroom guidance.