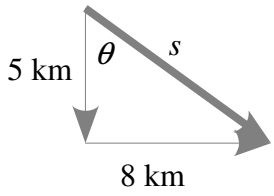
Vector Addition Solutions

(These are examples of working; you could get to the same answer using different methods)

1.



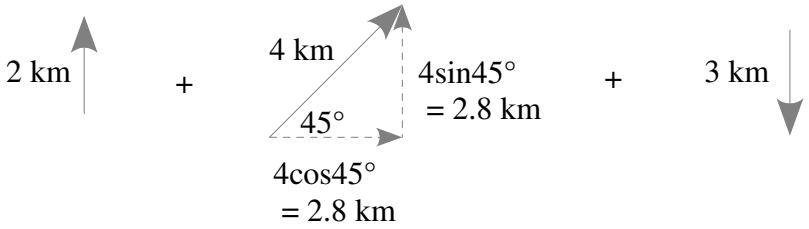
$s = \sqrt{5^2 + 8^2} = 9.4 \text{ km}$

$\theta = \tan^{-1}\left(\frac{8}{5}\right) = 58°$

The displacement of the car is 9.4 km at 58° east of south

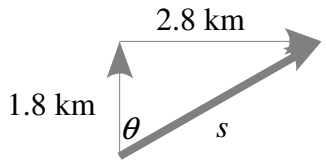
2.

(a) First calculate the components:



Total north/south component: 2 + 2.8 – 3 = 1.8 km north
Total east/west component: 2.8 km east

Now combine the components:



$s = \sqrt{1.8^2 + 2.8^2} = 3.4 \text{ km}$

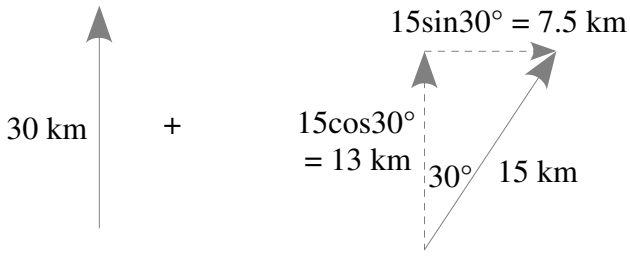
$\theta = \tan^{-1}\left(\frac{2.8}{1.8}\right) = 57°$

The displacement of the cyclist is 3.4 km at 57° east of north

(b) 2.0 + 4.0 + 3.0 = 9.0 km

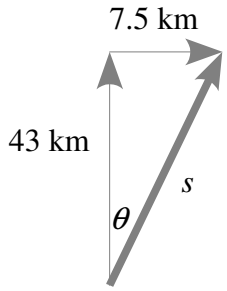
3.

(a) First convert speed and time to distance travelled:
20 kmh^{-1} for 1.5 hours: $s = vt = 20 \times 1.5 = 30$ km
30 kmh^{-1} for 0.5 hours: $s = vt = 30 \times 0.5 = 15$ km



Total north/south component: 30+13 = 43 km north
Total east/west component: 7.5 km east

Now combine components:



$s = \sqrt{43^2 + 7.5^2} = 44$ km

$\theta = \tan^{-1}\left(\frac{7.5}{43}\right) = 9.9°$

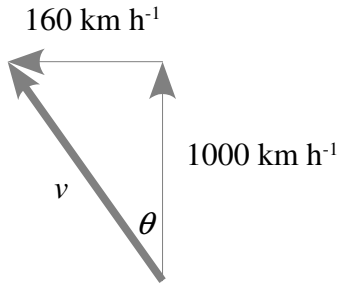
The displacement of the cyclist is 44 km at 9.9° east of north

(b) $v = \frac{s}{t} = \frac{44}{2} = 22$ km h^{-1}

The cyclist's average velocity is 22 km h^{-1} at 9.9° east of north

4.

(a)



$v = \sqrt{1000^2 + 160^2} = 1013 \text{ km h}^{-1}$

$\theta = \tan^{-1}\left(\frac{160}{1000}\right) = 9.1°$

The velocity of the jet is 1013 km h^{-1} at 9.1° west of north

(b) $s = vt = 1013 \times 3 = 3038 \text{ km}$

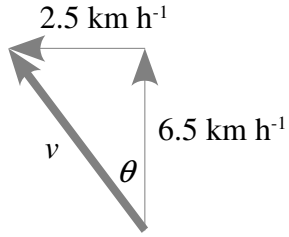
The jet's displacement would be 3038 km, 9.1° west of north

(c) The jet has been blown by a 160 km h^{-1} wind for 3 hours, so:
$s = vt = 160 \times 3.0 = 480 \text{ km}$

The jet's displacement would be 480 km (2 s.f.) west of where it would be without wind.

5.

(a)



$v = \sqrt{6.5^2 + 2.5^2} = 7.0 \text{ km h}^{-1}$

$\theta = \tan^{-1}\left(\frac{2.5}{6.5}\right) = 21°$

The velocity of the boat is 7.0 km h^{-1} at 21° west of north

(b) He will need to cancel out the current, so have a eastward component of 2.5 km h^{-1}.
He could do this by heading 21° east of north .

(c) He has a component across the river of 6.5 km h^{-1}, and 120 m is 0.12 km.

$t = \frac{s}{v} = \frac{0.12}{6.5} = 0.018 \text{ hours}$