

Determine the total displacement for each pair of vectors.

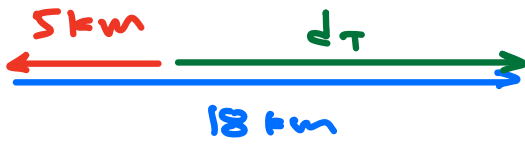
- a) 5 km west, 18 km east
- b) 560 m south, 370 m north
- c) 5.9 m east, 3.9 m north
- d) 0.45 m south, 0.89 m west
- e) 100 m north, 100 m 40° south of west
- f) 49 m east, 30 m 20° south of east
- g) 400 m northeast, 500 m southeast
- h) 5.4 km 15° south of east, 8.1 km 30° south of west

Determine the total displacement for each pair of vectors.

a) 5 km west, 18 km east

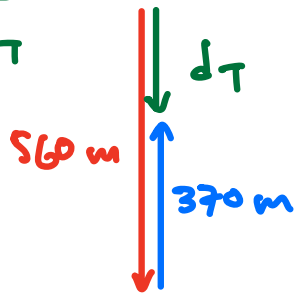
$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$

$$d_T = 18 - 5 = \boxed{13 \text{ km EAST}}$$



b) 560 m south, 370 m north

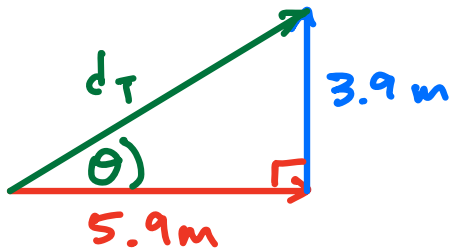
$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



$$d_T = 560 - 370 = \boxed{190 \text{ m SOUTH}}$$

c) 5.9 m east, 3.9 m north

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



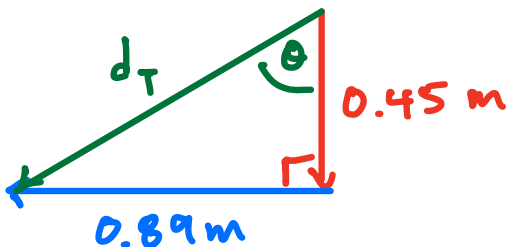
$$d_T = \sqrt{(5.9)^2 + (3.9)^2} = 7.07 \text{ m}$$

$$\theta = \tan^{-1}\left(\frac{3.9}{5.9}\right) = 33.5^\circ$$

$$\boxed{7.07 \text{ m } 33.5^\circ \text{ N of E}}$$

d) 0.45 m south, 0.89 m west

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



$$d_T = \sqrt{(0.45)^2 + (0.89)^2} = 0.997 \text{ m}$$

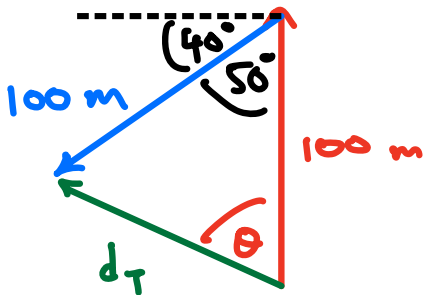
$$\theta = \tan^{-1}\left(\frac{0.89}{0.45}\right) = 63.2^\circ$$

$$0.997 \text{ m } 63.2^\circ \text{ W of S}$$

$$= \boxed{0.997 \text{ m } 26.8^\circ \text{ S of W}}$$

e) 100 m north, 100 m 40° south of west

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



$$d_T^2 = (100)^2 + (100)^2 - 2(100)(100)\cos 50^\circ$$

$$d_T = 84.5 \text{ m}$$

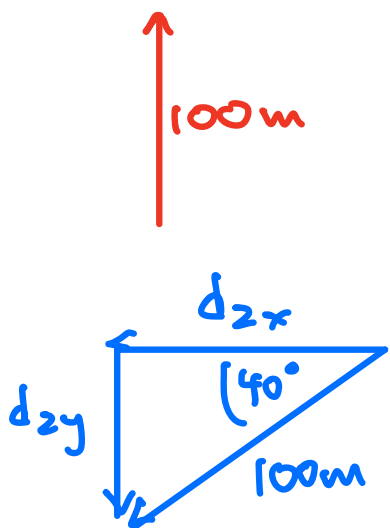
$$\frac{\sin \theta}{100} = \frac{\sin 50^\circ}{84.5}$$

$$\theta = \sin^{-1}\left(\frac{100}{84.5} \sin 50^\circ\right)$$

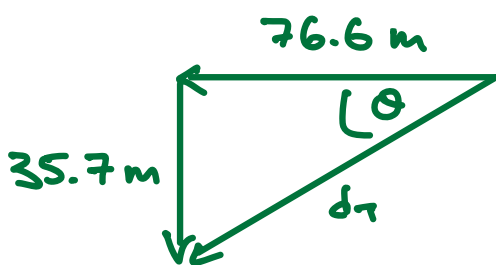
$$= 65.0^\circ$$

$$84.5 \text{ m} \quad 65.0^\circ \text{ W of N}$$

$$= \boxed{84.5 \text{ m} \quad 25.0^\circ \text{ N of W}}$$



x	y
$d_{1x} = 0$	$d_{1y} = +100 \text{ m}$
$d_{2x} = -100 \cos 40^\circ$ $= -76.6 \text{ m}$	$d_{2y} = -100 \sin 40^\circ$ $= -64.3 \text{ m}$
$d_{Tx} = -76.6 \text{ m}$	$d_{Ty} = +35.7 \text{ m}$



$$d_T = \sqrt{(76.6)^2 + (35.7)^2}$$

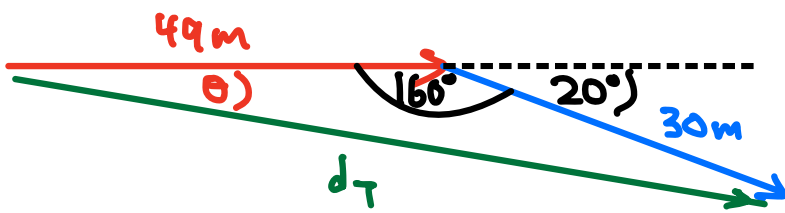
$$= 84.5 \text{ m}$$

$$\theta = \tan^{-1}\left(\frac{35.7}{76.6}\right) = 25.0^\circ$$

$$\boxed{84.5 \text{ m} \quad 25.0^\circ \text{ S of W}}$$

f) 49 m east, 30 m 20° south of east

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



$$d_T^2 = (49)^2 + (30)^2 - 2(49)(30)\cos 160^\circ$$

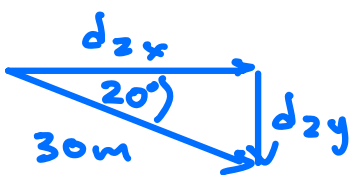
$$d_T = 77.9 \text{ m}$$

$$\frac{\sin \theta}{30} = \frac{\sin 160^\circ}{77.9}$$

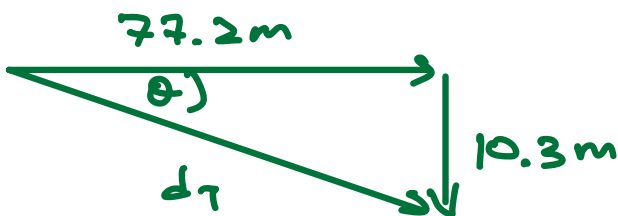
$$\theta = \sin^{-1}\left(\frac{30}{77.9} \sin 160^\circ\right)$$

$$= 7.57^\circ$$

77.9 m	7.59° S of E
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x	y
$d_{1x} = +49 \text{ m}$	$d_{1y} = 0$
$d_{2x} = +30 \cos 20^\circ$ $= +28.2 \text{ m}$	$d_{2y} = -30 \sin 20^\circ$ $= -10.3 \text{ m}$
$d_{Tx} = 77.2 \text{ m}$	$d_{Ty} = -10.3 \text{ m}$



$$d_T = \sqrt{(77.2)^2 + (10.3)^2}$$

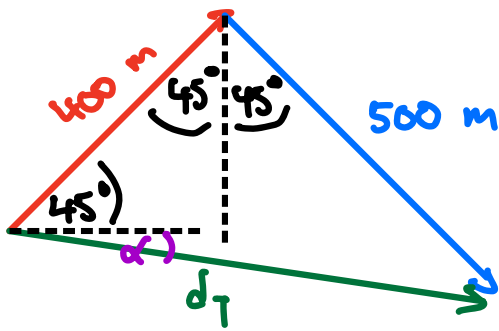
$$= 77.9 \text{ m}$$

$$\theta = \tan^{-1}\left(\frac{10.3}{77.2}\right) = 7.59^\circ$$

77.9 m	7.59° S of E
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g) 400 m northeast, 500 m southeast

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



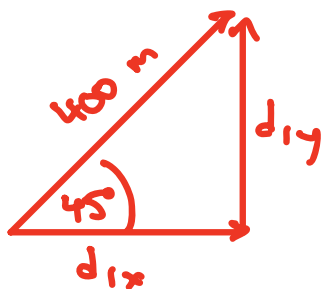
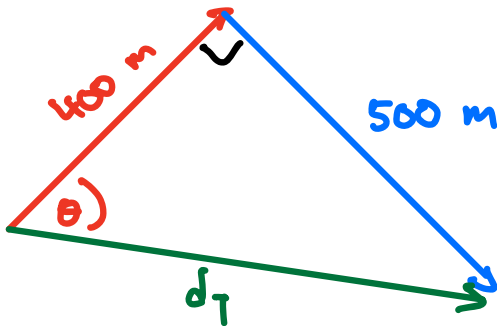
$$d_T = \sqrt{(400)^2 + (500)^2}$$

$$= 640 \text{ m}$$

$$\theta = \tan^{-1}\left(\frac{500}{400}\right) = 51.3^\circ$$

$$\alpha = \theta - 45^\circ = 6.3^\circ$$

640 m 6.3° S of E



$$d_{1x} = +400 \cos 45^\circ$$

$$= +283 \text{ m}$$

$$d_{1y} = +400 \sin 45^\circ$$

$$= +283 \text{ m}$$

$$d_{2x} = +500 \sin 45^\circ$$

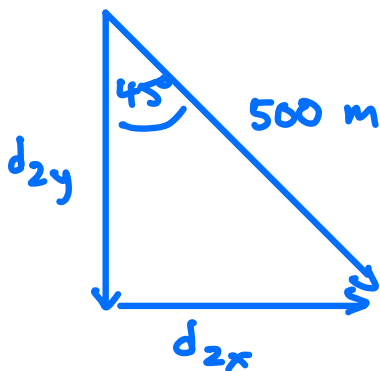
$$= +354 \text{ m}$$

$$d_{2y} = -500 \cos 45^\circ$$

$$= -354 \text{ m}$$

$$d_{Tx} = +636 \text{ m}$$

$$d_{Ty} = -70.7 \text{ m}$$

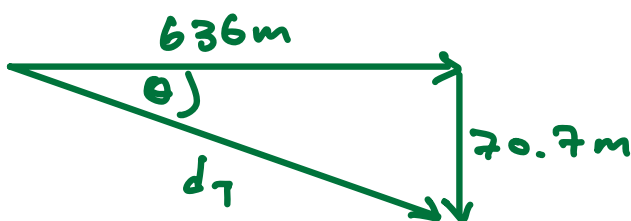


$$d_T = \sqrt{(636)^2 + (70.7)^2}$$

$$= 640 \text{ m}$$

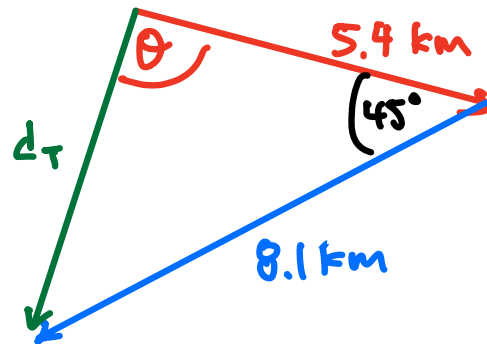
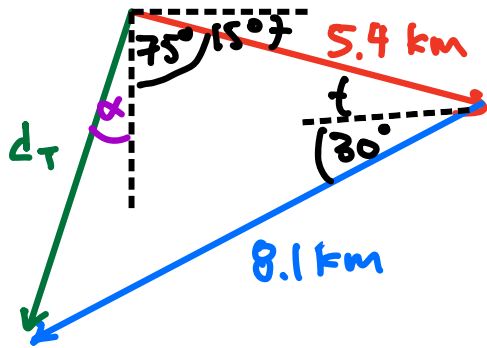
$$\theta = \tan^{-1}\left(\frac{70.7}{636}\right) = 6.34^\circ$$

640 m 6.34° S of E



h) 5.4 km 15° south of east, 8.1 km 30° south of west

$$\vec{d}_1 + \vec{d}_2 = \vec{d}_T$$



$$d_T^2 = (5.4)^2 + (8.1)^2 - 2(5.4)(8.1)\cos 45^\circ$$

$$d_T = 5.74 \text{ km}$$

$$\frac{\sin \theta}{8.1} = \frac{\sin 45^\circ}{5.74}$$

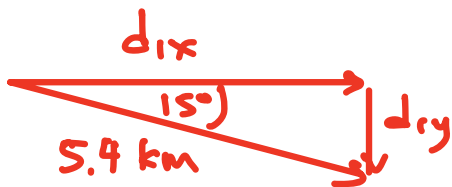
$$\theta = \sin^{-1}\left(\frac{8.1}{5.74} \sin 45^\circ\right)$$

$$= 86.7^\circ \text{ or } 93.3^\circ$$

obtuse ANGLE : $180^\circ - 86.7^\circ$

$$\alpha = \theta - 75^\circ = 18.3^\circ$$

5.74 km 18.3° W of S



$$d_{1x} = +5.4 \cos 15^\circ$$

$$= +5.22 \text{ km}$$

$$d_{1y} = -5.4 \sin 15^\circ$$

$$= -1.40 \text{ km}$$

$$d_{2x} = -8.1 \cos 30^\circ$$

$$= -7.01 \text{ km}$$

$$d_{2y} = -8.1 \sin 30^\circ$$

$$= -4.05 \text{ km}$$

$$d_{Tx} = -1.80 \text{ km}$$

$$d_{Ty} = -5.45 \text{ km}$$

$$d_T = \sqrt{(1.80)^2 + (5.45)^2}$$

$$= 5.74 \text{ km}$$

$$\theta = \tan^{-1}\left(\frac{1.80}{5.45}\right) = 18.3^\circ$$

5.74 km 18.3° W of S

