VECTORS QUIZ

A hiker's motion can be described by the following three displacement vectors.

22.0 km, 45 degrees + 16.0 km, 135 degrees + 12.0 km, 270 degrees

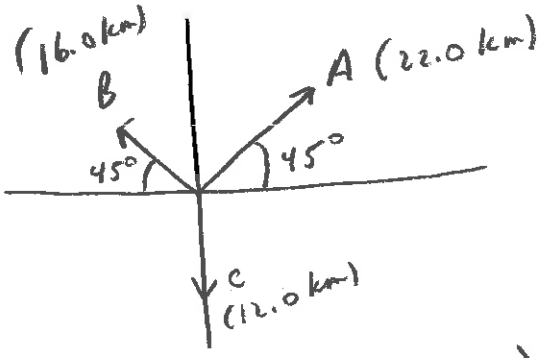
~~**Add the three displacement vectors using the head-to-tail method of vector addition. Then answer the following two questions.**~~

(a) What is the distance walked by the hiker?
(b) What is the resulting displacement of the hiker?

Key: Vector Quiz

a) distance = 22.0 + 16.0 + 12.0 = 50.0 km

b)



→ sketch

→ computation

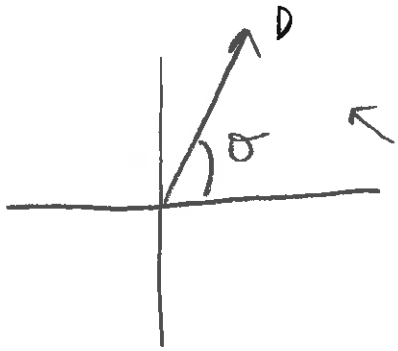
$\vec{A} = (22.0\cos 45°,\ 22.0\sin 45°)$ km $= (15.56,\ 15.56)$ km

$\vec{B} = (16.0\cos 45°,\ 16.0\sin 45°)$ km $= (-11.31,\ 11.31)$ km

$\vec{C} = (0,\ -12.0)$ km

↑ Q2

$\vec{A} + \vec{B} + \vec{C} = (4.25,\ 14.87)$ km $= \vec{D}$



← Q1

WATCH your signs!

magnitude $\vec{D} = \sqrt{4.25^2 + 14.87^2} = 15.5$ km

$\tan\theta = \dfrac{14.87}{4.25}$

$\theta = \tan^{-1}\left(\dfrac{14.87}{4.25}\right) =$

→ magnitude + direction

Displacement = 15.5 km, 74°

or, 15.5 km, E 74° N

or, 15.5 km, N 16° E

or, 15.5 km, −286°

a vector

Vector Quiz Tug of war

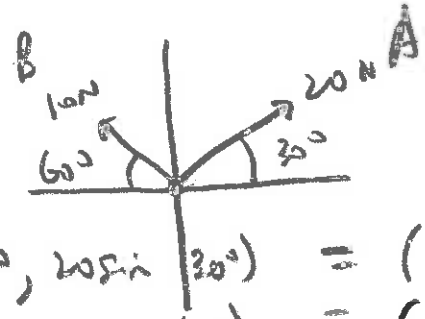
Group A pulls a rope at a force of 20 N at 30°
Group B pulls a rope at a force of 10 N at 120°
What force must group C pull a rope such that the <u>resultant force</u> is zero?

Note: all 3 ropes are attached at the <u>same centre</u>.

Key

Sketch

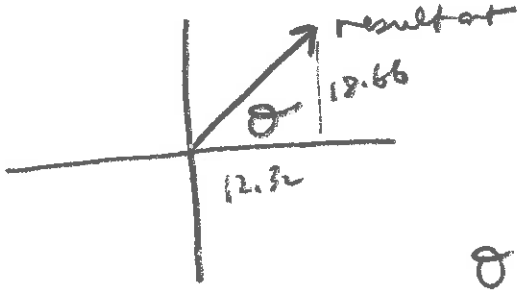
Tug of war



$\vec{A} = (20\cos 30°, 20\sin 30°) = (17.32\,N, 10\,N)$

$\vec{B} = (10\cos 60°, 10\sin 60°) = (-5\,N, 8.66\,N)$

$\vec{A} + \vec{B} = (12.32\,N, 18.66\,N)$



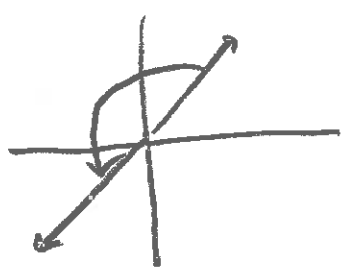
$mag = \sqrt{12.32^2 + 18.66^2}$

$= 22.36\,N$

$\theta = \tan^{-1}\left(\frac{18.66}{12.32}\right)$

$= 56.6°$

To attain a net force of zero,
magnitude of final vector must be 22.36 N,



but direction is

$56.6° + 180° = 236.6°$

∴ resultant force = 22.36 N, 236.6° ✓

or 22.36 N, W 56.6° S ✓

or 22.36 N, S 33.4° W ✓

or 22.36 N, −123.4° ✓

Vector Quiz

(1. Using components
2. (Graphing))

$\vec{u} = (4, 8)$

$\vec{v} = (-1, 6)$

$\vec{w} = (2, -3)$

Find $\vec{t}$, if $\vec{t} = \frac{1}{2}\vec{u} - \vec{v} + 2\vec{w}$

magnitude = ?

direction = ?

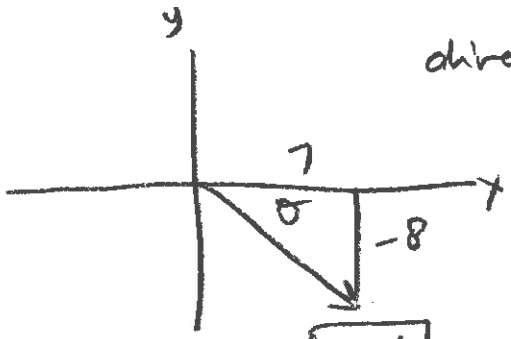
Key

$\vec{t}_x = \frac{1}{2}(4) - (-1) + 2(2) = 7$

$\vec{t}_y = \frac{1}{2}(8) - (6) + 2(-3) = -8$

$\therefore \vec{t} = (7, -8)$

magnitude $= \sqrt{(7)^2 + (-8)^2} = 10.7$



direction:

$\theta = \tan^{-1}\left|\left(-\frac{8}{7}\right)\right|$

$= \tan^{-1}(1.1429)$

$= 49°$

$\boxed{Q\ 4}$

$\vec{t} = (7, -8)$ components

magnitude $= 10.7$

direction $= -49°$

or, $311°$

or, E 49° S

or S 41° E

$\frac{1}{2}\vec{u} = (2,4)$ $\quad -\vec{v} = (1,-6)$ $\quad 2\vec{w} = (4,-6)$

Key (2)