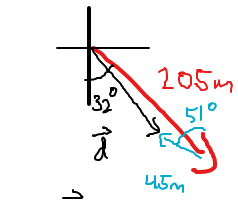
Name: Dhrumil Patel **MCV4U - Unit 1 Assignment – Vectors** **15A** **4T** **10C**

Include appropriate diagrams where applicable

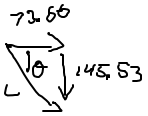
1. A bee flies from flower to flower. If it leaves the hive and travels 205 m [S32°E] and then 45 m [N51°W], how far and in what direction is the bee from its hive? [A4 C2]



Let $\vec{d}$ be the bee's position.

x	y
$+205\sin 32°$	$-(205\cos 32°)$
$= 108.63$ m	$= -173.85$ m
$-(45\sin 51°)$	$+45\cos 51°$
$= -34.97$ m	$= +28.32$ m
$108.63 - 34.97$	$-173.85 + 28.32$
$= 73.66$ m	$= -145.53$

$\therefore \vec{d} = (73.66, -145.53)$



$c = \sqrt{73.66^2 + (-145.53)^2}$

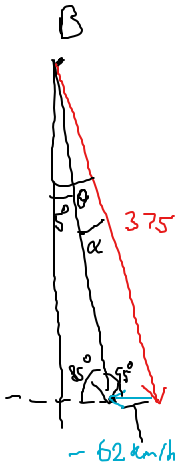
$= 163.11$

$\theta = \tan^{-1}\left(\frac{-145.53}{73.66}\right)$

$= 63.15°$

$\therefore$ The bee is 163.11 m away, at 63.15° South of East (163.11 m [E 63.15° S]).

2. An air ambulance is travelling from Barrie to Toronto. Toronto is located 90 km [S5°E] of Barrie. If the wind is blowing from the East with a velocity of 62 km/h, and the plane's air speed is 375 km/h, what direction must the pilot fly to make it to Toronto? [A4 C2]



$\frac{\sin 95°}{375} = \frac{\sin \alpha}{62}$

$\sin \alpha = \frac{62 \sin 95°}{375}$

$\sin \alpha = 0.1647$

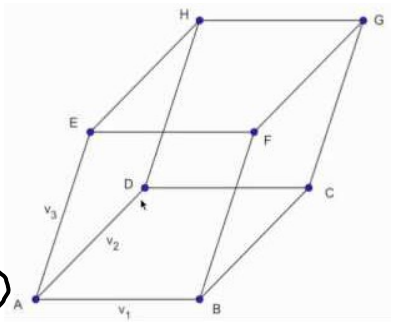
$\alpha = 9.48°$

$\theta = 5° + \alpha$

$= 5° + 9.48°$

$= 14.48°$ $\therefore$ The pilot must fly at S14.48°E to make it to Toronto.

3. Find the volume of a parallelepiped as shown with 4 vertices of A (4,7,6), B (-1,1,4), C (-1,4,-3) and F (-3,2,8) [A4 C2]



$\vec{BA} = \vec{A} - \vec{B}$
$= (4-(-1), 7-1, 6-4)$
$= (5, 6, 2)$

$\vec{BC} = \vec{C} - \vec{B}$
$= (-1-(-1), 4-1, -3-4)$
$= (0, 3, -7)$

$\vec{BF} = \vec{F} - \vec{B}$
$= (-3-(-1), 2-1, 8-4)$
$= (-2, 1, 4)$

$\vec{BA} \times \vec{BC} = (-42-6, 0-(-35), 15-0)$
$= (-48, 35, 15)$

6 x 2 x 5 x 6
3 - 70 3

$V = |(\vec{BA} \times \vec{BC}) \cdot \vec{BF}|$
$= (-48, 35, 15) \cdot (-2, 1, 4)$
$= (-48)(-2) + (35)(1) + (15)(4)$
$= 191 \text{ units}^3$ ∴ The volume is 191 units^3.

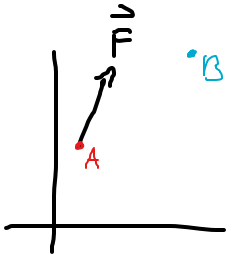
4. A 7 N force which acts along the direction vector *(1, 6)*, moves an object from *A(1, 4)* to *B(3, 8)*. Find the work done if the given units are metres. [A3 C2]

$\vec{d} = \vec{AB}$
$= \vec{B} - \vec{A}$
$= (3-1, 8-4)$
$\therefore \vec{d} = (2, 4)$

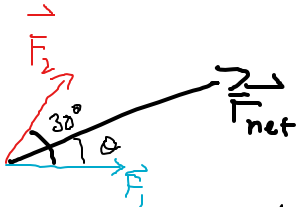
$\vec{u_F} = \frac{\vec{F}}{|\vec{F}|}$
$= \left(\frac{1}{\sqrt{1^2+6^2}}, \frac{6}{\sqrt{1^2+6^2}}\right)$
$\therefore \vec{u_F} = \left(\frac{1}{\sqrt{37}}, \frac{6}{\sqrt{37}}\right)$

$\vec{F} = 7\vec{u_F}$
$= \left(\frac{7}{\sqrt{37}}, \frac{42}{\sqrt{37}}\right)$

$W = \vec{F} \cdot \vec{d}$
$= \left(\frac{7}{\sqrt{37}}\right)(2) + \left(\frac{42}{\sqrt{37}}\right)(4)$
$= 29.92 \text{ J}$
∴ The work done is 29.92 J.



5. A force of magnitude *15 N* is the resultant of two forces, one of which has a magnitude of *8 N* and acts at an angle of *30°* to the other force. Find the magnitude of the other force and direction of the resultant. [T4 C2]



Let the other force, the given force and the resultant force be $\vec{F_1}$, $\vec{F_2}$ and $\vec{F_{net}}$ respectively.

x	y
$+8\cos 30^\circ$	$+8\sin 30^\circ$
$=+6.93$	$=+4$
$+\lvert\vec{F_1}\rvert$	0
$+\lvert\vec{F_1}\rvert+6.93$	$+4$

$\therefore \vec{f_{net}} = (|\vec{F_1}|+6.93, 4)$

$225 = (|\vec{F_1}|+6.93)^2 + 4^2$
$225-16 = (|\vec{F_1}|+6.93)^2$
$\sqrt{209} = |\vec{F_1}|+6.93$
$|\vec{F_1}| = 7.53 \text{ N}$

$\theta = \tan^{-1}\left(\frac{4}{|\vec{F_1}|+6.93}\right)$
$= \tan^{-1}\left(\frac{4}{7.53+6.93}\right)$
$= 15.47^\circ$

∴ The other force has a magnitude of 7.53 N and the resultant force is directed 15.47° from $\vec{F_1}$ (towards $\vec{F_2}$).