Intro to Vectors - Unit 1

Tentative TEST date Nov. 3 Chapter 6

Big idea/Learning Goals

Did you know that bees use vectors? A honey bee that has found a beautiful meadow full of ripe flowers must come back to the hive and communicate that information. A bee must tell its fellows in what direction and how far to travel to get to the meadow, they can even compensate for any wind direction in their communications! (Show a video from youtube.)

You will be introduced to the idea of a directed line segment, called a **vector**. You will explore vectors in their geometric and algebraic form, and will learn the notation used to describe vectors. You will then study vector addition and properties and how to understand vectors in 2D and 3D spaces. Vectors will enable you to define a line in 2D or 3D space (unit 3) after which you can then solve where two such lines meet, if ever (unit 4).

Corrections for the textbook answers:

Success Criteria

☐ I understand the new topics for this unit if I can do the practice questions in the textbook/handouts
Specific questions will not be assigned, since it will depend on your knowledge and skill (everyone is at a different level). The goal is to do all types of questions quickly and without reference to notes or back of textbook or another individual. BUT you may not have time to do every single question available… so… If you are a strong student you may just concentrate on harder TIPS or APP questions, while if you are a weak student you may want to use all your time practicing the basic KU or COMM questions. The number of questions done should also be proportional to your mark so far. If you have very low scores, more practice is required.

Date	pg	Topics	# of quest. done? You may be asked to show them
	2-4	Introduction – Geometric Vectors 6.1	
	5-7	Vector Addition/Subtraction & Properties 6.2 & 6.3	
	8-10	Vectors in R^2 and R^3 – Algebraic Vectors 6.5	
	11-12	Operations with Vectors in R^2 and R^3 6.6 & 6.7	
	13-14	Linear Combinations and Spanning Sets 6.8	
		Review	

Reflect – DIAGNOSTIC TEST mark _____

Introduction – GEOMETRIC vectors

Vector a quantity with magnitude and direction

Scalar a quantity with magnitude only

1. Which of these physical quantities is a vector and which is a scalar?

a. the mass of the moon g/kg Scalar

b. the acceleration of a drag racer m/s^2 km/h^2 Vector

c. the velocity of a wave at the beach m/s km/h Vector $\vec{V} = \frac{\text{displacement}}{\Delta t}$

d. the speed of light m/s km/h Scalar

e. the force of gravity $\vec{F}$, N Vector

f. the magnetic field of the earth Vector

g. the area of a rectangle m^2, km^2 Scalar

h. the temperature of a swimming pool °C, °F Scalar

Diagrams

- arrow → for direction
- length for magnitude

$\vec{a}$ direction magnitude $\overrightarrow{AB}$

$\overrightarrow{BA}$ A $\overrightarrow{AB}$ B

Notation

Vector - use letters with arrow on top. ex: $\vec{a}$, $\overrightarrow{AB}$ ....

Scalar - use just letters (no arrow) or number. ex: a, 5, ...

magnitude - use absolute value around vector name. ex: $|\overrightarrow{AB}|$, $|\vec{x}|$

Equal vectors (iff)

$\vec{u} = \vec{v}$ if and only if magnitude and direction are same

Opposite Vectors RULE

Same magnitude opposite direction $|\vec{a}| = |\vec{b}|$, $\vec{a} = -\vec{b}$, $-\vec{a} = \vec{b}$

2. ABCDEF is a regular hexagon. Give an example of vectors which are

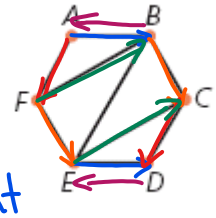
a. equal $\overrightarrow{AB} = \overrightarrow{EF}$

b. parallel but having different magnitudes $\overrightarrow{AF}$ and $\overrightarrow{BE}$ $\overrightarrow{AB} \parallel \overrightarrow{BE}$

c. equal in magnitude but opposite in direction $\overrightarrow{AB} = -\overrightarrow{DE}$ $|AB| = |DE|$

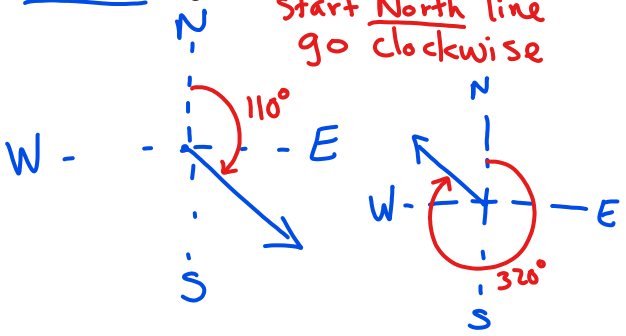
d. equal in magnitude but not equal vectors $\overrightarrow{AB} = -\overrightarrow{DE}$ $|\overrightarrow{AB}| = |\overrightarrow{DE}|$ different direction $|\overrightarrow{AB}| = |\overrightarrow{BC}|$

e. different in both magnitude and direction ✓ $\overrightarrow{AB}$ & $\overrightarrow{BE}$

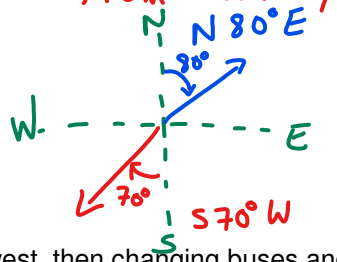


3. Angles can be quoted in different ways. Use the first two ways that follow for word problems, and the last one for non-word problem type question.

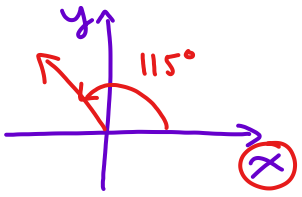
BEARING angles — start North line go clockwise



DIRECTION angles — tell you how much from North/South



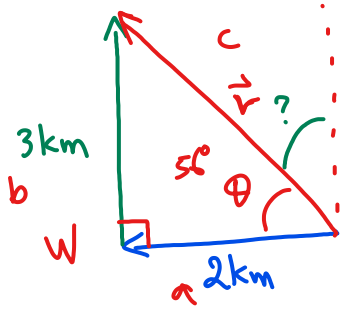
MATH angles — Counterclockwise from x-axis



4. A student travels to school by bus, first riding 2 km west, then changing buses and riding a further 3 km north. Find the resultant vector. (one decimal place)

$\vec{r}$ add vectors

Diagram:



N $|\vec{r}| = ?$

$\theta = ?$ direction

$\theta = \tan^{-1}\left(\frac{3}{2}\right)$

$\doteq 56°$

$90° - 56° = 34°$

Pythagorean Theorem

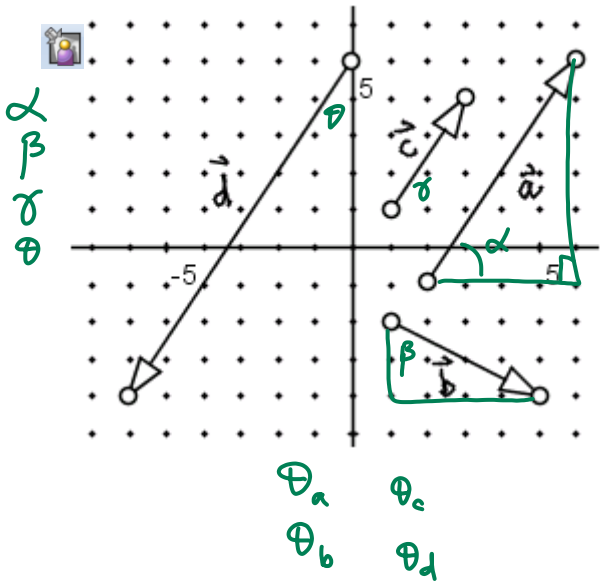
magnitude $c^2 = a^2 + b^2$

$|\vec{r}| = \sqrt{2^2 + 3^2}$

$= \sqrt{13}$

$\doteq 3.6$

∴ the resultant vector is 3.6 km [N 34° W]



θ_a θ_c

θ_b θ_d

5. Determine the magnitude and direction of each of the vectors in the given diagram. use math angles.

$|\vec{a}| = 7.2$ $\theta_a = 56°$

$|\vec{b}| = 7.2$ $\theta_b = 27°$

$|\vec{c}| = 3.6$ $\theta_c = 56°$

$|\vec{d}| = 10.8$ $\theta_d = 236°$

$\vec{a} \times \vec{b}$

negative opposite direction

0 and 1 Compress

>1 stretch

6. Examine the vectors in the diagram. Express $\vec{d}$ and $\vec{c}$ each as a scalar multiple of $\vec{a}$

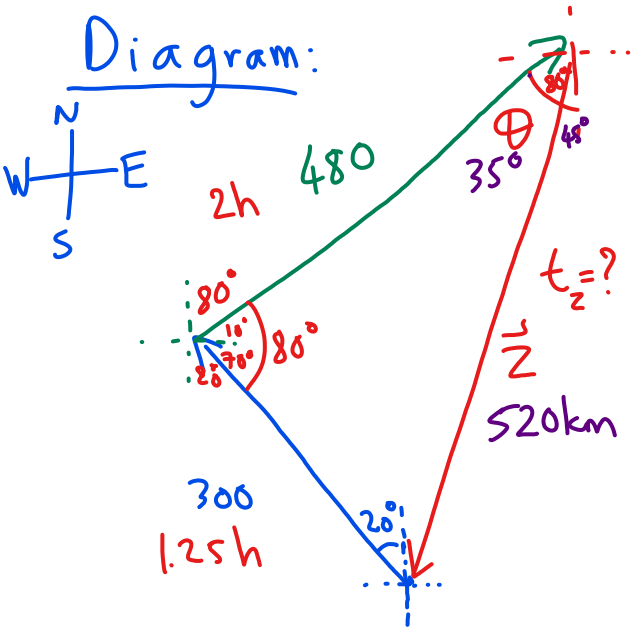
$\vec{d} = -\frac{3}{2}\vec{a}$ $\vec{c} = \frac{1}{2}\vec{a}$

only for collinear/parallel vectors.

7. A search and rescue aircraft, travelling at a speed of 240km/h, starts out at a heading of $N20^oW$. After travelling for one hour and fifteen minutes, it turns to a heading of $N80^oE$ and continues for another 2 hours before returning to base.
   a. Determine the displacement vector for each leg of the trip.
   b. Find the total distance the aircraft travelled and how long it took.

$D = VT$

Diagram:



a)

$|\vec{x}| = (240km/h)(1.25h) = 300km$

$|\vec{y}| = (240km/h)(2h) = 480km$

Cosine Law

$|\vec{z}|^2 = 300^2 + 480^2 - 2(300)(480)\cos(80^\circ)$

$\vec{z} \doteq 520km$

Sine Law

$\frac{\sin\theta}{300} = \frac{\sin 80^\circ}{520}$

$\theta = \sin^{-1}\left(\frac{300\sin 80^\circ}{520}\right)$

$\doteq 35^\circ$

tot displacement is 0.

$\vec{z} = 520km\ [S\ 45^\circ W]$

b) total distance = 300 + 480 + 520 = 1300 km

$t_z = \frac{520}{240}$

$\doteq 2.16h$

total time = 1.25h + 2h + 2.16h

$\doteq 5.41h$

Pg. 279-281 # 1, 4, 8, 9, 10