

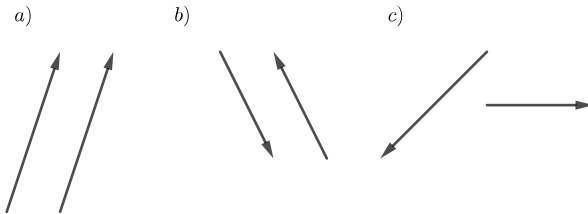


# Intermediate Math Circles

## Wednesday March 20, 2019

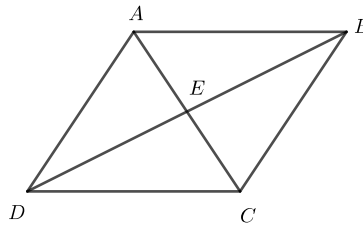
### Problem Set 1

1) For each pair below label them as equal, opposite or neither.



2)  $ABCD$  is a parallelogram. Name, where possible a vector equal to each of the following.

- a)  $\overrightarrow{BA}$    b)  $\overrightarrow{BD}$    c)  $\overrightarrow{AD}$    d)  $\overrightarrow{BE}$

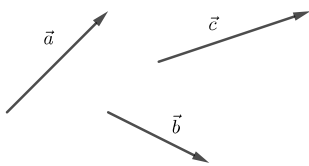


3.) Using parallelogram  $ABCD$  above, name where possible a vector opposite to each of the following:

- a)  $\overrightarrow{AB}$    b)  $\overrightarrow{BC}$    c)  $\overrightarrow{CE}$    d)  $\overrightarrow{ED}$

4) Given  $\vec{a}$ ,  $\vec{b}$ , and  $\vec{c}$ , draw the following

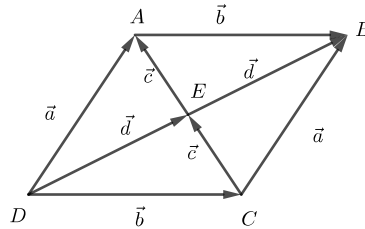
- a)  $\vec{a} + \vec{b}$    b)  $\vec{a} - \vec{c}$    c)  $\vec{c} - \vec{a}$    d)  $2\vec{a} + 3\vec{c}$    e)  $\vec{a} - \vec{c} + \vec{b}$





5) In parallelogram  $ABCD$ , express each of the following as a vector using the points  $A, B, C, D$  or  $E$

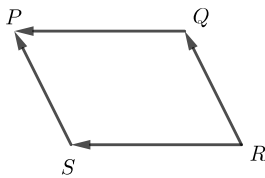
- a)  $\vec{b} + \vec{c}$     b)  $\vec{b} + \vec{c} + \vec{c}$     c)  $\vec{d} + \vec{c}$   
 d)  $\vec{a} + \vec{b}$     e)  $\frac{1}{2}(\vec{a} + \vec{b})$ .    f)  $\vec{d} - \vec{c}$



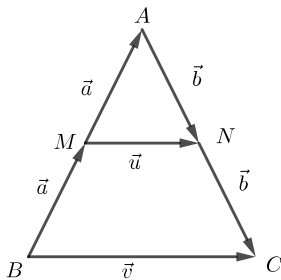
6) Given  $|\vec{u}| = |\vec{v}|$ . Is  $\vec{u} = \vec{v}$  always true? Explain.

7) Georgina drives 5km east then drives 5 km south. What is her resultant displacement?

8) Use parallelogram  $PQRS$  to show that  $\vec{RS} + \vec{RQ} = \vec{SP} + \vec{QP}$ .



9) Given isosceles triangle  $ABC$ .  $M$  is the midpoint of  $AB$  and  $N$  is the midpoint of  $AC$ . Show that  $\vec{u} = \frac{1}{2}\vec{v}$ . Can you show this result for any triangle? That is, the line segment joining two midpoints is parallel to the third side. Furthermore it is half the length of the third side.



10)  $P$  divides line segment  $AB$  in the ratio 3:2.  $O$  is a point not collinear with  $AB$ . Show that  $\vec{OP} = \frac{2}{5}\vec{OA} + \frac{3}{5}\vec{OB}$ .