

**Reading:**

Chapter 1 of the Vectors book.

**Objectives:**

By the end of Week 1, to achieve at least a pass level, you should

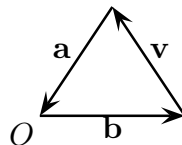
- 1A: be able to identify and distinguish between scalar and vector quantities.
- 1B: know what is meant by the position vector of a point and illustrate this with a diagram.
- 1C: be able to explain how to add vectors using either the triangle rule or the parallelogram rule.

To achieve higher than a pass level you should

- 1D: know what it means for a point to divide a line segment in a given ratio.
- 1E: be able to use position vectors to solve problems in geometry.
- 1F: be able to use the laws of vector algebra to simplify expressions involving vectors and scalars

**Preparatory questions.** (Answers are on the next page.)

1. Classify the following as scalar or vector quantities: (i) temperature, (ii) force.
2. In the diagram below, express the vector  $\mathbf{v}$  in terms of the vectors  $\mathbf{a}$  and  $\mathbf{b}$ .



3. In the diagram above, mark the point whose position vector relative to  $O$  is  $\frac{1}{2}(\mathbf{b} - \mathbf{a})$ .
4. If  $|\mathbf{v}| = 2$  and if  $\mathbf{u} = -3\mathbf{v}$ , what is the magnitude of  $\mathbf{u} + \mathbf{v}$ ?

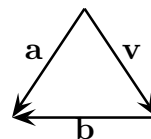
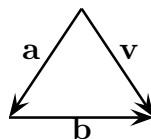
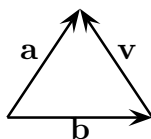
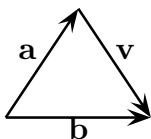
**Self-assessment checklist**

Tick the box or boxes and seek help from your tutor, if required.

- I was unable to complete the Preparatory Questions.
- I completed the Preparatory Questions:
  - with ease.
  - with some effort.
  - with difficulty.

**Practice questions**

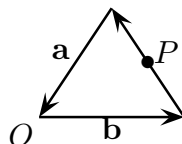
5. For each diagram below, express  $\mathbf{v}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .



6. Simplify  $3\mathbf{a} + 2\mathbf{b} - 6\mathbf{c} - 5(-\frac{1}{2}(\mathbf{c} + \mathbf{a}) + 3(\mathbf{c} - \frac{1}{2}\mathbf{b}))$ .
7. Let  $ABCDEF$  be a regular hexagon and denote  $\vec{AB}$  by  $\mathbf{a}$  and  $\vec{CD}$  by  $\mathbf{c}$ . Find vector expressions in terms of  $\mathbf{a}$  and  $\mathbf{c}$  for the vectors  $\vec{BC}$ ,  $\vec{DE}$ ,  $\vec{EF}$  and  $\vec{FA}$ .
8. (Group discussion) Suppose that  $ABCDEF$  is a regular hexagon. Is it true that  $\vec{AC} = \vec{FD}$ ? What does this mean?
9. (Group discussion) What is the difference (if any) between the *triangle* and the *parallelogram* rules of addition?
10. (Group discussion) Does your concept of vector allow for the zero vector? If not, how would you fix it?
11. Given points  $P$  and  $Q$  that divide the sides  $AB$  and  $AC$  of the triangle  $ABC$  in the ratios  $\lambda : (1 - \lambda)$  and  $\mu : (1 - \mu)$ , show that if  $\vec{PQ} = \nu\vec{BC}$ , then  $\lambda = \mu = \nu$ .
12. Given a plane quadrilateral  $ABCD$ , suppose that the diagonals  $AC$  and  $BD$  intersect at  $P$  and the sides  $AB$  and  $CD$  intersect at  $Q$ . If  $Q$  divides  $AB$  in the ratio  $3 : -1$  and if it divides  $CD$  in the ratio  $-5 : 7$ , show that  $P$  divides  $AC$  in the ratio  $7 : 1$  and  $BD$  in the ratio  $5 : 3$ .

### Answers to Preparatory Questions

1. (i) scalar (ii) vector
2.  $\mathbf{v} = -\mathbf{a} - \mathbf{b}$ .
- 3.



4. 4

### Self-assessment checklist:

Think about the work you have completed and how it relates to the objectives on the first page. This is aimed at helping you focus on how well you are going and on the areas in which you may need to do further practice or seek assistance. In the following table, each row corresponds to one of the objectives listed on the first page. Tick the box corresponding to the level of understanding you believe you have achieved.

My understanding is:	Nil	Small	Good	Very Good	Complete
Objective 1A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Objective 1B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Objective 1C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Objective 1D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Objective 1E	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Objective 1F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### **Web Quiz**

There are additional self assessment tasks on the Web. Follow the links from the School of Mathematics and Statistics main page <http://www.maths.usyd.edu.au> to MATH1902 and then do the Web Quiz for Week 1.