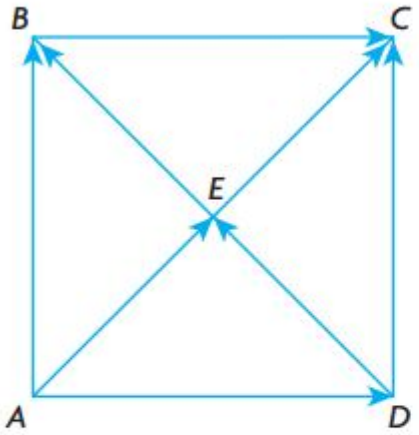
6.1 Introduction to Vectors

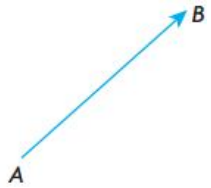
These problems taken from the Nelson text: Pg. 279 – 281

1. State whether each statement is true or false. Justify your decision.
   a. If two vectors have the same magnitude, then they are equal.
   b. If two vectors are equal, then they have the same magnitude.
   c. If two vectors are parallel, then they are either equal or opposite vectors.
   d. If two vectors have the same magnitude, then they are either equal or opposite vectors.
2. For each of the following, state whether the quantity is a scalar or a vector and give a brief explanation why: height, temperature, weight, mass, area, volume, distance, displacement, speed, force, and velocity.
4. Square *ABCD* is drawn as shown below with the diagonals intersecting at *E*.



   a. State four pairs of equivalent vectors.
   b. State four pairs of opposite vectors.
   c. State two pairs of vectors whose magnitudes are equal but whose directions are perpendicular to each other.

5. Given the vector $\overrightarrow{AB}$ as shown, draw a vector



a. equal to $\overrightarrow{AB}$

b. opposite to $\overrightarrow{AB}$

c. whose magnitude equals $|\overrightarrow{AB}|$ but is not equal to $\overrightarrow{AB}$

d. whose magnitude is twice that of $\overrightarrow{AB}$ and in the same direction

e. whose magnitude is half that of $\overrightarrow{AB}$ and in the opposite direction

8. For each of the following vectors, describe the opposite vector.

a. an airplane flies due north at 400 km/h

b. a car travels in a northeasterly direction at 70 km/h

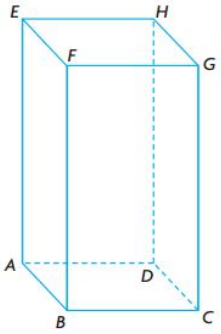
c. a bicyclist pedals in a northwesterly direction at 30 km/h

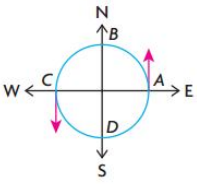
d. a boat travels due west at 25 km/h

9. a. Given the square-based prism shown where $AB = 3$ cm and $AE = 8$ cm, state whether each statement is true or false. Explain.

i) $\overrightarrow{AB} = \overrightarrow{GH}$ ii) $|\overrightarrow{EA}| = |\overrightarrow{CG}|$ iii) $|\overrightarrow{AD}| = |\overrightarrow{DC}|$ iv) $\overrightarrow{AH} = \overrightarrow{BG}$

b. Calculate the magnitude of $\overrightarrow{BD}$, $\overrightarrow{BE}$, and $\overrightarrow{BH}$.





10. James is running around a circular track with a circumference of 1 km at a constant speed of 15 km/h. His velocity vector is represented by a vector tangent to the circle. Velocity vectors are drawn at points A and C as shown. As James changes his position on the track, his velocity vector changes.

a. Explain why James's velocity can be represented by a vector tangent to the circle.

b. What does the length of the vector represent?

c. As he completes a lap running at a constant speed, explain why James's velocity is different at every point on the circle.

d. Determine the point on the circle where James is heading due south.

e. In running his first lap, there is a point at which James is travelling in a northeasterly direction. If he starts at point A how long would it have taken him to get to this point?

f. At the point he has travelled $\frac{3}{8}$ of a lap, in what direction would James be heading? Assume he starts at point A.

Answers to Selected Problems

4. Answers may vary. For example:

a. $\overrightarrow{AD} = \overrightarrow{BC}$; $\overrightarrow{AB} = \overrightarrow{DC}$; $\overrightarrow{AE} = \overrightarrow{EC}$; $\overrightarrow{DE} = \overrightarrow{EB}$

b. $\overrightarrow{AD} = -\overrightarrow{CB}$; $\overrightarrow{AB} = -\overrightarrow{CD}$; $\overrightarrow{AE} = -\overrightarrow{CE}$; $\overrightarrow{ED} = -\overrightarrow{EB}$; $\overrightarrow{DA} = -\overrightarrow{BC}$

c. $\overrightarrow{AC}$ & $\overrightarrow{DB}$; $\overrightarrow{AE}$ & $\overrightarrow{EB}$; $\overrightarrow{EC}$ & $\overrightarrow{DE}$; $\overrightarrow{AB}$ & $\overrightarrow{CB}$

9. a. i. False; they have equal magnitude, but opposite direction.

ii. True; they have equal magnitude.

iii. True; the base has sides of equal length, so the vectors have equal magnitude.

iv. True; they have equal magnitude and direction.

b. $|\overrightarrow{BD}| = \sqrt{18}$, $|\overrightarrow{BE}| = \sqrt{73}$, $|\overrightarrow{BH}| = \sqrt{82}$

10. a. The tangent vector describes James's velocity at that moment. At point A, his speed is 15 km/h and he is heading north. The tangent vector shows his velocity is 15 km/h, north.

b. James's speed

c. The magnitude of James's velocity (his speed) is constant, but the direction of his velocity changes at every point.

d. C

e. 3.5 min

f. southwest