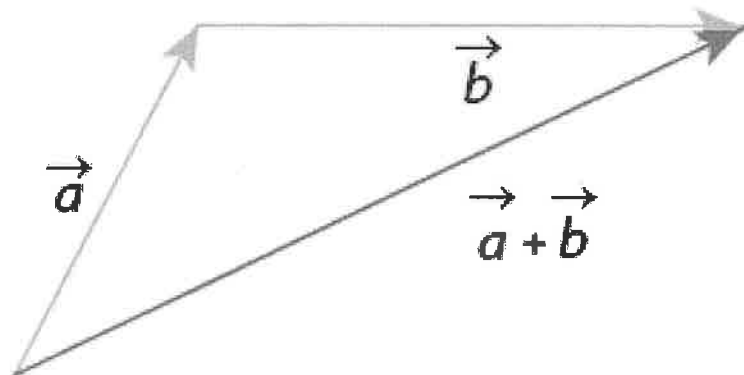


Name: SOLUTIONS

Unit 4- Geometric Vectors

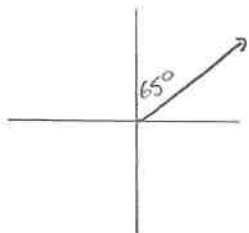
WORKBOOK

MCV4U

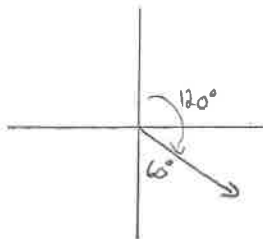


1) Convert each true bearing to its equivalent quadrant bearing.

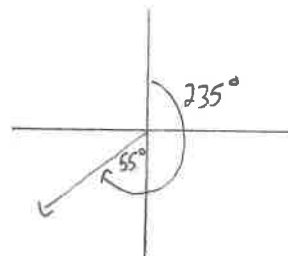
a) $065^\circ = N65^\circ E$



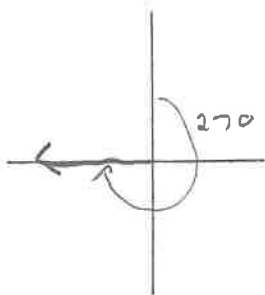
b) $120^\circ = S60^\circ E$



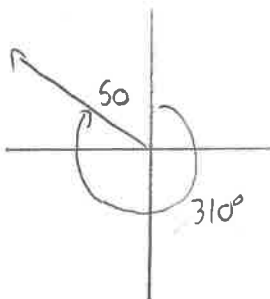
c) $235^\circ = S55^\circ W$



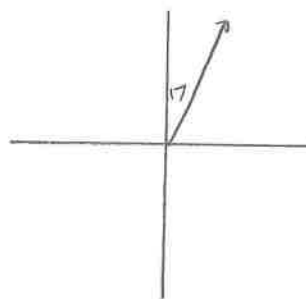
d) $270^\circ = W$



e) $310^\circ = N50^\circ W$

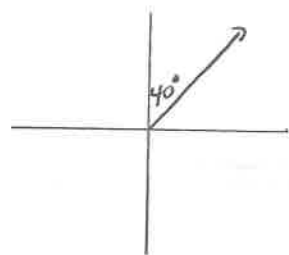


f) $017^\circ = N17^\circ E$

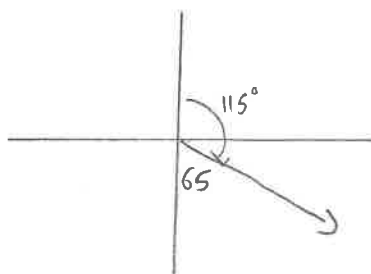


2) Convert each quadrant bearing to its equivalent true bearing.

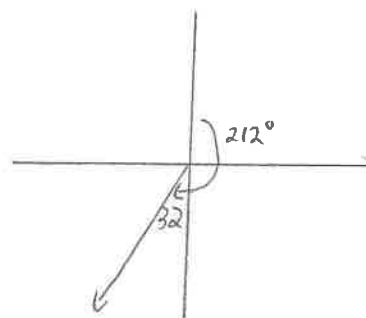
a) $N40^\circ E = 040^\circ$



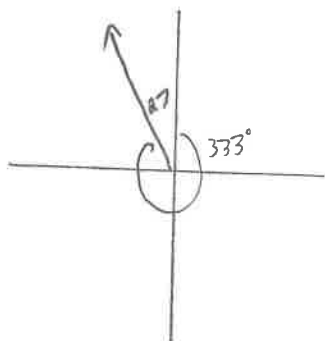
b) $S65^\circ E = 115^\circ$



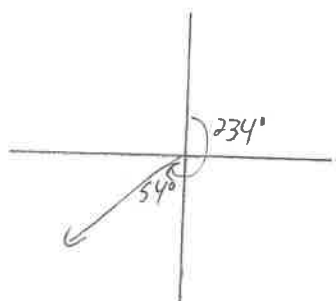
c) $S32^\circ W = 212^\circ$



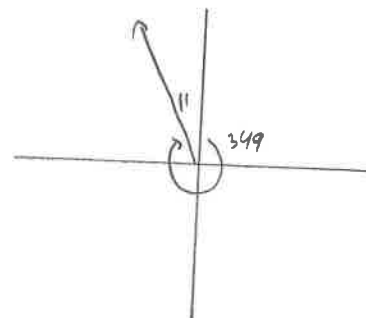
d) $N27^\circ W = 333^\circ$



e) $S54^\circ W = 234^\circ$



f) $N11^\circ W = 349^\circ$

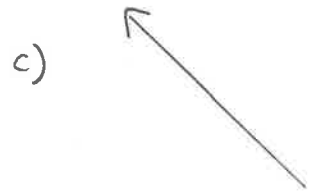


3) In the space to the right, draw and name...

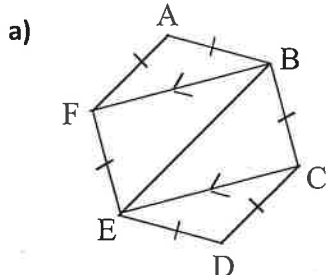
a) a vector parallel to \vec{AB}

b) a vector opposite to \vec{AB}

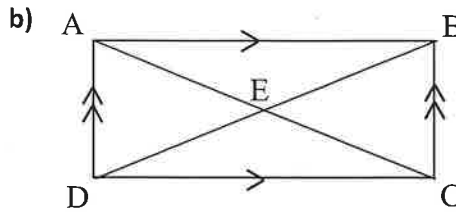
c) a vector equivalent to \vec{AB}



4) Name all the equivalent vectors in each diagram.



$$\begin{array}{ll} \vec{AB} = \vec{ED} & \vec{BA} = \vec{DE} \\ \vec{AF} = \vec{CD} & \vec{FA} = \vec{DC} \\ \vec{BC} = \vec{FE} & \vec{CB} = \vec{EF} \\ \vec{CE} = \vec{BF} & \vec{EC} = \vec{FB} \end{array}$$



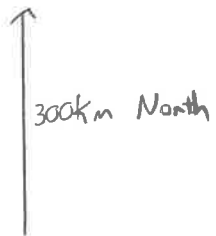
$$\begin{array}{ll} \vec{AD} = \vec{BC} & \vec{DA} = \vec{CB} \\ \vec{AE} = \vec{EC} & \vec{CE} = \vec{EA} \\ \vec{DE} = \vec{EB} & \vec{BE} = \vec{ED} \\ \vec{AB} = \vec{DC} & \vec{BA} = \vec{CD} \end{array}$$

5) State the opposite of each vector.

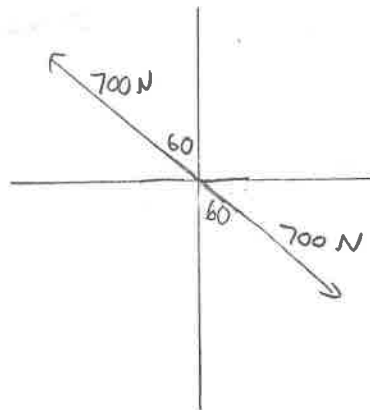
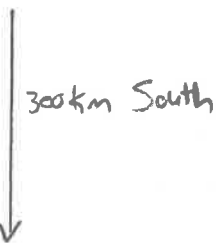
a) 300 km north

b) 700 N on a bearing of 120°

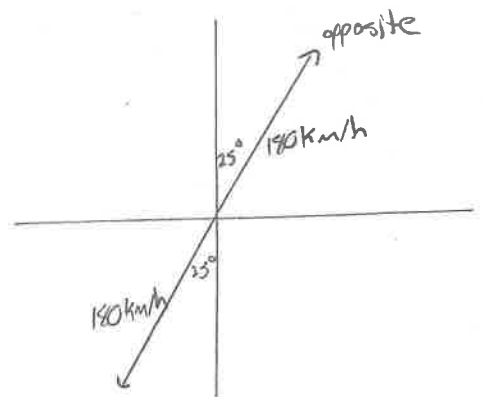
c) 180 km/h on a quadrant bearing of $S25^\circ W$



opposite:



opposite: 700 N on a bearing of 330°

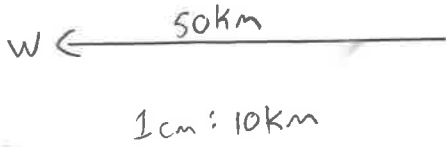


opposite:

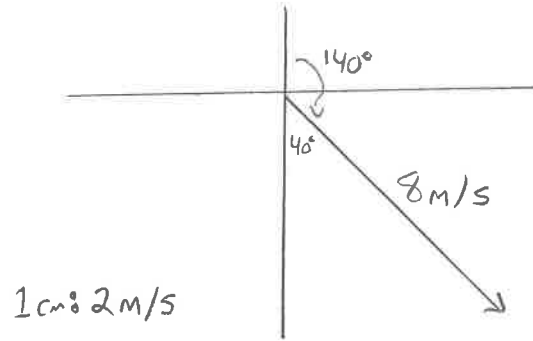
180 km/h on a quadrant bearing of $N25^\circ E$.

6) Use an appropriate scale to draw each vector. Label magnitude, direction

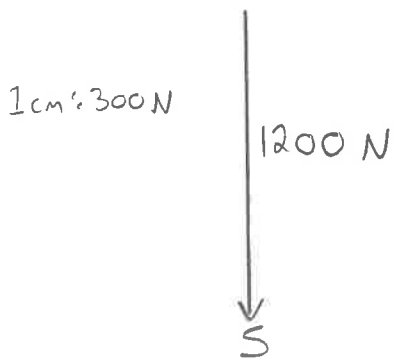
a) displacement of 50 km west



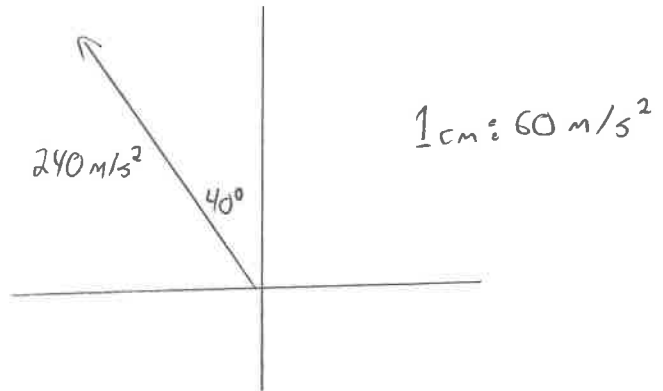
b) velocity of 8 m/s on a true bearing of 140°



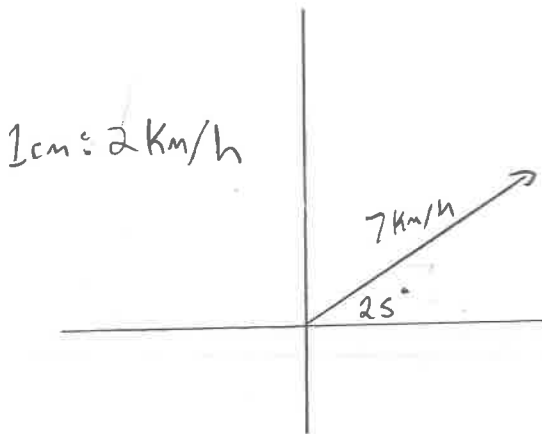
c) force of 1200 N downward



d) acceleration of 240 m/s² on a quadrant bearing of N40°W



e) velocity of 7 km/h at 25° to the horizontal



7) State whether the following are vectors or scalars:

- a) A table weighs 80 N VECTOR
- b) A woman's age is 60 years old SCALAR
- 30 km/h SCALAR
- d) An elevator lifts a person 20 m VECTOR

8)a) Which vectors are parallel to \overrightarrow{AB} ?

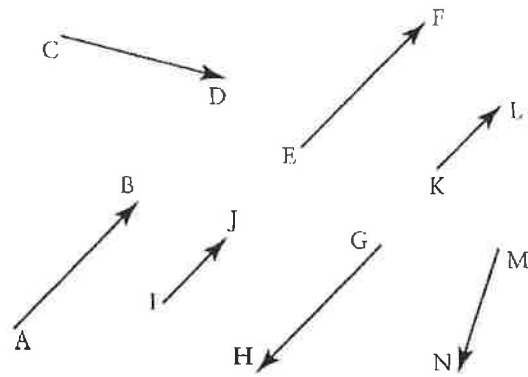
$\vec{IJ}, \vec{GH}, \vec{KL}, \vec{EF}$

b) Which vectors are equivalent to \overrightarrow{AB} ?

\vec{EF}

c) Which vectors are opposite to \overrightarrow{AB} ?

\vec{GH}

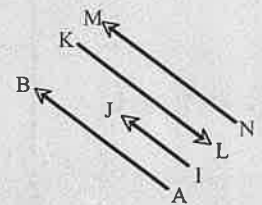


Answer Key:

1) a) N65°E b) S60°E c) S55°W d) W e) N50°W f) N17°E

2) a) 40° b) 115° c) 212° d) 333° e) 234° f) 349°

3) Diagrams may vary. For example, in the diagram shown, \vec{IJ} is parallel to \overrightarrow{AB} , \vec{KL} is opposite to \overrightarrow{AB} , and \vec{MN} is equivalent to \overrightarrow{AB} .



4) a) $\overrightarrow{AB} = \overrightarrow{ED}, \overrightarrow{BC} = \overrightarrow{FE}, \overrightarrow{CD} = \overrightarrow{AF}, \overrightarrow{DE} = \overrightarrow{BA}, \overrightarrow{EF} = \overrightarrow{CB}, \overrightarrow{FA} = \overrightarrow{DC}, \overrightarrow{FB} = \overrightarrow{EC}, \overrightarrow{BF} = \overrightarrow{CE}$

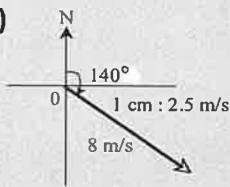
b) $\overrightarrow{AB} = \overrightarrow{DC}, \overrightarrow{BA} = \overrightarrow{CD}, \overrightarrow{AD} = \overrightarrow{BC}, \overrightarrow{DA} = \overrightarrow{CB}, \overrightarrow{DE} = \overrightarrow{EB}, \overrightarrow{BE} = \overrightarrow{ED}, \overrightarrow{AE} = \overrightarrow{EC}, \overrightarrow{CE} = \overrightarrow{EA}$

5) a) 300 km south b) 700 N on a bearing of 300° c) 180 km/h on a quadrant bearing of N25°E

6) Diagrams may vary.

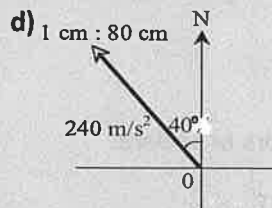
a)

b)

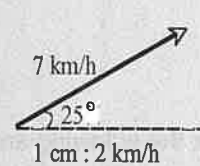


c)

d)



e)



7) a) Vector – weight is due to the force of gravity and therefore has a direction

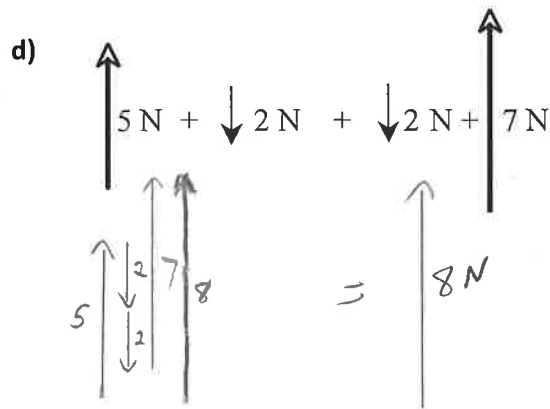
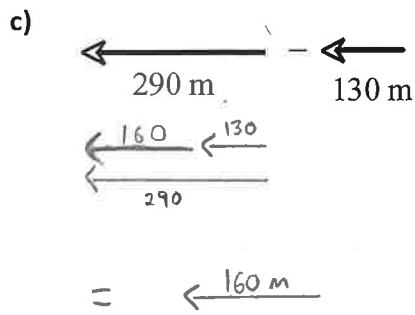
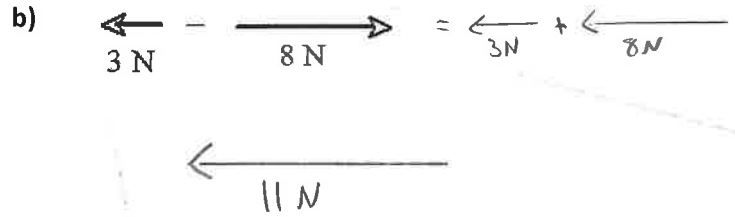
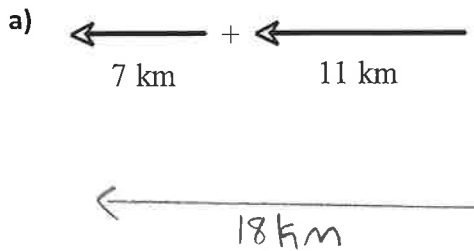
b) Scalar – this has no direction

c) Scalar – there is no direction so this is just speed

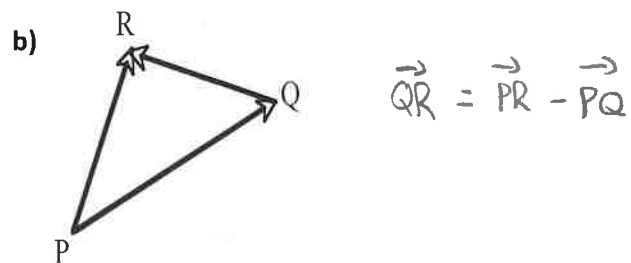
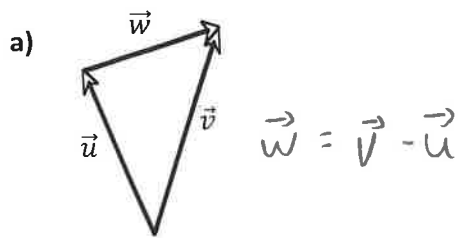
d) Vector – there is magnitude and direction (up)

8)a) $\overrightarrow{EF}, \overrightarrow{IJ}, \overrightarrow{KL}, \overrightarrow{GH}$ b) \overrightarrow{EF} c) \overrightarrow{GH}

1) Draw a diagram to illustrate each vector sum or difference.

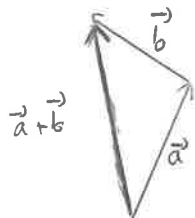


2) Express the shortest vector in each diagram as the sum or difference of the other two vectors.

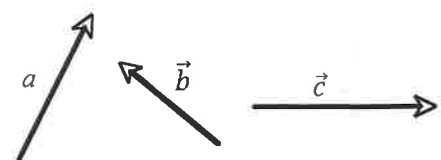
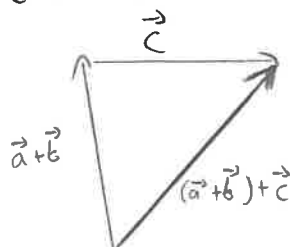


3) Given the vectors \vec{a} , \vec{b} and \vec{c} , construct $\vec{a} + \vec{b}$ and $(\vec{a} + \vec{b}) + \vec{c}$.

$\vec{a} + \vec{b}$:



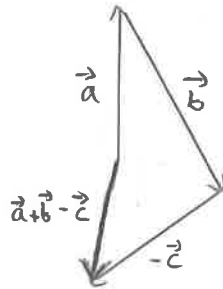
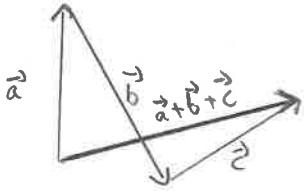
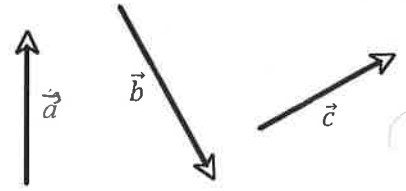
$(\vec{a} + \vec{b}) + \vec{c}$:



4) Given the vectors \vec{a} , \vec{b} and \vec{c} , draw a diagram of each expression.

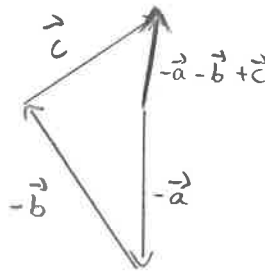
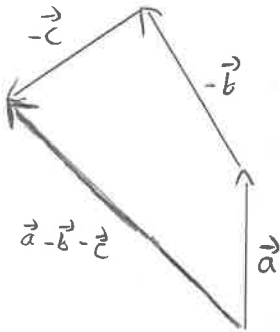
a) $\vec{a} + \vec{b} + \vec{c}$

b) $\vec{a} + \vec{b} - \vec{c}$
 $= \vec{a} + \vec{b} + (-\vec{c})$



c) $\vec{a} - \vec{b} - \vec{c}$

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

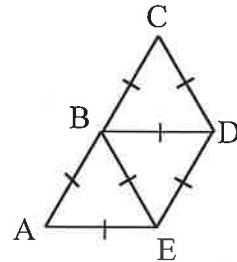


5) The diagram shows three congruent equilateral triangles.

Express each difference as a single vector. Show your simplification steps.

a) $\vec{AB} - \vec{AE}$
 $= \vec{EB}$

b) $-\vec{AB} + \vec{AE} + \vec{ED}$
 $= \vec{BE} + \vec{ED}$
 $= \vec{BD}$



c) $\vec{BD} - \vec{BE}$
 $= \vec{ED}$

d) $\vec{CD} - \vec{BD}$
 $= \vec{CD} + (-\vec{BD})$
 $= \vec{CD} + \vec{DB}$
 $= \vec{CB}$

6) An airplane leaves the airport travelling N30°W at 720 km/h. After 1 h, the airplane then turns north and travels another 1.5 h at 850 km/h. What is the displacement of the airplane after 2.5 h?



$$|\vec{a}|^2 = 720^2 + 1275^2 - 2(720)(1275)\cos(150^\circ)$$

$$|\vec{a}| \approx 1932.4 \text{ km}$$

$$\frac{\sin \theta}{1275} = \frac{\sin 150}{1932.4}$$

$$\theta \approx 19.26^\circ$$

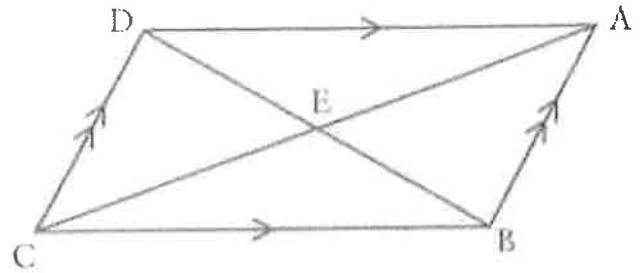
$$\beta = 30 - 19.26$$

$$\beta = 10.74^\circ$$

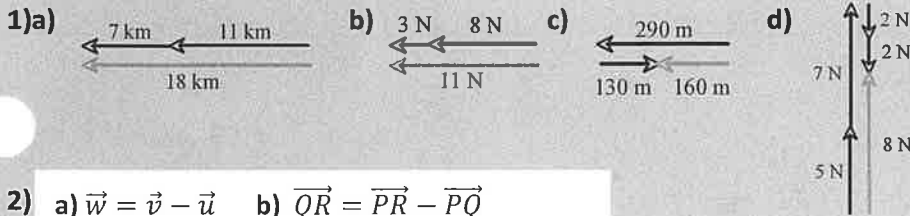
Answer: 1932.4 km N10.74°W

7) ABCD is a parallelogram, and E is the intersection point of the diagonal AC and BD. Name a single vector equivalent to each expression.

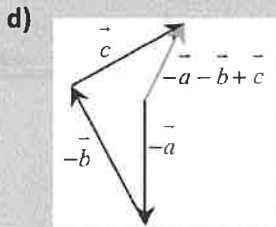
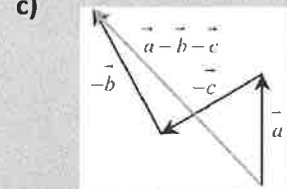
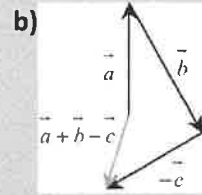
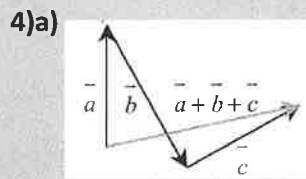
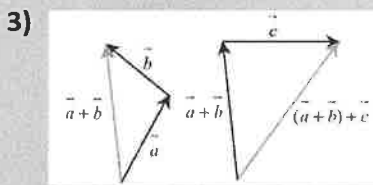
- a) $\vec{AE} + \vec{EB}$
 \vec{AB}
- b) $\vec{BC} + \vec{BA}$
 \vec{BD}
- c) $\vec{AE} + \vec{CE}$
 \vec{AC}
- d) $\vec{AD} + \vec{AB}$
 \vec{AC}
- e) $\vec{BA} + \vec{AE} + \vec{ED} + \vec{DC}$
 \vec{BC}
- f) $\vec{AB} - \vec{DB} = \vec{AB} + \vec{BD}$
 \vec{AD}
- g) $\vec{AB} - \vec{CB} - \vec{DC}$
 $= \vec{AB} + \vec{BC} + \vec{CD}$
 $= \vec{AD}$
- h) $\vec{AE} - \vec{EB} - \vec{BC}$
 $= \vec{AE} + \vec{BE} + \vec{CB}$
 $= \vec{AB} + \vec{CB}$
 $= \vec{0}$



Answer Key:



2) a) $\vec{w} = \vec{v} - \vec{u}$ b) $\vec{QR} = \vec{PR} - \vec{PQ}$



5) a) \vec{EB} b) \vec{BD} c) \vec{ED} d) \vec{CB}

6) 1932.4 km N10.7°W

7) a) \vec{AB} b) \vec{BD} c) \vec{AC} d) \vec{AC} e) \vec{BC} f) \vec{AD} g) \vec{AD} h) $\vec{0}$

W3 – Multiplication of a Vector by a Scalar

MCV4U

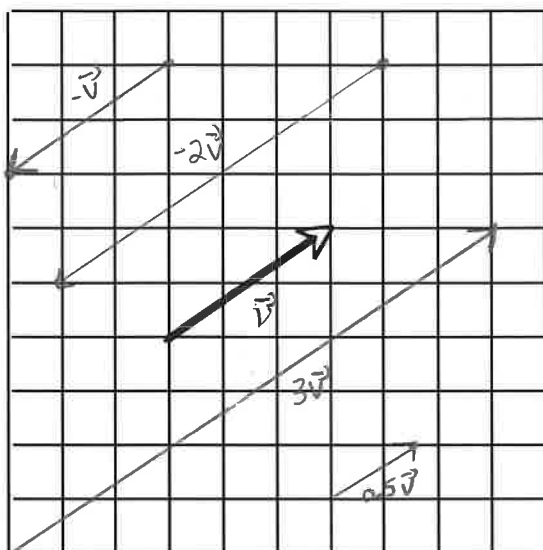
Jensen

Unit 4

SOLUTIONS

1) Draw representatives of the following vectors on the grid provided.

- a) $3\vec{v}$
- b) $0.5\vec{v}$
- c) $-2\vec{v}$
- d) $-\vec{v}$



2) Simplify each of the following algebraically.

a) $\vec{a} + 2\vec{a} + 4\vec{a}$

$= 7\vec{a}$

b) $7\vec{u} + 5\vec{v} - 2\vec{u} + 8\vec{v}$

$= 5\vec{u} + 13\vec{v}$

c) $2(\vec{u} + \vec{v}) - 3(\vec{u} - 2\vec{v})$

$= 2\vec{u} + 2\vec{v} - 3\vec{u} + 6\vec{v}$
 $= -\vec{u} + 8\vec{v}$

d) $7\vec{u} + 5\vec{v} - 2(\vec{u} - \vec{v}) + 2\vec{u}$

$= 7\vec{u} + 5\vec{v} - 2\vec{u} + 2\vec{v} + 2\vec{u}$
 $= 7\vec{u} + 7\vec{v}$

e) $-3(\vec{u} + \vec{v}) + 2(\vec{u} - \vec{v})$

$= -3\vec{u} - 3\vec{v} + 2\vec{u} - 2\vec{v}$
 $= -\vec{u} - 5\vec{v}$

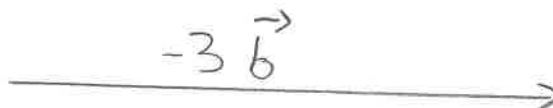
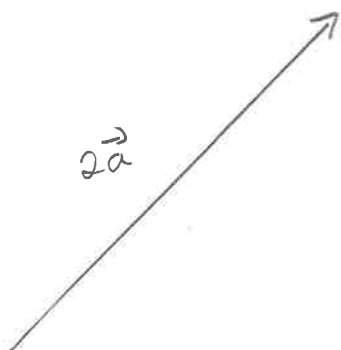
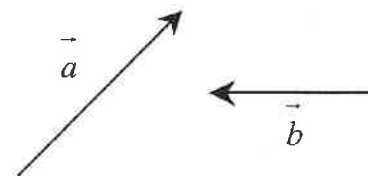
f) $6(\vec{u} + 2\vec{v}) - 5(\vec{u} - 3\vec{v})$

$= 6\vec{u} + 12\vec{v} - 5\vec{u} + 15\vec{v}$
 $= \vec{u} + 27\vec{v}$

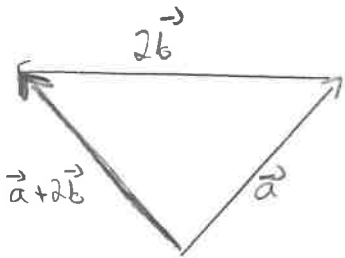
3) For the vectors \vec{a} and \vec{b} shown, draw and label...

a) $2\vec{a}$

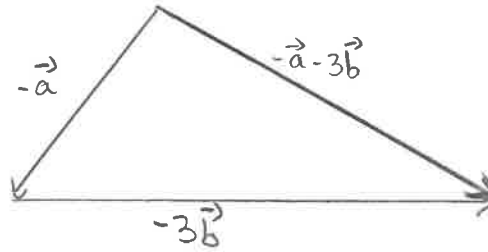
b) $-3\vec{b}$



c) $\vec{a} + 2\vec{b}$

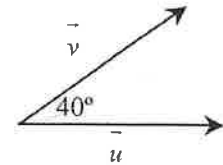
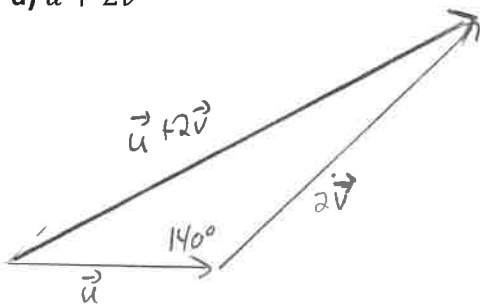


d) $-\vec{a} - 3\vec{b}$

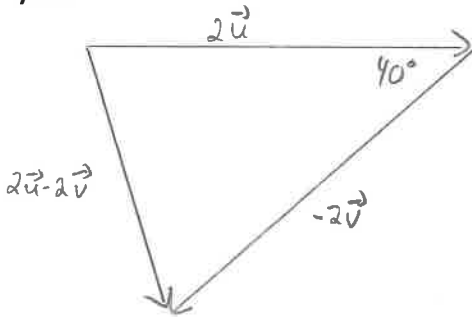


4) Two vectors \vec{u} and \vec{v} make an angle of 40° with each other. Construct each vector sum or difference.

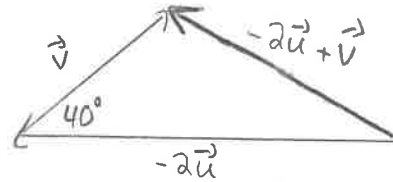
a) $\vec{u} + 2\vec{v}$



b) $2\vec{u} - 2\vec{v}$



c) $-2\vec{u} + \vec{v}$



5) In parallelogram ABCD, opposite sides are parallel and equal, $\overline{BP} = \overline{PA}$, and $\overline{AQ} = \overline{QD}$. Let $\overline{BP} = \vec{u}$ and $\overline{AQ} = \vec{v}$. Express the following vectors in terms of \vec{u} and \vec{v} .

a) \overline{AD}

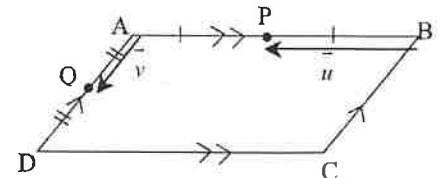
$= 2\vec{v}$

b) \overline{PA}

$= \vec{u}$

c) \overline{CD}

$= 2\vec{u}$



d) \overline{PQ}

$= \vec{u} + \vec{v}$

e) \overline{BD}

$= 2\vec{v} + 2\vec{u}$

f) \overline{PD}

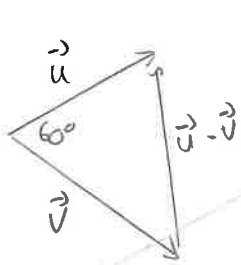
$= \vec{u} + 2\vec{v}$

g) \overline{AC}

$= 2\vec{v} - 2\vec{u}$

6) Given that $|\vec{u}| = 8$ and $|\vec{v}| = 10$ and the angle between \vec{u} and \vec{v} is 60° determine:

a) $|\vec{u} - \vec{v}|$

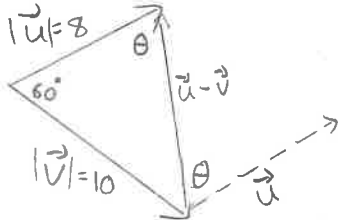


$$|\vec{u} - \vec{v}|^2 = 8^2 + 10^2 - 2(8)(10)\cos(60^\circ)$$

$$|\vec{u} - \vec{v}| = \sqrt{84}$$

$$|\vec{u} - \vec{v}| = 2\sqrt{21}$$

b) the direction of $\vec{u} - \vec{v}$ relative to \vec{u}

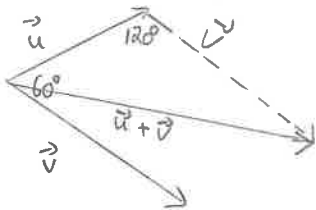


$$\frac{\sin\theta}{10} = \frac{\sin 60}{2\sqrt{21}}$$

$$\theta \approx 70.9^\circ$$

70.9° between \vec{u} and $\vec{u} - \vec{v}$

c) the unit vector in the direction of $\vec{u} + \vec{v}$



$$|\vec{u} + \vec{v}|^2 = 8^2 + 10^2 - 2(8)(10)\cos(120)$$

$$|\vec{u} + \vec{v}| = \sqrt{244}$$

$$|\vec{u} + \vec{v}| = 2\sqrt{61}$$

$$\text{unit vector} = \frac{1}{2\sqrt{61}} (\vec{u} + \vec{v})$$

d) $|5\vec{u} + 2\vec{v}|$

$$|5\vec{u}| = 40$$

$$|2\vec{v}| = 20$$

$$|5\vec{u} + 2\vec{v}|^2 = 40^2 + 20^2 - 2(40)(20)\cos(120)$$

$$|5\vec{u} + 2\vec{v}| = \sqrt{2800}$$

$$|5\vec{u} + 2\vec{v}| = 20\sqrt{7}$$

7) $|\vec{v}| = 2$. Draw the following factors and express each of them as a scalar multiple of \vec{v} .

a) A vector in the same direction as \vec{v} with twice its magnitude

b) a vector in the same direction as \vec{v} with one half its magnitude

c) a vector in the opposite direction as \vec{v} with two-thirds its magnitude

d) a vector in the opposite direction as \vec{v} with twice its magnitude

e) a unit vector in the same direction as \vec{v}

a)

$$2\vec{v}$$

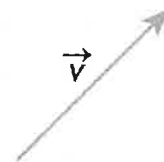
$$0.5\vec{v}$$

$$-\frac{2}{3}\vec{v}$$

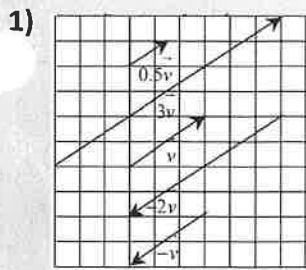
$$-2\vec{v}$$

e)

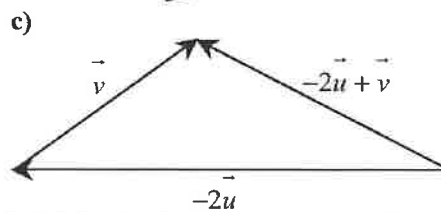
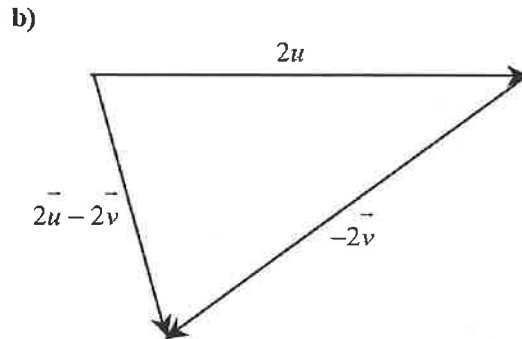
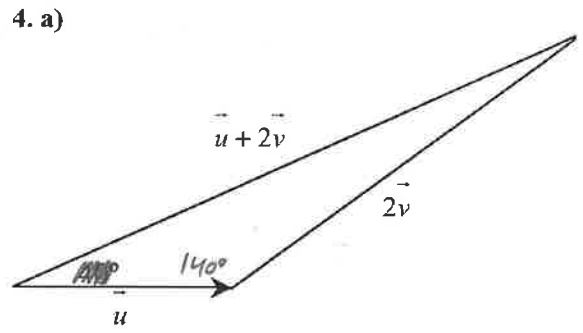
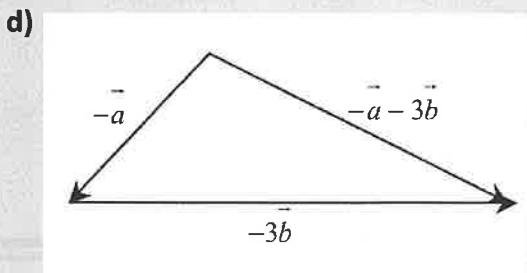
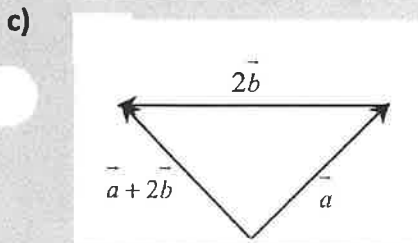
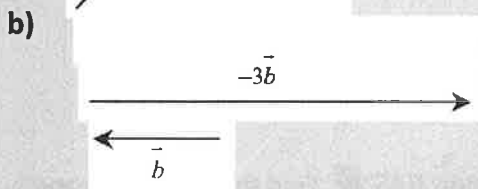
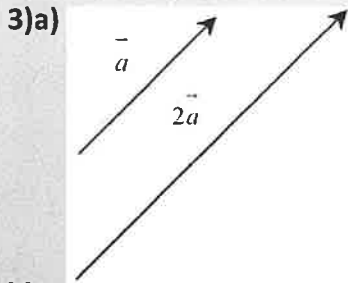
$$\frac{1}{|\vec{v}|}\vec{v}$$



Answers:

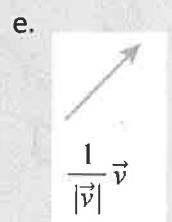
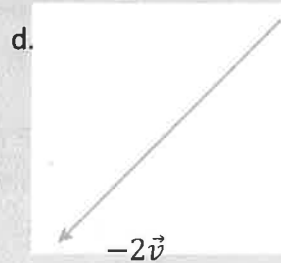
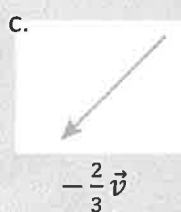
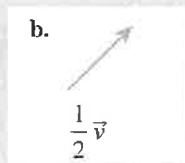
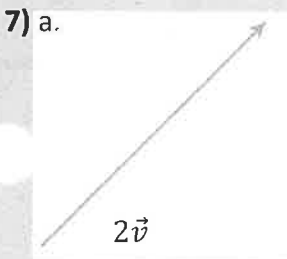


2)a) $7\vec{a}$ b) $5\vec{u} + 13\vec{v}$ c) $-\vec{u} + 8\vec{v}$ d) $7\vec{u} + 7\vec{v}$ e) $-\vec{u} - 5\vec{v}$ f) $\vec{u} + 27\vec{v}$

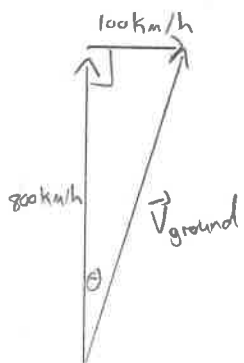


5)a) $2\vec{v}$ b) \vec{u} c) $2\vec{u}$ d) $\vec{u} + \vec{v}$ e) $2\vec{u} + 2\vec{v}$ f) $\vec{u} + 2\vec{v}$ g) $2\vec{v} - 2\vec{u}$

6)a) $2\sqrt{21}$ b) 71° c) $\frac{1}{2\sqrt{5}}(\vec{u} + \vec{v})$ d) $20\sqrt{7}$



1) The velocity of an airplane is 800 km/h north. A wind is blowing due east at 100 km/h. Determine the velocity of the airplane relative to the ground.



$$|\vec{V}_{\text{ground}}|^2 = 800^2 + 100^2$$

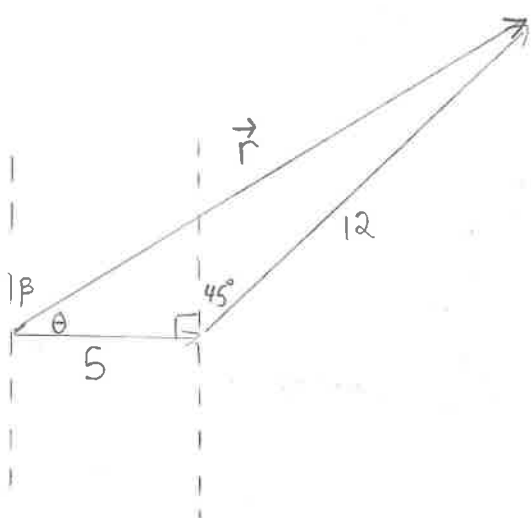
$$|\vec{V}_{\text{ground}}| \approx 806.2 \text{ km/h}$$

$$\tan \theta = \frac{100}{800}$$

$$\theta \approx 7.1^\circ$$

The ground velocity is 806.2 km/h at a quadrant bearing of N 7.1° E

2) A particle is displaced 5 units to the west and then displaced 12 units in a direction N 45° E. Find the magnitude and direction of the resultant displacement.



$$|\vec{R}|^2 = 5^2 + 12^2 - 2(5)(12)\cos(135^\circ)$$

$$|\vec{R}| \approx 15.93 \text{ units}$$

$$\cos \theta = \frac{12^2 - 5^2 - 15.93^2}{-2(5)(15.93)}$$

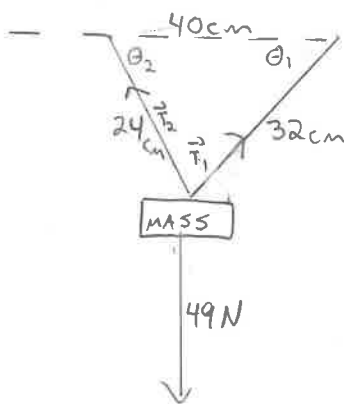
$$\theta \approx 32.2^\circ$$

$$\beta = 90 - 32.2^\circ$$

$$\beta \approx 57.8^\circ$$

The resultant is 15.93 units at a quadrant bearing of N 57.8° E.

3) A mass of 5 kg is suspended by two strings, 24 cm and 32 cm long, from two points that are 40 cm apart and at the same level. Determine the tension in each of the strings.



$$\cos \theta_1 = \frac{24^2 - 40^2 - 32^2}{-2(40)(32)}$$

$$\theta_1 \approx 36.87^\circ$$

$$\cos \theta_2 = \frac{32^2 - 24^2 - 40^2}{-2(24)(40)}$$

$$\theta_2 \approx 53.13^\circ$$

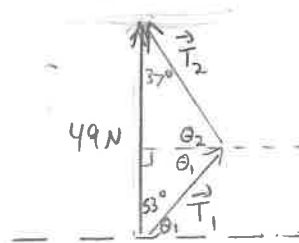
$$\theta_1 + \theta_2 = 90^\circ$$

$$\cos 53.13 = \frac{T_1}{49}$$

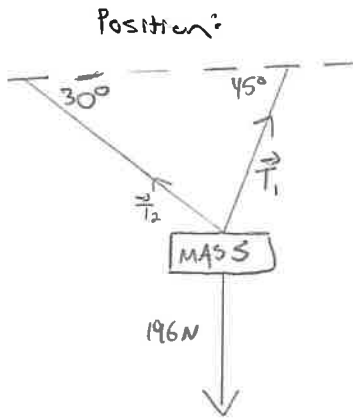
$$T_1 \approx 29.4 \text{ N (32 cm string)}$$

$$\sin 53.13 = \frac{T_2}{49}$$

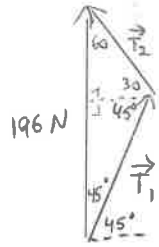
$$T_2 \approx 39.20 \text{ N (24 cm string)}$$



4) A mass of 20 kg is suspended from a ceiling by two lengths of rope that make angles of 30° and 45° with the ceiling. Determine the tension in each rope.



Vector:



$$\frac{196}{\sin 75} = \frac{|\vec{T}_1|}{\sin 60} = \frac{|\vec{T}_2|}{\sin 45}$$

$$|\vec{T}_1| \approx 175.73 \text{ N (45° rope)}$$

$$|\vec{T}_2| \approx 143.48 \text{ N (30° rope)}$$

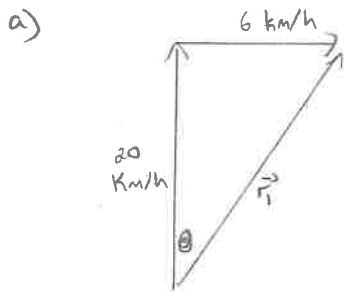
5) A river is 2 km wide and flows at 6 km/h. Anna is driving a motorboat, which has a speed of 20 km/h in still water and she heads out from one bank in a direction perpendicular to the current. A marina lies directly across the river from the starting point on the opposite bank.

a) How far downstream from the marine will the current push the boat?

How long will it take for the boat to cross the river?

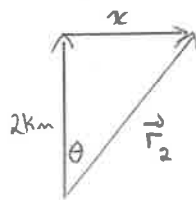
If Anna decides that she wants to end up directly across the river at the marina, in what direction should she head?

What is the resultant velocity of the boat?



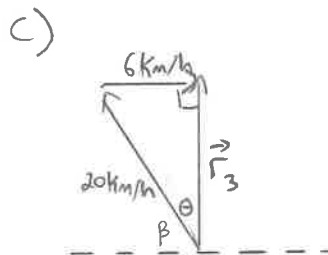
$$\tan \theta = \frac{6}{20}$$

$$\theta \approx 16.7^\circ$$



$$\tan 16.7 = \frac{x}{2}$$

$$x \approx 0.6 \text{ km}$$



$$\sin \theta = \frac{6}{20}$$

$$\theta \approx 17.5^\circ$$

$$\beta \approx 72.5^\circ$$

$$|\vec{r}_3|^2 = 20^2 - 6^2$$

$$|\vec{r}_3| \approx 19.1 \text{ km/h}$$

b)

$$\cos 16.7 = \frac{20}{|\vec{r}_1|}$$

$$|\vec{r}_1| \approx 20.9 \text{ km/h}$$

$$\cos 16.7 = \frac{2}{|\vec{r}_2|}$$

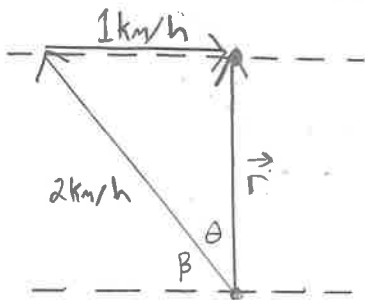
$$|\vec{r}_2| \approx 2.1 \text{ km}$$

$$\text{Time to cross} = \frac{2.1 \text{ km}}{20.9 \text{ km/h}} \approx 0.1 \text{ hours}$$

or 6 minutes

The boat needs to head out at an angle of 72.5° with the shore. The resultant velocity is 19.1 km/h.

6) Adam can swim at the rate of 2 km/h in still water. At what angle to the bank of a river must he head if he wants to swim directly across the river and the current in the river move at the rate of 1 km/h.



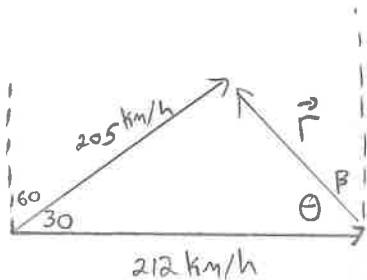
$$\sin \theta = \frac{1}{2}$$

$$\theta = 30^\circ$$

$$\beta = 60^\circ$$

60° to the bank of the river.

7) An airplane is travelling $N60^\circ E$ with a resultant ground speed of 205 km/h. The nose of the plane is actually pointing east with an airspeed of 212 km/h. Find the wind speed and direction.



$$|\vec{r}|^2 = 205^2 + 212^2 - 2(205)(212)\cos(30)$$

$$|\vec{r}| \approx 108.1 \text{ km/h}$$

$$\cos \theta = \frac{205^2 - 212^2 - 108.1^2}{-2(212)(108.1)}$$

$$\theta \approx 71.4^\circ$$

$$\beta \approx 18.6^\circ$$

The wind speed is 108.1 km/h at $N18.6^\circ W$

ANSWER KEY:

1. 806 km/h $N 7.1^\circ E$ 2. 15.93 units $N 57.8 W$ 3. 24 cm string: 39.2 N, 32 cm string: 29.4 N
 4. 45° rope: 175.73 N 30° rope: 143.48 N 5. a) 0.6 downstream from the marina b) 6 minutes (0.1 hours)
 c) upstream 17.5° , resultant velocity: 19.08 km/h 6. 30° upstream 7. 108 km/h $N18.4^\circ W$

W5 – Resolution of Vectors in to Rectangular Components

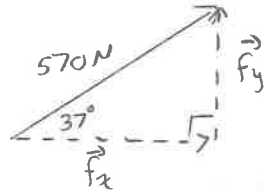
Unit 4

MCV4U

lensen

1) Determine the horizontal and vertical components of each force.

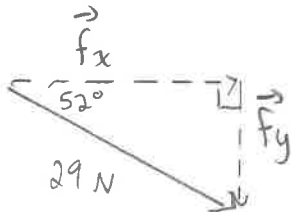
a) magnitude of 570 N, $\theta = 37^\circ$ counterclockwise from the horizontal



$$|\vec{F}_x| = 570 \cos(37) \approx 455.2 \text{ N}$$

$$|\vec{F}_y| = 570 \sin(37) \approx 343.0 \text{ N}$$

b) magnitude of 29 N, $\theta = 52^\circ$ clockwise from the horizontal



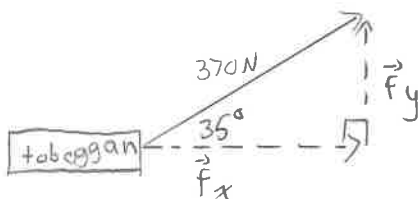
$$|\vec{F}_x| = 29 \cos(52) \approx 17.9 \text{ N}$$

$$|\vec{F}_y| = 29 \sin(52) \approx 22.9 \text{ N}$$

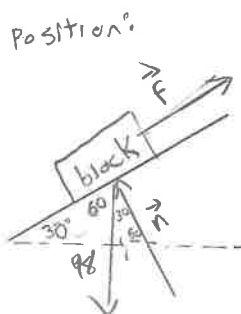
2) A woman is pulling on a rope attached to a toboggan with a 370 N force at an angle of 35° to the horizontal. Find the magnitude of the force pulling the sled forward and the magnitude of the force pulling the sled upward.

$$|\vec{F}_x| = 370 \cos(35) \approx 303.1 \text{ N forward}$$

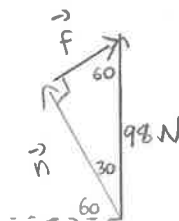
$$|\vec{F}_y| = 370 \sin(35) \approx 212.2 \text{ N upward.}$$



3) A 10 kg block lies on a smooth ramp that is inclined at 30° . What force, parallel to the ramp, would prevent the block from moving. (Assume that 1 kg exerts a force of 9.8 N)



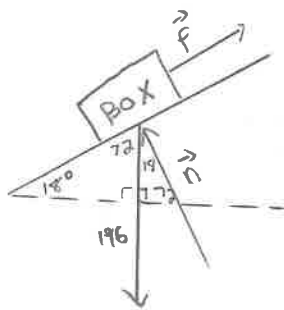
Vector:



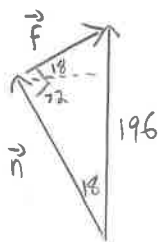
$$|\vec{F}| = 98 \sin(30) = 49 \text{ N}$$

4) A 20 kg box rests on a ramp that is inclined 18° . Resolve the weight into rectangular vector components that keep the box at rest.

Position:



Vector:

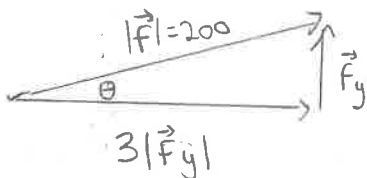


$$|\vec{n}| = 196 \cos(18^\circ) \approx 186.4 \text{ N}$$

$$|\vec{f}| = 196 \sin(18^\circ) \approx 60.6 \text{ N}$$

186.4 N perpendicular to the ramp
60.6 N parallel to the ramp.

5) Resolve a 200 N force into two rectangular vector components such that the ratio of their magnitudes is 3:1. Calculate the angle between the greater component and the 200 N force.



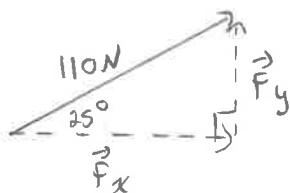
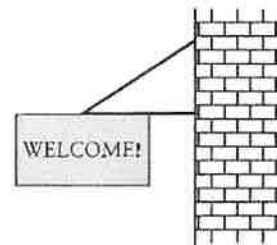
$$\tan \theta = \frac{|\vec{F}_y|}{3|\vec{F}_y|}$$

$$\tan \theta = \frac{1}{3}$$

$$\theta \approx 18.43^\circ$$

6) A sign is supported as shown in the diagram. The tension in the slanted rod supporting the sign is 110 N at an angle of 25° to the horizontal.

a) Draw a vector diagram showing the vector components of the tension vector.



b) What are the vertical and horizontal vector components of the tension?

$$|\vec{F}_x| = 110 \cos(25^\circ) \approx 99.7 \text{ N}$$

$$|\vec{F}_y| = 110 \sin(25^\circ) \approx 46.5 \text{ N}$$

ANSWER KEY:

1) a) $\vec{F}_h = 455.2 \text{ N}$, $\vec{F}_v = 343.0 \text{ N}$ b) $\vec{F}_h = 17.9 \text{ N}$, $\vec{F}_v = -22.9 \text{ N}$

2) forward: 303.1 N; upward: 212.2 N

3) 49 N

4) $|\vec{n}| = 186.41 \text{ N}$ $|\vec{f}| = 60.57 \text{ N}$

5) 18.4°

6) a) b) 99.7 N c) 46.5 N

