Unit 4 Pre-Test Review – Geometric Vectors Unit 4

MCV4U

Jensen

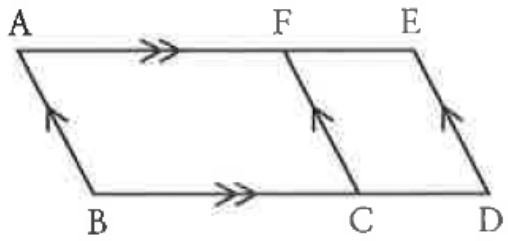
1) Convert each true bearing to its equivalent quadrant bearing.

a) $159°$ **b)** $064°$ **c)** $280°$ **d)** $202°$

2) Use an appropriate scale to draw each vector. Label the magnitude, direction, and scale.

a) a force of 120 N downward
b) a velocity of 85 km/h at a true bearing of $085°$.
c) a force of 8 N at a quadrant bearing of $N70°W$

3) Name all the equivalent vectors in the diagram

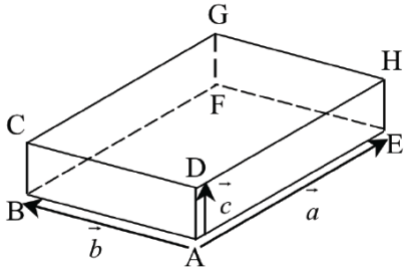


4) State the opposite of each vector.

a) 150 km/h on a quadrant bearing of $S50°W$
b) $\overrightarrow{AB}$
c) $\vec{v}$
d) 200 N upward

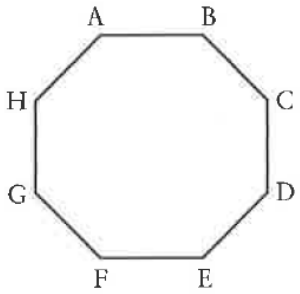
5) The diagram shows a rectangular prism. Name the resulting vector that each sum or difference represents.

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



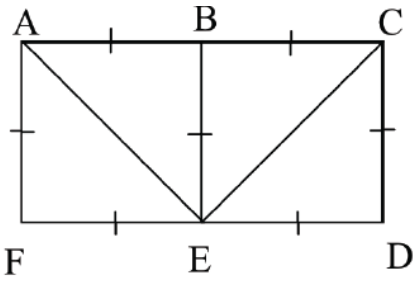
6) The diagram shows a regular octagon. Write a single vector that is equivalent to each vector expression.

a) $\overrightarrow{HA} + \overrightarrow{AB}$
b) $\overrightarrow{GH} - \overrightarrow{GF}$
c) $\overrightarrow{FE} + \overrightarrow{BA}$
d) $\overrightarrow{GA} - \overrightarrow{EH} + \overrightarrow{DG}$



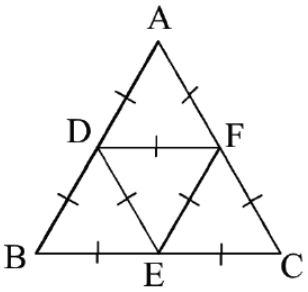
7) The diagram shows two squares. Name a single vector equivalent to each expression.

a) $\overrightarrow{FA} - \overrightarrow{FE}$
b) $-\overrightarrow{EB} + \overrightarrow{EF} - \overrightarrow{AF}$
c) $\overrightarrow{AE} + \overrightarrow{ED} - \overrightarrow{CD}$



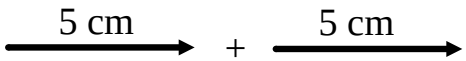
8) Equilateral triangle DEF joins the midpoints of equilateral triangle ABC. Write and expression that is equivalent to each single vector.

a) $\overrightarrow{AF}$ in terms of $\overrightarrow{AC}$
b) $\overrightarrow{AE}$ in terms of $\overrightarrow{AB}$ and $\overrightarrow{BC}$
c) $\overrightarrow{AB}$ in terms of $\overrightarrow{AF}$ and $\overrightarrow{EC}$

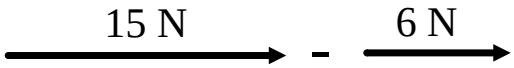


9) Draw a diagram to represent each vector sum or difference.

a)

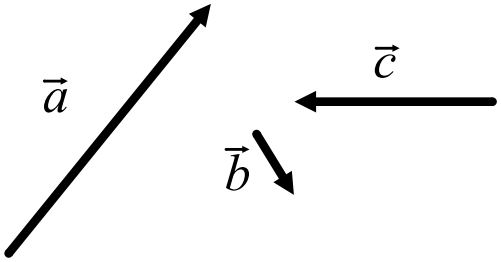


b)



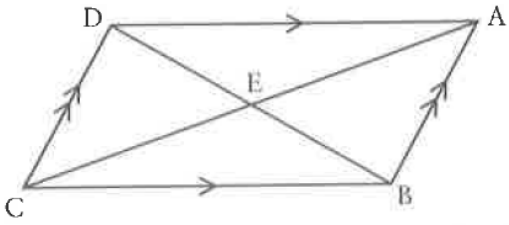
10) Use the following set of vectors to draw a diagram of each expression.

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



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

a) $\overrightarrow{AE} + \overrightarrow{EB}$
b) $\overrightarrow{AE} + \overrightarrow{AE}$
c) $\overrightarrow{BA} + \overrightarrow{AE} + \overrightarrow{ED} + \overrightarrow{DC}$
d) $\overrightarrow{AB} - \overrightarrow{DB}$
e) $\overrightarrow{AB} - \overrightarrow{CB} - \overrightarrow{DC}$



12) Let $|\vec{v}| = 500$ km/h, at a quadrant bearing of $S30°E$. Draw a scale diagram illustrating each related vector.

a) $2\vec{v}$
b) $0.4\vec{v}$
c) $-3\vec{v}$
d) $-5\vec{v}$

13) In hexagon ABCDEF, opposite sides are parallel and equal, and $\overrightarrow{FC} = 2\overrightarrow{AB}$. Let $\overrightarrow{AB} = \vec{u}$ and $\overrightarrow{FA} = \vec{v}$. Express each vector in terms of $\vec{u}$ and $\vec{v}$.

a) $\overrightarrow{CF}$
b) $\overrightarrow{FB}$
c) $\overrightarrow{FD}$
d) $\overrightarrow{CA}$
e) $\overrightarrow{EB}$
f) $\overrightarrow{BE}$

14) The vectors $\vec{d}$ and $\vec{e}$ are such that $|\vec{d}| = 3$ and $|\vec{e}| = 5$, and the angle between them is $30°$. Determine each of the following:

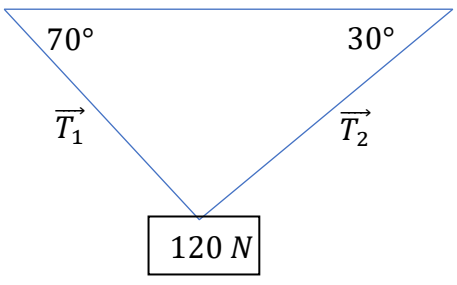
a) $|\vec{d} + \vec{e}|$
b) $|\vec{d} - \vec{e}|$
c) a unit vector in the direction of $\vec{d} + \vec{e}$

15) Given $|\vec{F}_1| = 85\ N$ and $|\vec{F}_2| = 125\ N$ and they are acting at an angle of $140°$ to each other…

a) Find the magnitude of the resultant.
b) Describe the direction of $\vec{F}_1 + \vec{F}_2$ relative to $\vec{F}_1$

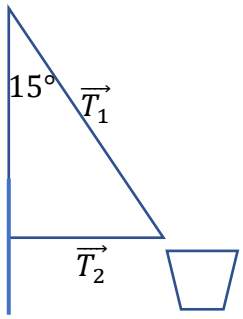
16) A 120 N sign is hanging from two chains attached to a ceiling as shown.

a) Draw the vector diagram that illustrates this situation.
b) Determine the magnitude of the tensions in the chains.



17) A sign weighing 98 N is suspended from the middle of a 4 m long chain. The ends of the chain are attached to a ceiling at points 3 m apart. Determine the tensions in the chains.

18) A community center plans to install a new basketball hoop on the side of the building. The hoop and backboard have a combined weight of 196 N and are supported by a brace and a wire. Determine the magnitude of the tensions in the wire and the brace.

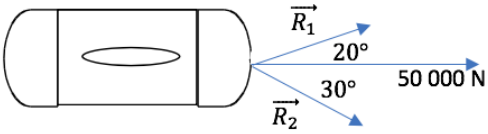


19) An airplane is flying at 560 km/h on a heading of 340°. The wind is blowing at 140 km/h from the east.
a) Draw a vector diagram of this situation.
b) Determine the ground velocity of the airplane.

20) A sailor wishes to sail to a port that is located S25°E of his present position. The average speed of his sailboat is 23 knots and the wind is blowing from N85°E at 12 knots.
a) Draw a vector diagram of this situation.
b) In which direction should the sailor sail?
c) What will the sailboat's groundspeed be?

21) A canoeist leaves a dock and paddles her canoe at an angle across a river. The current is flowing at 3 km/h. The resulting velocity of the boat is 5.4 km/h downstream, in a direction that forms a 15° angle with the adjacent shore.
a) Draw a vector diagram of this situation.
b) Determine the canoeist's velocity relative to the water.
c) How far downstream will she be in 20 min?

22) A cruise ship is being pulled into a dock using two ropes, as shown in the diagram. Find the magnitude of the force in each rope if a resultant force of 50 000 N is needed to pull the cruise ship at the desired speed.



23) A truck weighing 17 000 N is resting on a ramp that is inclined at an angle of 15° to the horizontal. Resolve the weight of the truck into the rectangular components keeping it at rest.

24) A rope attached to a box is being used to drag it up a ramp. A 130 N force is applied to the box at an angle of 35° to the ramp.
a) Find the magnitude of the force in the direction of motion of the box. Round your answer to the nearest tenth of a newton.
b) Find the magnitude of the force perpendicular to the direction of motion of the box. Round your answer to the nearest tenth of a newton.

25) Suppose forces of 45N and 70N act at an angle of 110° to each other. Find the magnitude (to 1 decimal place) and direction (to the nearest degree) of the resultant force. State the direction as an angle off the 70N force.

26) A plane is headed N10^0W with a speed of 600 km/h. An east wind (i.e. wind FROM the east towards the west) causes it to travel at N16^0W. Find the resultant ground speed of the plane, and the speed of the wind, each to 1 decimal place.

27) The force at which a tow truck pulls a car has a horizontal component of 20 000 N and a vertical component of 12 000 N. What is the resultant force on the car?

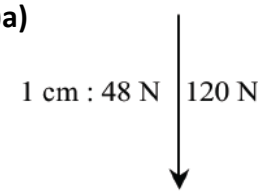
28) Determine the magnitude of the horizontal and vertical vector components of a 300 N force acting at an angle of $33°$ to the horizontal.

29) A box with a mass of 275 N rests on a frictionless ramp inclined at an angle of $25°$ to the level ground. What force must be applied to the box at an angle of $45°$ to the ramp so that it remains at rest?

ANSWER KEY:

1)a) $S21°E$ **b)** $N64°E$ **c)** $N80°W$ **d)** $S22°W$

2)a)



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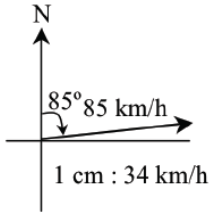

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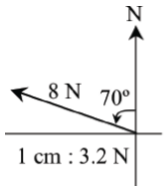


3) $\overrightarrow{AE} = \overrightarrow{BD}, \overrightarrow{EA} = \overrightarrow{DB}, \overrightarrow{AF} = \overrightarrow{BC}, \overrightarrow{FA} = \overrightarrow{CB}, \overrightarrow{FE} = \overrightarrow{CD}, \overrightarrow{EF} = \overrightarrow{DC}, \overrightarrow{AB} = \overrightarrow{FC} = \overrightarrow{ED}, \overrightarrow{BA} = \overrightarrow{CF} = \overrightarrow{DE}$

4)a) 150 km/h $N50°E$ **b)** $-\overrightarrow{AB} = \overrightarrow{BA}$ **c)** $-\vec{v}$ **d)** 200 N downward

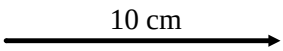
5)a) $\overrightarrow{AF}$ **b)** $\overrightarrow{AC}$ **c)** $\overrightarrow{DE}$ **d)** $\overrightarrow{BD}$ **e)** $\overrightarrow{ED}$ **f)** $\overrightarrow{BE}$

6)a) $\overrightarrow{HB}$ **b)** $\overrightarrow{FH}$ **c)** $\vec{0}$ **d)** $\vec{0}$

7)a) $\overrightarrow{EA}$ **b)** $\overrightarrow{BA}$ **c)** $\overrightarrow{AC}$

8)a) $0.5\overrightarrow{AC}$ **b)** $\overrightarrow{AB} + 0.5\overrightarrow{BC}$ **c)** $2\overrightarrow{AF} - 2\overrightarrow{EC}$

9)a)



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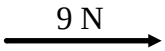
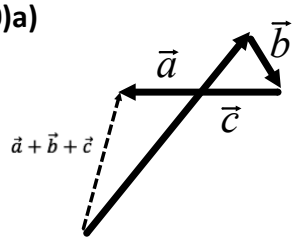


10)a)



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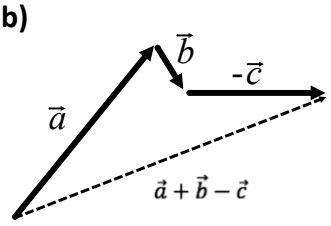

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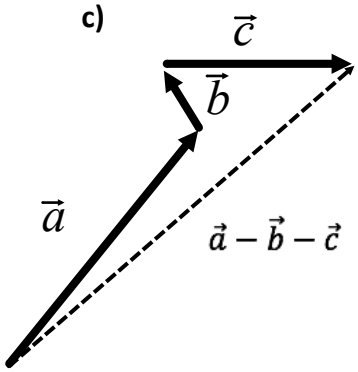
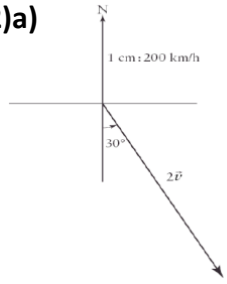


11)a) $\overrightarrow{AB}$ **b)** $\overrightarrow{AC}$ **c)** $\overrightarrow{BC}$ **d)** $\overrightarrow{AD}$ **e)** $\overrightarrow{AD}$

12)a)



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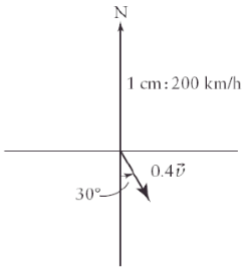

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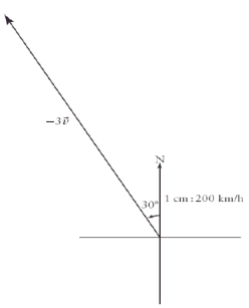

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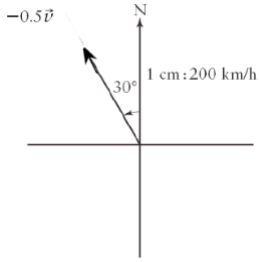
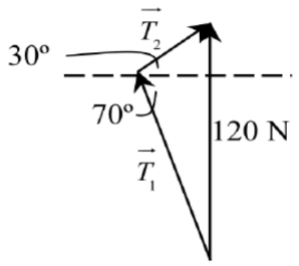


13)a) $-2\vec{u}$ **b)** $\vec{v} + \vec{u}$ **c)** $2\vec{u} - \vec{v}$ **d)** $-2\vec{u} + \vec{v}$ **e)** $2\vec{v}$ **f)** $-2\vec{v}$

14)a) $\sqrt{34+15\sqrt{3}} \cong 7.7$ units **b)** $\sqrt{34-15\sqrt{3}} \cong 2.83$ units **c)** $\frac{1}{\sqrt{34+15\sqrt{3}}}(\vec{d}+\vec{e})$

15)a) 81.1 **b)** $\vec{F}_1 + \vec{F}_2$ makes an angle of 97.6° relative to $\vec{F}_1$

16)a)

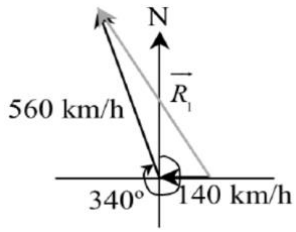


b) $\overrightarrow{T_1} = 105.5\ N; \overrightarrow{T_2} = 41.7\ N$

17) 74.1 N

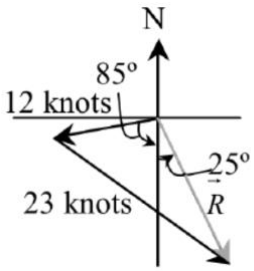
18) $\overrightarrow{T_1} = 202.9\ N\ \ \overrightarrow{T_2} = 52.5\ N$

19)a)



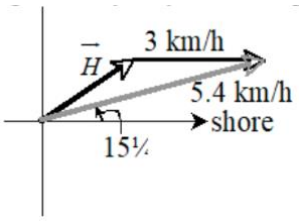
b) 622 km/h at a bearing of 328°

20)a)



b) $S54.4°E$ **c)** 15.9 knots

21)a)



b) 2.6 km/h at an angle of 32.2° with the adjacent shore
c) 1.7 km

22) $\overrightarrow{R_1} = 32\ 635.2\ N\ \ \overrightarrow{R_2} = 22\ 323.8\ N$

23) Force parallel to ramp: 4399.9 N, Normal force: 16 420.7 N

24)a) 106.5 N **b)** 74.6 N

25) 69.1 N at an angle of 37.8° with the 70 N force.

26) Magnitude of wind = 65.2 km/h, magnitude of ground speed = 614.7 km/h

27) 23 323.8 N at 31° above the horizontal

28) $\left|\vec{f}_{horizontal}\right| = 251.6\ N$ $\left|\vec{f}_{vertical}\right| = 163.39\ N$

29) 164.36 N