Grade 12 Calculus and Vectors Exam Review Lesson (Unit 4)

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Vectors Exam Review – Unit 4: Geometric Vectors

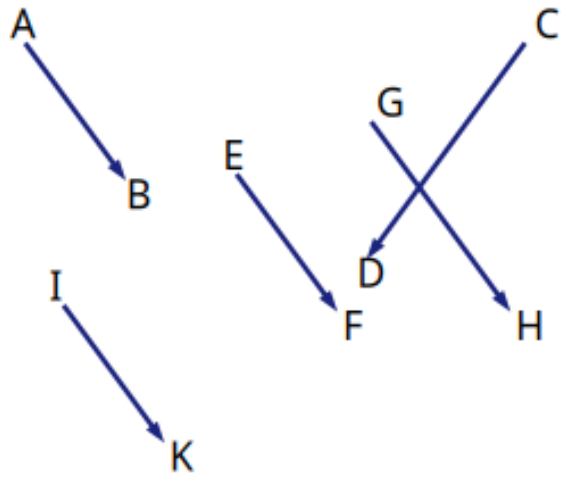
1) Write each true bearing as an equivalent quadrant bearing.

a) 130°	**b)** 330°

2) Write each quadrant bearing as an equivalent true bearing.

a) $S20°W$	**b)** $E47°N$

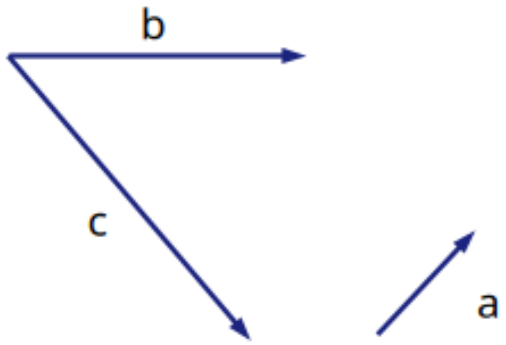
3) Consider these vectors. List the vectors in each set.



a) same direction as $\overrightarrow{AB}$	**b)** parallel to $\overrightarrow{AB}$
c) equivalent to $\overrightarrow{AB}$	**d)** opposite to $\overrightarrow{AB}$

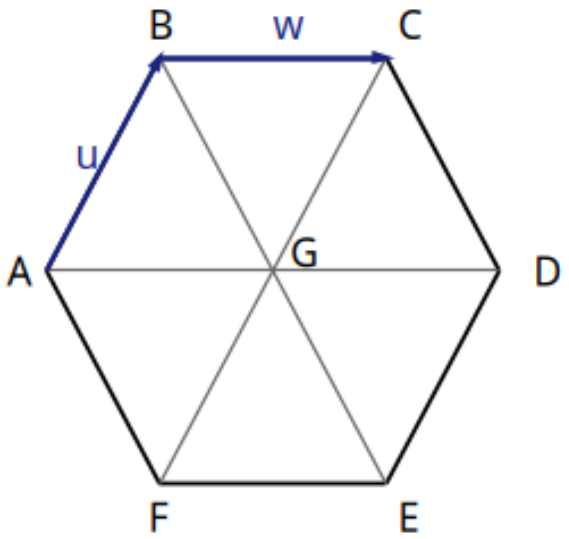
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4) Given vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$, draw each of the following:



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

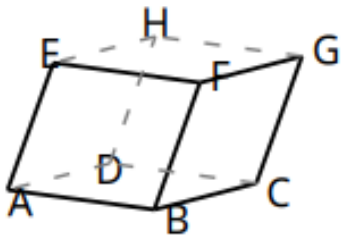
5) Consider the regular hexagon $ABCDEF$ with G at the center. $\overrightarrow{AB} = \vec{u}$ and $\overrightarrow{BC} = \vec{w}$. Write each of the following vectors in terms of $\vec{u}$ and $\vec{w}$. *Note: each triangle is equilateral.*



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a) $\overrightarrow{FE}$	**b)** $\overrightarrow{DE}$
c) $\overrightarrow{DA}$	**d)** $\overrightarrow{GE}$
e) $\overrightarrow{AE}$	

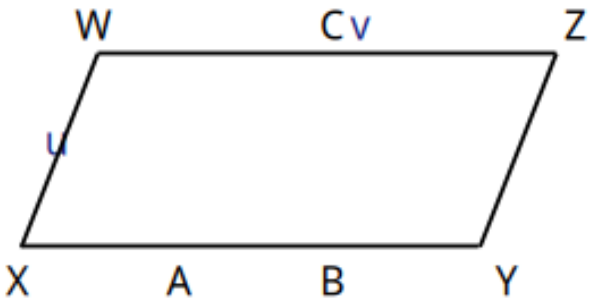
6) The diagram shows a parallelepiped. Determine a single vector that is equivalent to each sum or difference.



a) $\overrightarrow{AB} - \overrightarrow{BF}$	**b)** $\overrightarrow{AB} + \overrightarrow{CG}$
c) $\overrightarrow{EF} + \overrightarrow{DH}$	**d)** $\overrightarrow{AB} + \overrightarrow{HD} + \overrightarrow{FG}$
e) $\overrightarrow{AB} - \overrightarrow{HD} + \overrightarrow{FG}$	**f)** $\overrightarrow{ED} + \overrightarrow{AB} - (\overrightarrow{HG} + \overrightarrow{FB})$

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7) In the diagram, C is the midpoint of WZ, and A and B are the points of trisection of XY. Express each vector in terms of a linear combination of $\vec{u} = \overrightarrow{XW}$ and $\vec{v} = \overrightarrow{WZ}$.



a) $\overrightarrow{AB}$	**b)** $\overrightarrow{AZ}$
c) $\overrightarrow{WB}$	**d)** $\overrightarrow{AC}$

8) Given that $|\vec{u}| = 12$ and $|\vec{v}| = 5$ and the angle between $\vec{u}$ and $\vec{v}$ is $30°$, determine:

a) the unit vector in the direction of $\vec{u} + \vec{v}$	**b)** $\lvert 3\vec{u} + 2\vec{v} \rvert$

9) An airplane is flying with airspeed 400 km/h on a heading of $000°$. There is a 50 km/h wind blowing from the direction $090°$. Calculate the ground velocity of the plane.

10) An object weighing 400 N is hanging from two ropes attached to the ceiling. One rope makes an angle of $40°$ with the ceiling, the other makes an angle of $50°$ with the ceiling. Determine the tension in each rope.

11) A car is moving north at a speed of 25 m/s. A child in the back seat of the car throws a toy to the passenger in the front seat with a speed of 10 m/s in the direction forward $50°$ right (relative to the car). Calculate the speed and direction of the toy relative to the road.

12) 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.

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13) 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. Determine the canoeist's velocity relative to the water.

14) A pilot flies with a heading of $160°$ and an airspeed of 250 km/h. There is a steady wind of 30 km/h from the direction $030°$. Calculate the ground velocity of the plane.

15) A pilot flies on a heading of $N40°W$ with an airspeed of 240 km/h. Her actual ground velocity is 250 km/h at a bearing of $N42°W$. Determine the velocity of the wind.

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

a) 30 N at an inclination of $40°$ counterclockwise from the horizontal	**b)** 50 m/s, $50°$ clockwise from the horizontal

17) A 500 N crate is resting on a ramp that is inclined $8°$ counterclockwise from the horizontal. Resolve the weight into two rectangular components, one parallel to the ramp and the other perpendicular to the ramp.

18) A person is pushing on the handle of a lawn mower with a force of 400 N acting $30°$ clockwise below the horizontal. What is the magnitude of the force pushing the lawn mower horizontally? Pushing down on the lawn mower?

19) A plane on takeoff has a velocity of 300 km/h at an angle of $10°$ up from the horizontal. Calculate the rate at which the plane is climbing and its horizontal speed, to one decimal place.

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Answer Key

1)a) $S50°E$ **b)** $N30°W$ **2)a)** $200°$ **b)** $043°$ **3)a)** $\overrightarrow{EF}$, $\overrightarrow{GH}$, $\overrightarrow{IK}$ **b)** $\overrightarrow{CD}$, $\overrightarrow{EF}$, $\overrightarrow{GH}$, $\overrightarrow{IK}$ **c)** $\overrightarrow{EF}$, $\overrightarrow{IK}$ **d)** $\overrightarrow{CD}$ **4)** see diagrams in solutions **5)a)** $\vec{w}$ **b)** $-\vec{u}$ **c)** $-2\vec{w}$ **d)** $\vec{w}-\vec{u}$ **e)** $2\vec{w}-\vec{u}$ **6)a)** $\overrightarrow{EB}$ or $\overrightarrow{HC}$ **b)** $\overrightarrow{AF}$ or $\overrightarrow{DG}$ **c)** $\overrightarrow{AF}$ or $\overrightarrow{DG}$ **d)** $\overrightarrow{EC}$ **e)** $\overrightarrow{AG}$ **f)** $\overrightarrow{BC}$ **7)a)** $\frac{1}{3}\vec{v}$ **b)** $\frac{2}{3}\vec{v}+\vec{u}$ **c)** $-\vec{u}+\frac{2}{3}\vec{v}$ **d)** $\frac{1}{6}\vec{v}+\vec{u}$ **8)a)** $\frac{1}{\sqrt{169+60\sqrt{3}}}(\vec{u}+\vec{v})$ **b)** $\sqrt{1396+360\sqrt{3}}$ **9)** 403.1 km/h $N7.1°W$ **10)** $40°$ rope: 257.1 N; $50°$ rope: 306.4 N **11)** 32.35 m/s, $N13.7°E$ **12)** 74.1 N **13)** 2.62 km/h at $32.24°$ with the adjacent shore **14)** 270.26 km/h $S15.12°E$ **15)** 13.16 km/h $N81.1°W$ **16)a)** $F_h \approx 22.98$ N, $F_v \approx 19.28$ N **b)** $F_h \approx 32.14$ m/s, $F_v \approx 38.30$ m/s **17)** $|\vec{n}| \approx 495.13$ N; $|\vec{f}| \approx 69.59$ N **18)** horizontal force: 346.41 N; downward force: 200 N **19)** horizontal speed ≈ 295.4 km/h; rate of climbing ≈ 52.1 km/h

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