

Vectors Exam Review

Unit 4 – Geometric Vectors

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

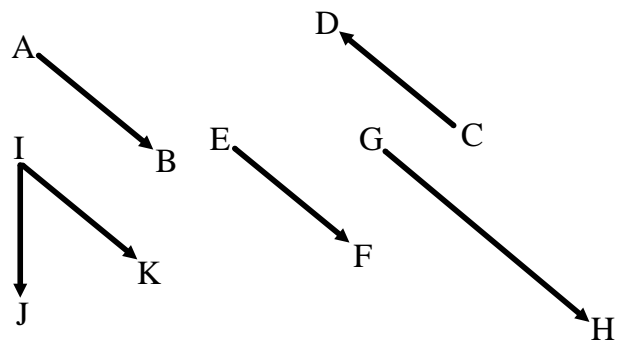
- a) 130°
- b) 330°

2) Write each quadrant bearing as an equivalent true bearing

- a) $S20^\circ W$
- b) $E47^\circ N$

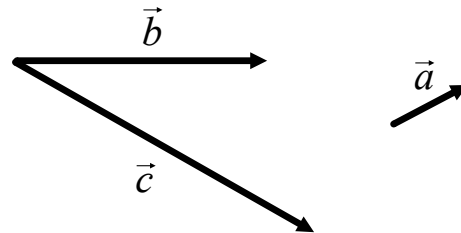
3) Consider these vectors. List the vectors in each set.

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



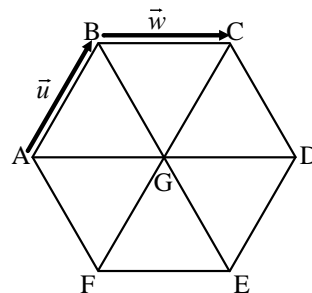
4) Given vectors \vec{a} , \vec{b} , and \vec{c} , draw each of the following:

- 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) $-2\vec{a}$



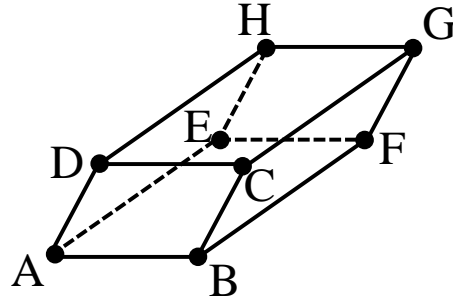
5) Consider the regular hexagon ABCDEFG with G at the center. $\overrightarrow{AB} = \vec{u}$ and $\overrightarrow{BC} = \vec{w}$. Write each of the following vectors in terms of \vec{u} and \vec{w} . **Note:** each triangle is equilateral.

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



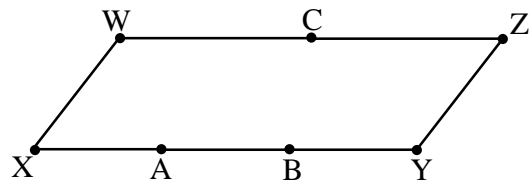
6) The diagram shows a parallelepiped. Determine a single vector that is equivalent to each sum or difference.

- 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) $\overrightarrow{ED} + \overrightarrow{AB} - (\overrightarrow{HG} + \overrightarrow{FB})$



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) $|3\vec{u} + 2\vec{v}|$

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. The ropes are attached to the ceiling. One makes an angle of 40° with the ceiling the other makes an angle of 50° with the ceiling.

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.

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 $N40^\circ W$ with an airspeed of 240 km/h. Her actual ground velocity is 250 km/h at a bearing of $N42^\circ W$.

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

a) 30 N at an inclination of 40° counter clockwise 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° counter clockwise 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.

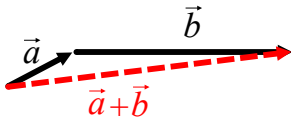
Unit 4 Answers

1)a) $S50^\circ E$ b) $N30^\circ W$

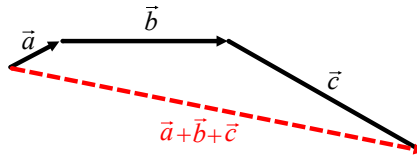
2)a) 200° b) 43°

3)a) $\overline{EF}, \overline{GH}, \overline{IK}$ b) $\overline{CD}, \overline{EF}, \overline{GH}, \overline{IK}$ c) $\overline{EF}, \overline{IK}$ d) \overline{CD}

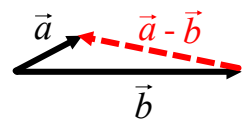
4)a)



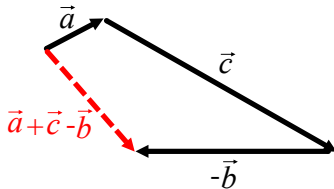
b)



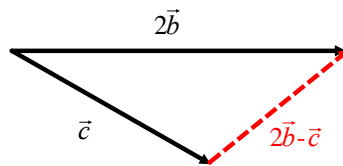
c)



d)



e)



f)



5)a) \vec{w} b) $-\vec{u}$ c) $-2\vec{w}$ d) $\vec{w} - \vec{u}$ e) $2\vec{w} - \vec{u}$

6)a) \overline{EB} or \overline{HC} b) \overline{AF} or \overline{DG} c) \overline{AF} or \overline{DG} d) \overline{EC} e) \overline{AG} f) \overline{EF}

7)a) $\frac{1}{3}\vec{v}$ b) $\frac{2}{3}\vec{v} + \vec{u}$ c) $-\vec{u} + \frac{2}{3}\vec{v}$ d) $\vec{u} + \frac{1}{6}\vec{v}$

8)a) $\frac{1}{\sqrt{169+60\sqrt{3}}}(\vec{u} + \vec{v})$ b) $\sqrt{1396 + 360\sqrt{3}}$

9) 403 km/h $N7.1^\circ W$

10) For the shorter rope: 306.4 N; for the longer rope: 257.1 N

11) 32 m/s forward 14° right

12) 74.1 N

13) 2.6 km/h at an angle of 32.2° with the adjacent shore

14) 270 km/h $S15^\circ E$

15) 13 km/h $N82^\circ W$

16)a) $\vec{F}_h = 23$ N; $\vec{F}_v = 19$ N b) $\vec{F}_h = 32$ m/s; $\vec{F}_v = 38$ m/s

17) $|\vec{n}| = 495$ N; $|\vec{f}| = 70$ N

18) horizontal force: 346 N; downward force: 200 N

19) $\vec{v}_h = 52.1$ km/h; $\vec{v}_v = 295.4$ km/h