

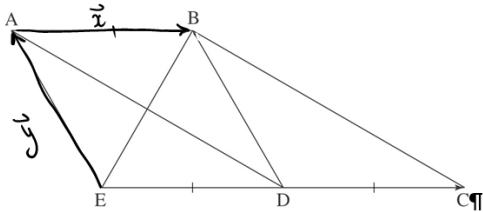
# Review

September 9, 2014 8:50 PM

① Indicate whether the following are scalars or vectors.

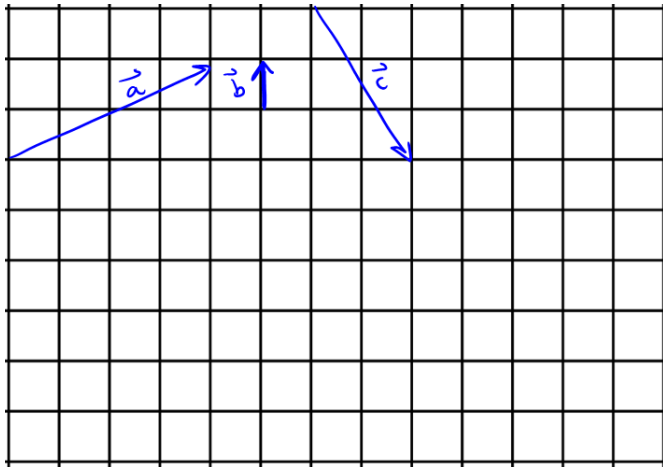
- a) 40 km/h
- b) 10 km Northwest
- c) downward force of 12 N
- d) distance of the moon from Earth
- e) 100 km/h on a bearing of 230°

② Express the following in terms of  $\vec{x}$ ,  $\vec{y}$



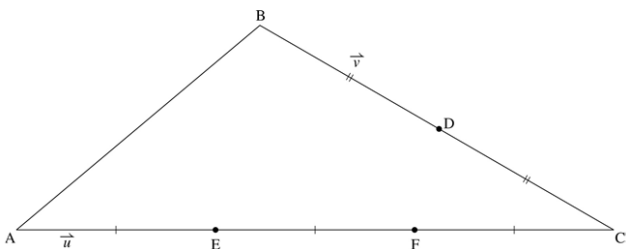
- a)  $\vec{AD}$
- b)  $\vec{AC}$
- c)  $\vec{CB}$

③ a) Sketch  $\vec{c} + 2\vec{b} - 3\vec{a}$   
 b) Find its magnitude, if each square on the grid is 1 unit  
 c) Find its direction in relation to vector  $\vec{c}$



④ Use the diagram below to express the following vectors as a linear combination of  $\vec{u}$  and  $\vec{v}$ , where  $\vec{AE} = \vec{u}$  and  $\vec{BD} = \vec{v}$ .

- a)  $\vec{AD}$
- b)  $\vec{BF}$
- c)  $\vec{EB}$
- d)  $\frac{1}{2}\vec{AB}$



5) The vector  $\vec{XY} = [-3, -1, 4]$  has its initial point at  $X(5, 7, 4)$ . Determine the coordinates of  $Y$ .

6) Given  $A(-2, 1, 3)$ ,  $B(3, -5, -1)$ , and  $C(0, 2, 0)$ .

- Determine the coordinates of midpoints  $D$  and  $E$  of lengths  $AB$  and  $AC$ , respectively.
- Express  $\vec{DE}$  and  $\vec{BC}$  as position vectors. State their relationship.
- Calculate the lengths of  $DE$  and  $BC$ . Explain how they are related.
- Determine the direction cosines and corresponding angles for  $\vec{BC}$ .

7) Use a diagram to explain how the vector combination  $\vec{CA} + \vec{BC} - \vec{DA}$  can be expressed as a single vector.

8) a) Convert to geometric form by quoting magnitude and direction angles for the vector  $\vec{u} = (1, 8, -3)$

b) Convert to 2-D algebraic component form  
 $\vec{u} = 12[\theta = 150^\circ]$

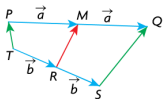
c) Convert to 3-D algebraic component form  
 $\vec{u} = \sqrt{5}[\alpha = 30^\circ, \gamma = 60^\circ]$

9) An airplane is travelling  $N30^\circ E$  at an airspeed of 340 km/h when it encounters a wind blowing north at 100 km/h. Determine the resultant vector of the airplane.

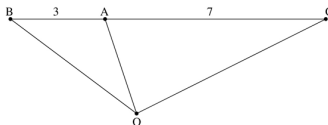
10) Given  $P(-1, 0, 5)$ ,  $Q(5, -4, 12)$ ,  $R(-19, 12, -16)$ , and  $S(2, -2, 5)$ , is it possible to express  $\vec{PQ}$  as a linear combination of  $\vec{PR}$  and  $\vec{PS}$ ? Use your result to find if the given points are coplanar/collinear/vertical.

- The set of vectors  $\{(1, 0, 0), (0, 1, 0)\}$  spans a set in  $R^3$ . Describe this set.
- Write the vector  $(-2, 4, 0)$  as a linear combination of these vectors.
- Explain why it is not possible to write  $(3, 5, 8)$  as a linear combination of these vectors.
- If the vector  $(1, 1, 0)$  were added to this set, what would these three vectors span in  $R^3$ ?

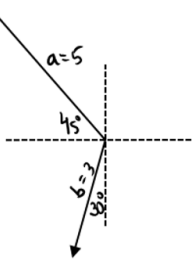
11)  $M$  is the midpoint of line segment  $PQ$ , and  $R$  is the midpoint of  $TS$ . If  $\vec{PM} = \vec{MQ} = \vec{a}$  and  $\vec{TR} = \vec{RS} = \vec{b}$ , as shown, prove that  $2\vec{RM} = \vec{TP} + \vec{SQ}$ .



12) Suppose  $A, B,$  and  $C$  are three collinear points such that  $A$  divides  $BC$  in the ratio  $7 : 3$ . Suppose  $O$  is a point not on the line formed by  $A, B,$  and  $C$ . Prove that  $\vec{OA} = \frac{7}{10}\vec{OB} + \frac{3}{10}\vec{OC}$ .



14) Find  $\vec{b} - \vec{a}$ . Use both methods



15) Find  $\vec{a} + \vec{b}$ . Show both methods.

