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***An introduction to vectors***

1. Given the magnitude of two vectors  $|\vec{a}| = 4$  and  $|\vec{b}| = 7$ , and the angle between them when placed tail to tail as being  $\theta = 60^\circ$ , find the magnitude of the vector sum  $\vec{s} = \vec{a} + \vec{b}$  and the direction (the angles between the vector sum and each vector). Draw a diagram.

2. Given the magnitude of two vectors  $|\vec{a}| = 10$  and  $|\vec{b}| = 14$ , and the angle between them when placed tail to tail as being  $\theta = 120^\circ$ , find the magnitude of the vector difference  $\vec{d} = \vec{a} - \vec{b}$  and the direction (the angles between the vector difference and each vector). Draw a diagram.

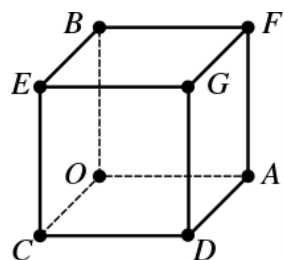
3. Given  $|\vec{a}| = 10$ ,  $|\vec{b}| = 15$ , and  $|\vec{a} + \vec{b}| = 20$ , find  $|\vec{a} - \vec{b}|$ .

4. If point  $P$  is the midpoint of the segment  $AB$ , then for any point  $O$ , we have

$$\overrightarrow{OP} = \frac{1}{2}(\overrightarrow{OA} + \overrightarrow{OB})$$

5. In  $\triangle ABC$ ,  $AM$ ,  $BN$ , and  $CP$  are medians. Prove that  $\overrightarrow{AM} + \overrightarrow{BN} + \overrightarrow{CP} = \vec{0}$ .

**6.** The drawing below shows a unit cube. Let  $\hat{i} = \overrightarrow{OA}$ ,  $\hat{j} = \overrightarrow{OB}$ ,  $\hat{k} = \overrightarrow{OC}$ . Write each of the following vectors in terms of  $\hat{i}$ ,  $\hat{j}$ , and  $\hat{k}$ .



a.  $\overrightarrow{OF}$

b.  $\overrightarrow{ED}$

c.  $\overrightarrow{AG}$

**7.** Find the magnitude of the sum  $\vec{a} + \vec{b}$  and the difference  $\vec{a} - \vec{b}$  between the vectors  $\vec{a} = \vec{i} - \vec{j}$  and  $\vec{b} = (1, 2, -1)$ .

**8.** Prove that the vectors  $\vec{a} = (2, 4, -6)$  r and  $\vec{b} = (-1, -2, 3)$  are parallel.

9. Prove that the points  $A(2, -1, 0)$ ,  $B(-1, 0, 2)$ , and  $C(0, 1, 2)$  are not collinear.

10. For points  $R(-1, 2, -4\sqrt{5})$  and  $Q(-1, -2, 0)$  given, find

a. The position vector and the magnitude of the position vector  $\overrightarrow{OR}$

b. The displacement vector  $\overrightarrow{RQ}$  and its magnitude.

11. Find a unit vector parallel to each of the given vectors.

a.  $\vec{v} = (2, -5)$

b.  $\overrightarrow{OZ} = \hat{i} - 2\hat{j} + 4\hat{k}$