**Chapter 11 Review : Vectors**

1. Vectors operations: sum/difference/ scalar multiplication/**dot product**/**cross product**. Sketch the resultant vector sum/difference in the plane.
2. Find the **normalized form** of a vector v (unit vector in the direction of v).
3. Find the equation of the sphere. Identify the center and radius of the sphere.
4. Describe the solid that satisfies the given condition.
5. Determine whether the points are vertices of a triangle (collinear) or a parallelogram. Find the area of the triangle/parallelogram.
6. Determine whether two lines or two planes are parallel or orthogonal.
7. Find the angles between two planes or between two lines.
8. Find the **vector component** of u along v (**projection**) and orthogonal to v.
9. Find the **distance** from a point to a line, from a point to a plane, or between two planes.
10. Find the **intersection** between two planes, between two lines, between a line and a plane.
11. Find equation of a plane through 3 points, or through 2 points and perpendicular to a given line.
12. Find equation of a line through 2 points, or through a point and parallel to a given line.

**Problems**

Given three points $A\left(1,2,3\right), B\left(-1,0,4\right), C(0,4,6)$

1. Find $\vec{AB}∙\vec{AC}$
2. Find $4 \vec{AB}-3\vec{AC}$
3. Find the normalized form of vector $\vec{AC}$
4. Find sets of parametric equations of the line $L\_{1}$ through A and B, and the line $L\_{2}$ through A and C.
5. Is $L\_{1}$ orthogonal to $L\_{2}$ ?
6. Are A, B and C collinear?
7. Find the angle between the lines $L\_{1}$ and $L\_{2}$.
8. Find the projection of vector $\vec{AB}$ onto $\vec{AC}$.
9. Find $\vec{AB}×\vec{AC}$
10. Find the area of the triangle ABC.
11. Find the distance from the point C to the line $L\_{1}$ .
12. Find the equation (general form) of the plane $P\_{1}$ through A, B, and C.
13. Find the symmetric equation of the line $L\_{3}$ through B and is perpendicular to the plane $P\_{1}$.
14. Find *k* such that $E(-9,5,k)$ is on the line $L\_{3}$.
15. Find the distance from E to $P\_{1}$.
16. Find the distance from E to B.
17. Find the standard equation of the sphere with BE as a diameter.
18. Find the intersection between the plane $P\_{1}$ and the line $L\_{4} :\frac{x-2}{2}=y-1=\frac{z+4}{3} $.
19. Show that $L\_{3}$ is orthogonal to $L\_{1}$ and$ L\_{2} $; and $P\_{1}$ // $ P\_{2 }:8x-5y+6z=4$.
20. Find the distance from the line $L\_{1}$ to the plane $P\_{2}$.
21. Find the point D such that ABCD is a parallelogram, and find its area. (Hint: $\vec{AD}=\vec{AB}+\vec{AC}$)

**Answer key**

1. Dot product is 1.
2. $<-5,-14,-5>$
3. Normalized form of the vector (unit vector) is $<\frac{-1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}>$
4. $L\_{1}: \left\{\begin{array}{c}x=1-2t\\y=2-2t\\z=3+t\end{array}\right.$ $L\_{2}: \left\{\begin{array}{c}x=1-t\\y=2+2t\\z=3+3t\end{array}\right. $
5. No because the dot product of their direction vectors is not 0.
6. No.
7. $θ=arccos⁡(\frac{1}{3\sqrt{14}})≈85^{0}$
8. $<\frac{-1}{14},\frac{2}{14},\frac{3}{14}>$
9. $<-8, 5,-6>$
10. Area of triangle ABC $=\frac{1}{2}\sqrt{125}≈5.6$
11. Approximately 3.
12. $P\_{1}: -8x+5y-6z+16=0$
13. Symmetric equation of $L\_{3} : \frac{x+1}{-8}=\frac{y}{5}=\frac{z-4}{-6}$
14. *k* = -2
15. $\sqrt{125}$
16. $\sqrt{125}$
17. $\left(x+5\right)^{2}+\left(y-\frac{5}{2}\right)^{2}+\left(z-1\right)^{2}=\frac{125}{4}$
18. $( 4, 2,-1)$
19. Show that the dot product of their direction vectors is 0.
20. $\frac{12}{\sqrt{125}}≈1$
21. $D(-2 , 2 , 7)$ . Area of ABCD is $\sqrt{125}$.