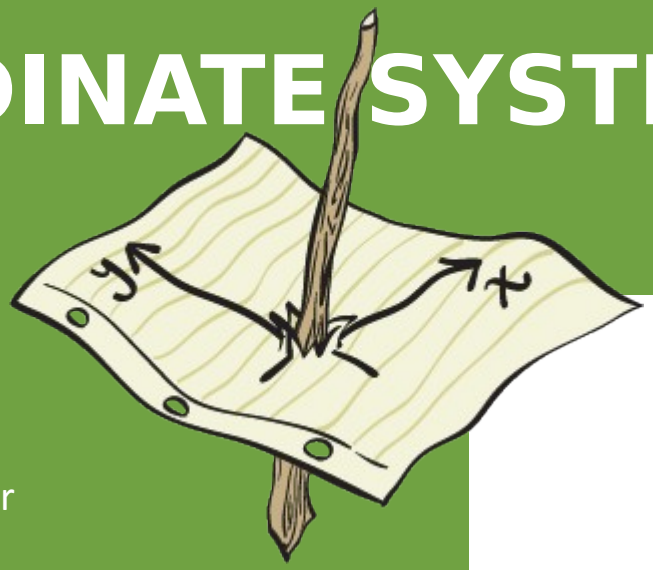
ANALYTICAL GEOMETRY IN THREE DIMENSIONS

3-D COORDINATE SYSTEM

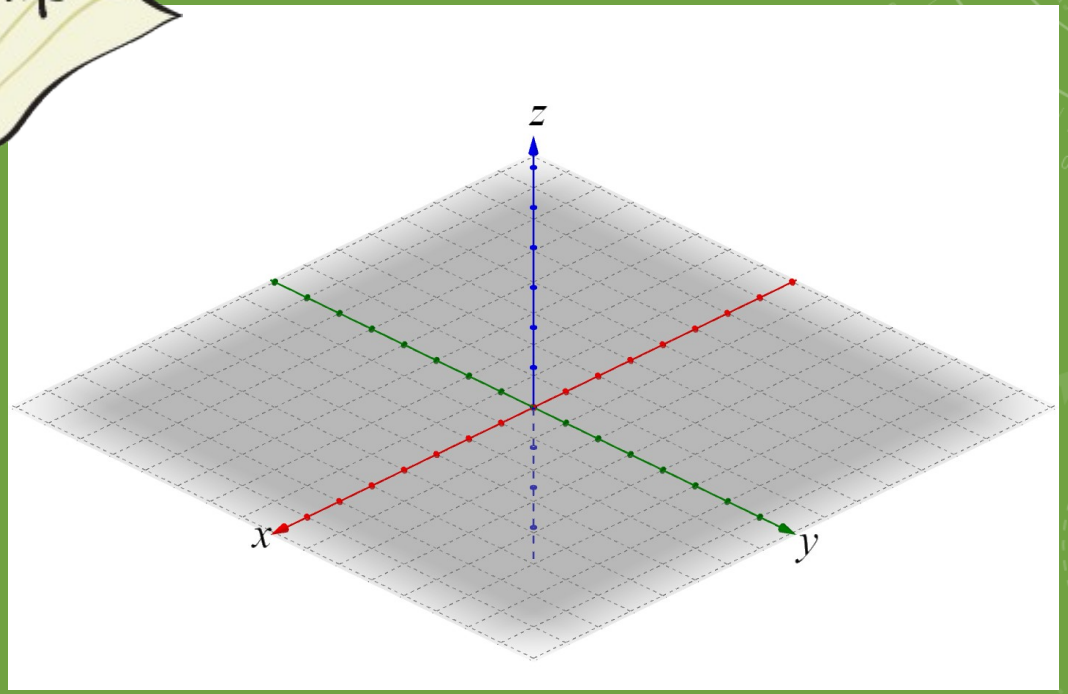
IN THIS SECTION, YOU WILL:

- PLOT A POINT IN 3-DIMENSIONS.
- CALCULATE 3-DIMENSIONAL DISTANCE AND MIDPOINT.
- FIND AND GRAPH THE EQUATION OF A SPHERE.
- FIND A TRACE OF A SPHERE.

3-D COORDINATE SYSTEM



- Points in 3 dimensions
  - (x, y, z)
  - *x* comes out/into of paper
  - *y* is left/right
  - *z* is up/down
- Graph by moving out the *x*, over the *y*, then up the *z*.
  - Graph A(5, 6, 3)
  - Graph B(-2, -4, 0)



3-D COORDINATE SYSTEM

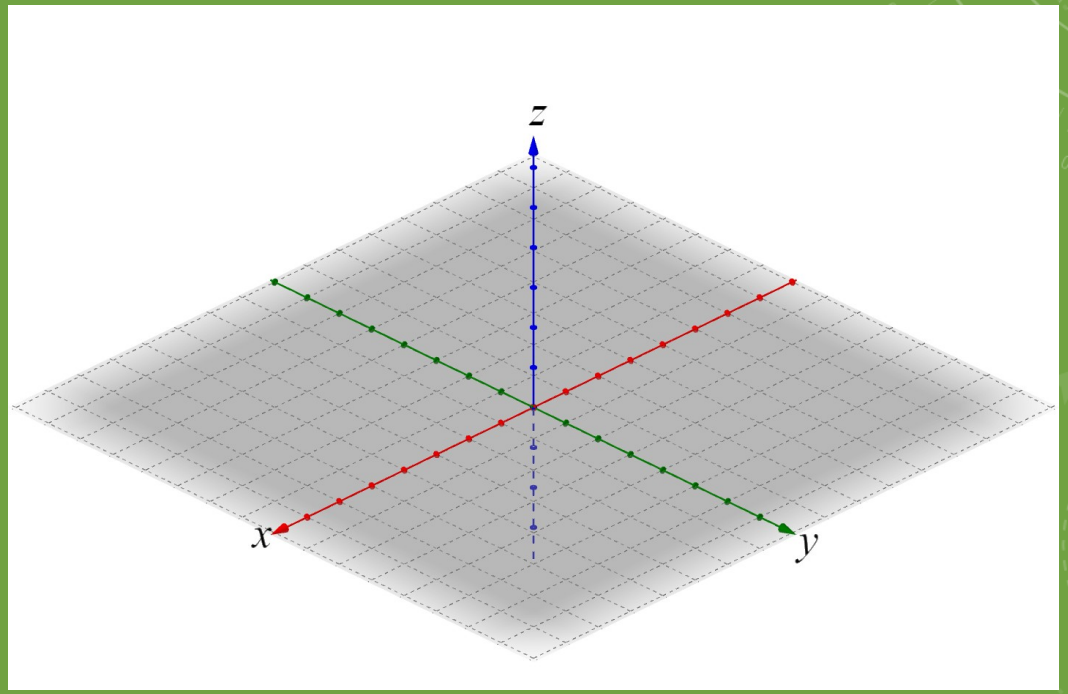
- Distance Formula
  - In 2-D:
  - In 3-D: (just add the *z*)

3-D COORDINATE SYSTEM

- Midpoint Formula
  - In 2-D:
  - In 3-D: (just add the *z*)

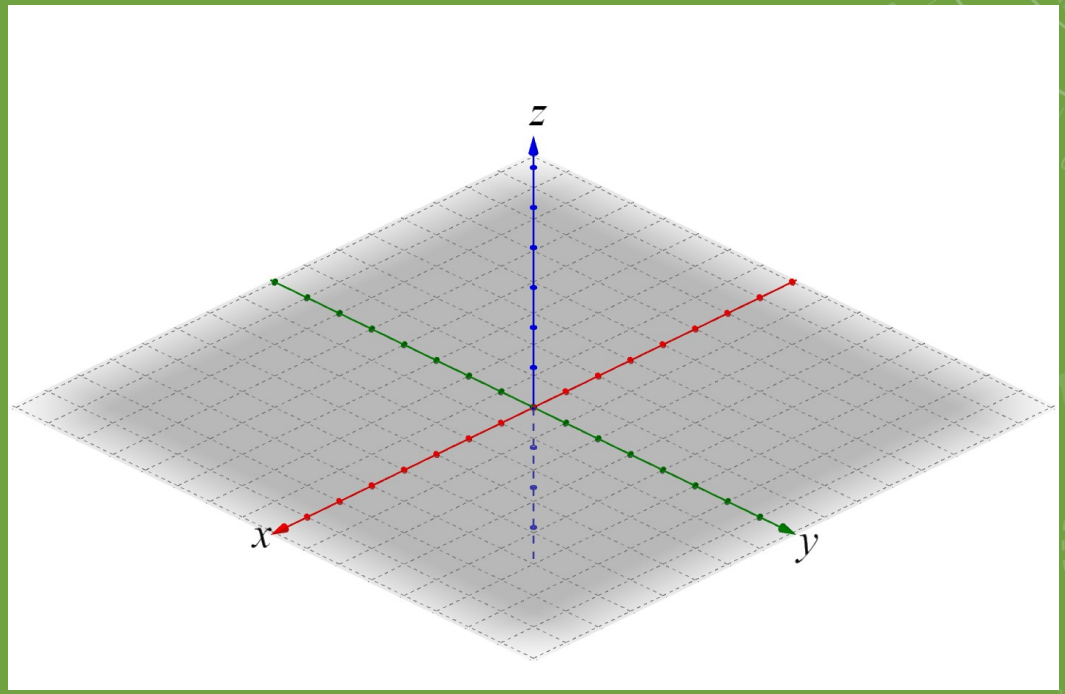
3-D COORDINATE SYSTEM

- Equation of Circle (2-D)
- Equation of Sphere (3-D) (just add *z*)
  - Center is (h, k, j), r = radius
  - Graph by plotting the center and moving each direction the radius
  - Graph



3-D COORDINATE SYSTEM

- Trace (like intercepts for a sphere)
  - Draw the *xy* trace for



VECTORS IN SPACE

IN THIS SECTION, YOU WILL:

- USE VECTOR OPERATIONS IN THREE DIMENSIONS.
- FIND THE ANGLE BETWEEN VECTORS.

VECTORS IN SPACE

- Vectors in 2-D
- Vectors in 3-D (just add *z*)
- To find a vector from the initial point to the terminal point

- If and ,
- Addition
  - Add corresponding elements
- Scalar multiplication
  - Distribute

VECTORS IN SPACE

- If and ,
- Dot Product
- Magnitude
- Unit vector in the direction of

VECTORS IN SPACE

- Angle between vectors

  - If (and)
    - Then vectors are orthogonal
  - If
    - Then vectors are parallel

VECTORS IN SPACE

- Let and
- Find

- Find unit vector in direction of

- Find

VECTORS IN SPACE

- Let and
- Find

- Find the angle between and

VECTORS IN SPACE

- Are and parallel, orthogonal, or neither?

- Parallel if

VECTORS IN SPACE

- Are , , and collinear?

CROSS PRODUCTS

IN THIS SECTION, YOU WILL:

- EVALUATE A CROSS PRODUCT.
- USE A CROSS PRODUCT TO SOLVE AREA AND VOLUME PROBLEMS.

CROSS PRODUCTS

- is unit vector in *x*, is unit vector in *y*, and is unit vector in *z*
- and

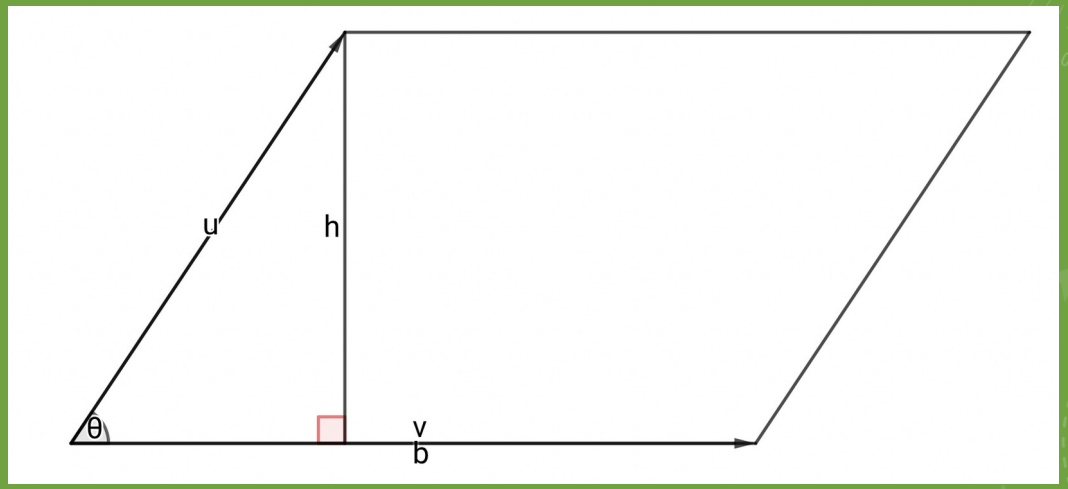
- If and , find

CROSS PRODUCTS

- Properties of Cross Products
- is orthogonal to and
- If , then and are parallel

CROSS PRODUCTS

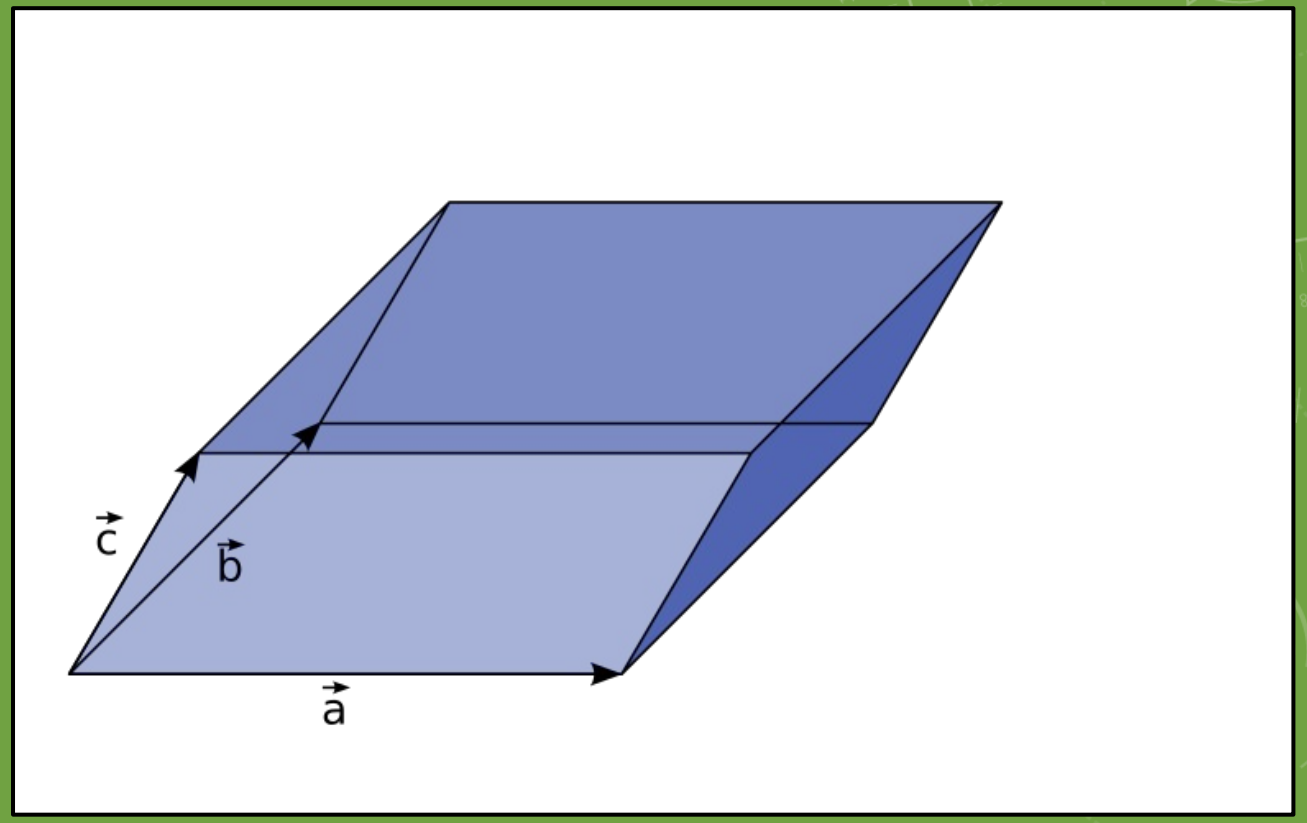
- Area of a Parallelogram
  - where and represent adjacent sides



CROSS PRODUCTS

- Triple Scalar Product (shortcut)

- Volume of Parallelepiped
  - (3-D parallelogram)
  - where , , and represent adjacent edges



LINES AND PLANES IN SPACE

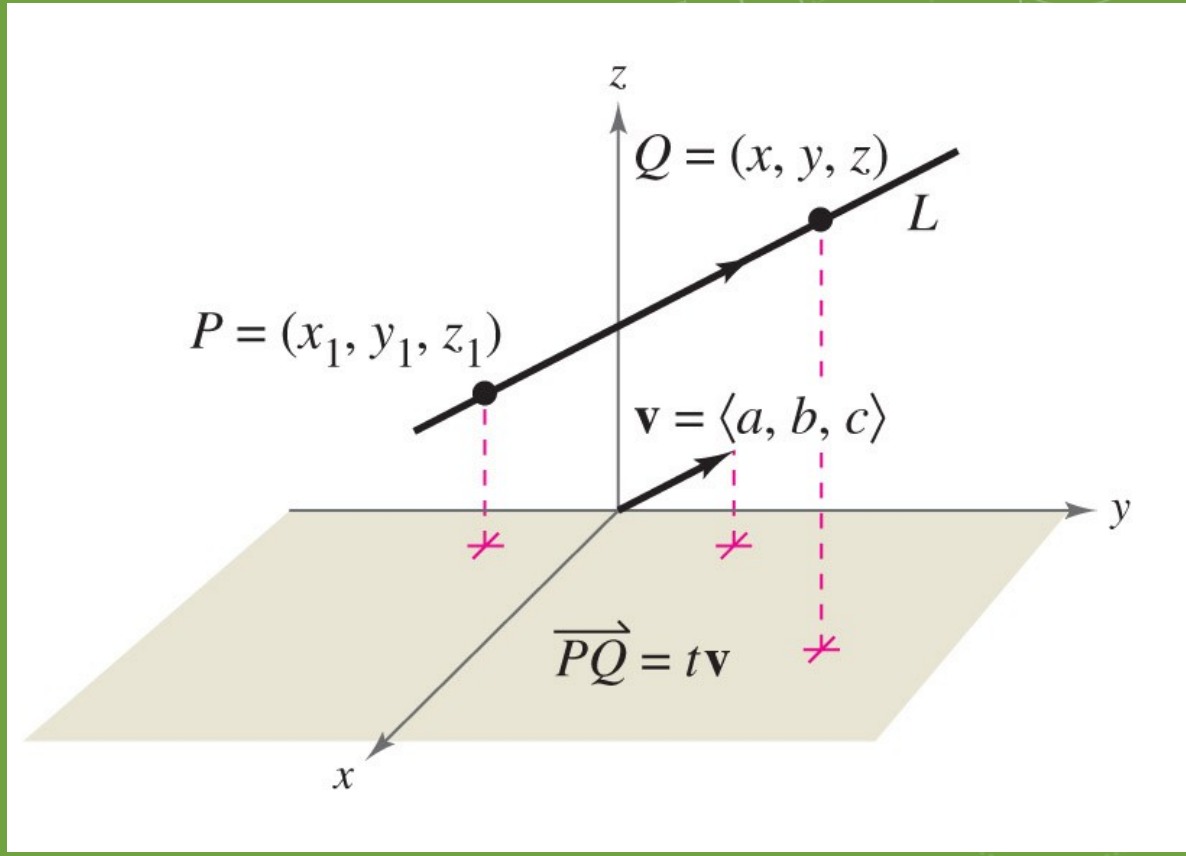
IN THIS SECTION, YOU WILL:

- WRITE AN EQUATION FOR A LINE IN THREE DIMENSIONS.
- WRITE AN EQUATION FOR A PLANE.
- FIND THE ANGLE BETWEEN TWO PLANES.
- GRAPH A PLANE.

LINES AND PLANES IN SPACE

- Lines
  - Line *L* goes through points *P* and *Q*
  - is a direction vector for *L*
  - Start at *P* and move any distance in direction to get some point *Q*
  - because they are parallel

    - General form



LINES AND PLANES IN SPACE

- Parametric Equations of Line
  - Take each component of the general form and solve for *x*, *y*, or *z*.
  - We used these when we solved 3-D systems of equations and got many solutions
- Symmetric Equation of Line
  - Solve each equation in parametric equations for *t*

LINES AND PLANES IN SPACE

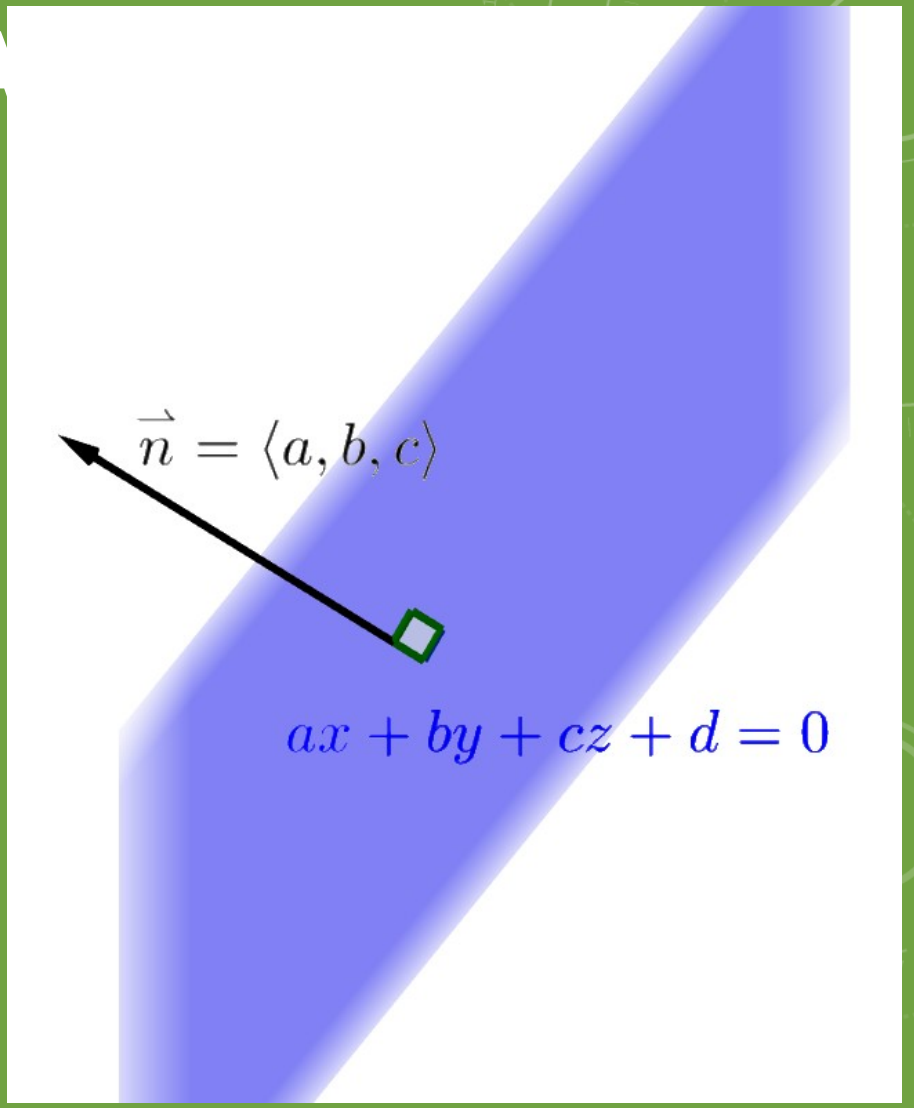
- Find a set of parametric equations of the line that passes through (1, 3, -2) and (4, 0, 1).

LINES AND PLANES IN SPA

- Planes
- because they are perpendicular

- Standard form

- General form

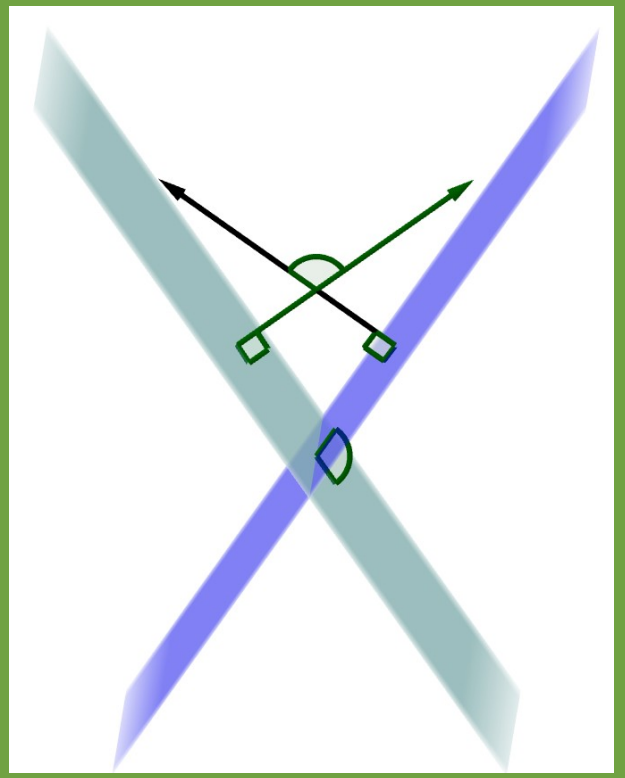


LINES AND PLANES IN SPACE

- Find the general equation of plane passing through , , and

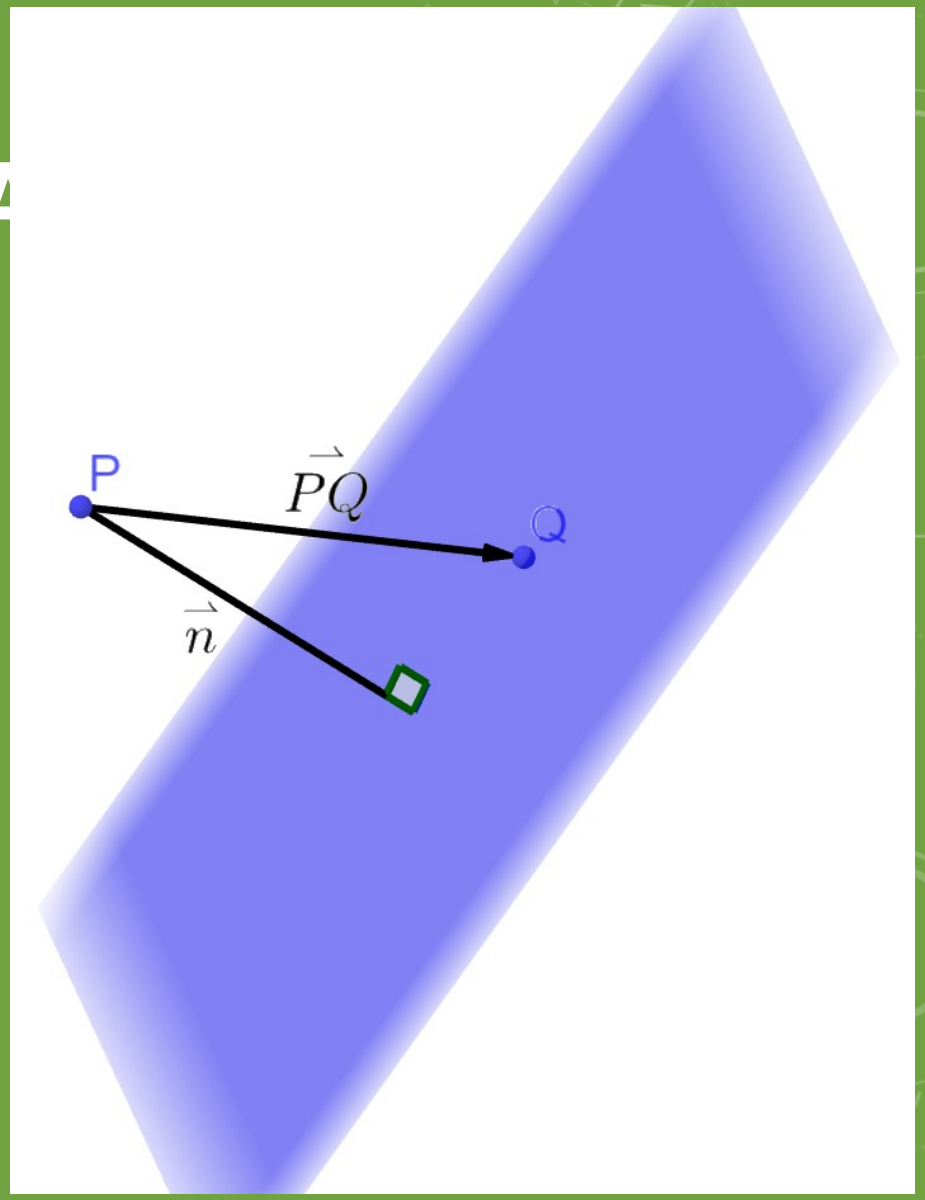
LINES AND PLANES IN SPACE

- Angle between two planes
  - Find the angle between normal vectors
  - Normal vectors are coefficients in the equations of the plane



LINES AND PLANES IN SPA

- Distance between a Point and a Plane



LINES AND PLANES IN SPACE

- Graphing planes in space
  - Find the intercepts
  - Plot the intercepts
  - Draw a triangle to represent the plane
- Sketch