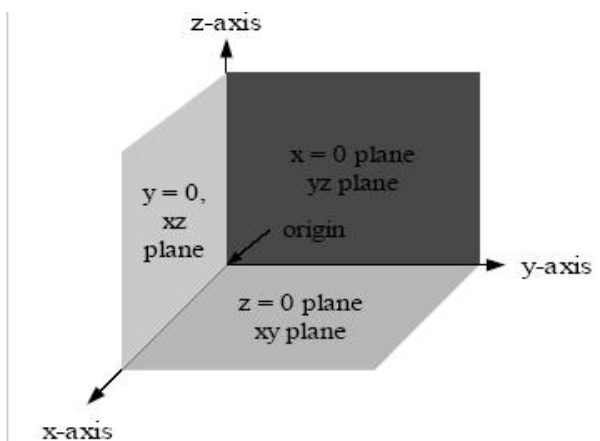# ALGEBRA OF 3-SPACE

- Coordinate geometry that represents space in **three** dimensions
- Coordinates are in the form of an ordered triplet **(x, y, z)**
- Three planes exist: **xy** plane, **xz** plane, **yz** plane

x axis -axis coming "out of the page"

y axis - horzontal axis

z axis - vertical axis

ALGEBRA OF 3-SPACE

Three equations with three unknowns!!

Solving 3 x 3 Systems

REMEMBER:
- you can multiply or divide equations by a constant
- can add & subtract 2 equations to get a new equation
- you can rearrange the order of equations

STEPS:
1) Eliminate one of the variables
2) Solve the 2 x 2 system
3) Use "backward substitution" to obtain a solution

$$2x + y - 3z = -9$$
$$x - y + z = 6$$
$$3x + y - 2z = -5$$

$$\begin{array}{c} 2x+y-3z=-9 \\ \oplus \quad x-y+z=6 \\ \hline 3x - 2z = -3 \end{array}$$

$$\begin{array}{c} x-y+z=6 \\ \oplus \quad 3x+y-2z=-5 \\ \hline 4x - z = 1 \end{array}$$

"2x2 System"

$$3x - 2z = -3$$
$$\text{(·)} \quad \frac{8x - 2z = 2}{-5x = -5}$$
$$\boxed{x = 1}$$

$$3x - 2z = -3$$
$$3(1) - 2z = -3$$
$$3 - 2z = -3$$
$$-2z = -6$$
$$\boxed{z = 3}$$

$$x - y + z = 6$$
$$1 - y + 3 = 6$$
$$-y + 4 = 6$$
$$-y = 2$$
$$\boxed{y = -2}$$

$$\boxed{(1, -2, 3)}$$

$$4x + 3y - z = -7$$
$$3x - 2y + 3z = -10$$
$$x + y - z = -2$$

$$12x + 9y - 3z = -21$$
$$(+) \ 3x - 2y + 3z = -10$$
$$\overline{15x + 7y = -31}$$

$$3x - 2y + 3z = -10$$
$$(+) \ 3x + 3y - 3z = -6$$
$$\overline{6x + y = -16}$$

$$15x + 7y = -31$$
$$(-) \ 42x + 7y = -112$$
$$\overline{-27x = 81}$$
$$\boxed{x = -3}$$

$$6x + y = -16$$
$$6(-3) + y = -16$$
$$-18 + y = -16$$
$$\boxed{y = 2}$$

$$x + y - z = -2$$
$$-3 + 2 - z = -2$$
$$-1 - z = -2$$
$$-z = -1$$
$$\boxed{z = 1}$$

$$\boxed{(-3, 2, 1)}$$

Homework

② a, e, g

③ a, b, c

③ b) $4x - y + 3z = -11$ $12x - 3y + 9z = -33$ $12x - 6y - 4z = -6$

$6x - 3y - 2z = -3$ (-) $6x - 3y - 2z = -3$ (-) $24x - 6y + 15z = 57$

$8x - 2y + 5z = 19$ $\boxed{6x + 11z = -30 \qquad -12x - 19z = 51}$

$12x + 22z = -60$ $\longrightarrow$ $6x + 11z = -30$ $4x - y + 3z = -11$

(-) $-12x - 19z = 51$ $6x + 11(-3) = -30$ $4(\frac{1}{2}) - y + 3(-3) = 11$

$\overline{ 3z = -9}$ $6x - 33 = -30$ $2 - y - 9 = 11$

$\boxed{z = -3}$ $6x = 3$ $-y = -4$

$\boxed{x = \frac{1}{2}}$ $\boxed{y = 4}$