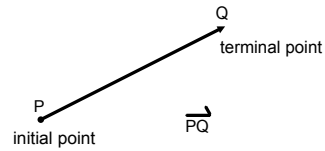## 6-3 Vectors in the Plane
Day 1

I. Directed Line Segments: read page 408

Directed Line Segments have

1. magnitude = length =

2. direction

Bold lowercase letters (**u**, **v**, and **w**) represent vectors

Q
terminal point

P
initial point $\overrightarrow{PQ}$

II. Equivalent Directed Line Segments

Ex 1) let u represent $\overrightarrow{PQ}$ if P = (0, 0) and Q = (3, 2)

let v represent $\overrightarrow{RS}$ if R = (1, 2) and S = (4, 4)

Show that u = v.

$$\|\overrightarrow{PQ}\| = \sqrt{(3-0)^2 + (2-0)^2} = \sqrt{9+4} = \sqrt{13}$$

$$\|\overrightarrow{RS}\| = \sqrt{(4-1)^2 + (4-2)^2} = \sqrt{9+4} = \sqrt{13}$$

Same magnitude

$$m_{\overrightarrow{PQ}} = \frac{\Delta Y}{\Delta X} = \frac{2-0}{3-0} = \frac{2}{3}$$

$$m_{\overrightarrow{RS}} = \frac{\Delta Y}{\Delta X} = \frac{4-2}{4-1} = \frac{2}{3}$$

Same slopes, so u = v

III. Component Form: initial point P = (p_1, p_2), terminal point Q = (q_1, q_2)

$$PQ = < q_1 - p_1, q_2 - p_2 > \qquad \text{(must start with q)}$$

Ex 2) Find the component form and magnitude of the vector.

A)
terminal
Q(-1, 5)

terminal → initial

initial
P (4, -7)

$$\overrightarrow{PQ} = <-1-4, 5--7>$$
$$\overrightarrow{PQ} = <-5, 12>$$
$$\|\overrightarrow{PQ}\| = \sqrt{(-5)^2 + (12)^2}$$
$$= \sqrt{25+144}$$
$$= \sqrt{169} = \boxed{13}$$

B)

P (0,0)

Q (4, -2)

$$\overrightarrow{PQ} = <4-0, -2-0>$$
$$= <4, -2>$$
$$\|\overrightarrow{PQ}\| = \sqrt{(4)^2 + (-2)^2}$$
$$= \sqrt{16+4}$$
$$= \sqrt{20}$$
$$= \sqrt{4} \cdot \sqrt{5}$$
$$= 2\sqrt{5}$$

III. **Addition/Scalar Multiplication**: Page 410 and Properties on page 412

Ex 3) u = < 2, 8 > and v = < -3, 4>

Find:
a) u + v $= \langle 2+-3, 8+4 \rangle = \langle -1, 12 \rangle$

b) u - v $= \langle 2--3, 8-4 \rangle = \langle 5, 4 \rangle$

c) 3u + 5v

$3u = \langle 3\cdot 2, 3\cdot 8 \rangle = \langle 6, 24 \rangle$

$5v = \langle 5\cdot -3, 5\cdot 4 \rangle = \langle -15, 20 \rangle$

$\langle 6, 24 \rangle + \langle -15, 20 \rangle = \boxed{\langle -9, 44 \rangle}$

IV. **Unit Vectors**: have a magnitude or length of 1. They are useful in many applications of vectors.

u = unit vector = $\dfrac{\vec{v}}{\|\vec{v}\|}$

Ex 4) Find a unit vector in the direction of the given vector. v = < -2, 5 >

$\dfrac{\vec{v}}{\|\vec{v}\|} = \dfrac{\langle -2, 5 \rangle}{\sqrt{(-2)^2 + (5)^2}} = \dfrac{\langle -2, 5 \rangle}{\sqrt{29}} = \boxed{\langle \frac{-2}{\sqrt{29}}, \frac{5}{\sqrt{29}} \rangle}$

$4 + 25$