Physics 231: General Physics I

Eric Hill

Motion is neither created nor destroyed, but transferred via interactions.

Today

- 1st-Day-of-Class logistics
- 1st-chapter-of-the –book big picture / stage setting
- vector refresher

Wed.	1.1-.5 Matter, Interactions, & Vectors	RE0 (getting familiar with WebAssign)

Intro to Course

- **This Semester: Modern Mechanics**
  - Mechanics = Kinematics (motion) & Dynamics (interaction)
    - **Fundamental Principle of Mechanics**
    - **"Modern"**
    - **Simulations**
  - **Level**
    - **Math**
      - **Algebra & basic Trig**
      - **Calculus**
        - **Slow start**
    - **Physics**
      - **No Previous required**
      - **Deeper than High School**
- **Alternative**
  - **Phys 220-221**
    - **The Difference**
    - **Time to decide.**
- **Special Needs**
- **Roll Call**

Syllabus

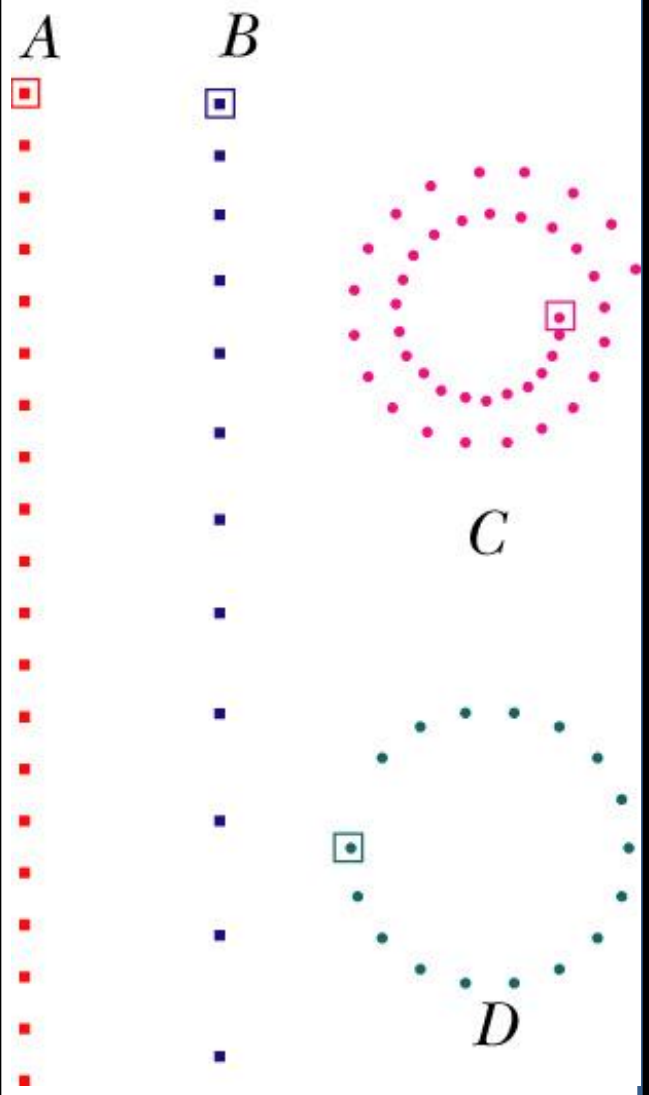
- Office Hours
- Course Components
  - Reading
    - Text
      - If you don't have it
  - Assignments
    - Reading Exercises
      - WebAssign
        - www.webassign.net. User name: first_last, Password: Appleton
        - Free Trial
        - Demonstration
        - First Assignment
    - (Weekly) Homework
    - Exploring Physics
      - First One
    - Lab – bring laptop if you have one
    - Quizes
    - Exams
  - Schedule

Misc.

- **Web-site – it's all there**
- **Supplies**
  - **Pencil**
  - **Paper / notebook**
  - **Calculator**
- **Working Together**
- **Cheating**

Today's Reading

1.1	Kinds of Matter
1.2	Detecting Interactions
1.3	Newton's First Law of Motion
1.4	Indicators of Interactions
1.5	Describing the 3D World: Vectors



Q1.2.a: Moving objects left the traces shown at left. The dots were laid down at equal time intervals. Which objects did NOT interact with another object somewhere?

A

B

C

D

A and D

A and B

A, B, and D

Q1.2.b

Which of the following can NOT be true for an object moving in a straight line at a constant speed?

1. Nothing is interacting with the object (it is in interstellar space, far from all other objects).

2. The object is experiencing a net interaction.

3. The object is experiencing multiple interactions, and these interactions add up to zero.

4. The object has no net interaction with the rest of the world.

Newton's First Law –

"An object moves in a straight line and at a constant speed except to the extent that it interacts with other objects."

Indicators of interaction

- Change of *motion* (velocity)

Other indicators of Interactions:

- Change in *identity*
- Change in *configuration*
- Change in *temperature*
- Change in *position*?

Indirect Evidence of an interactions

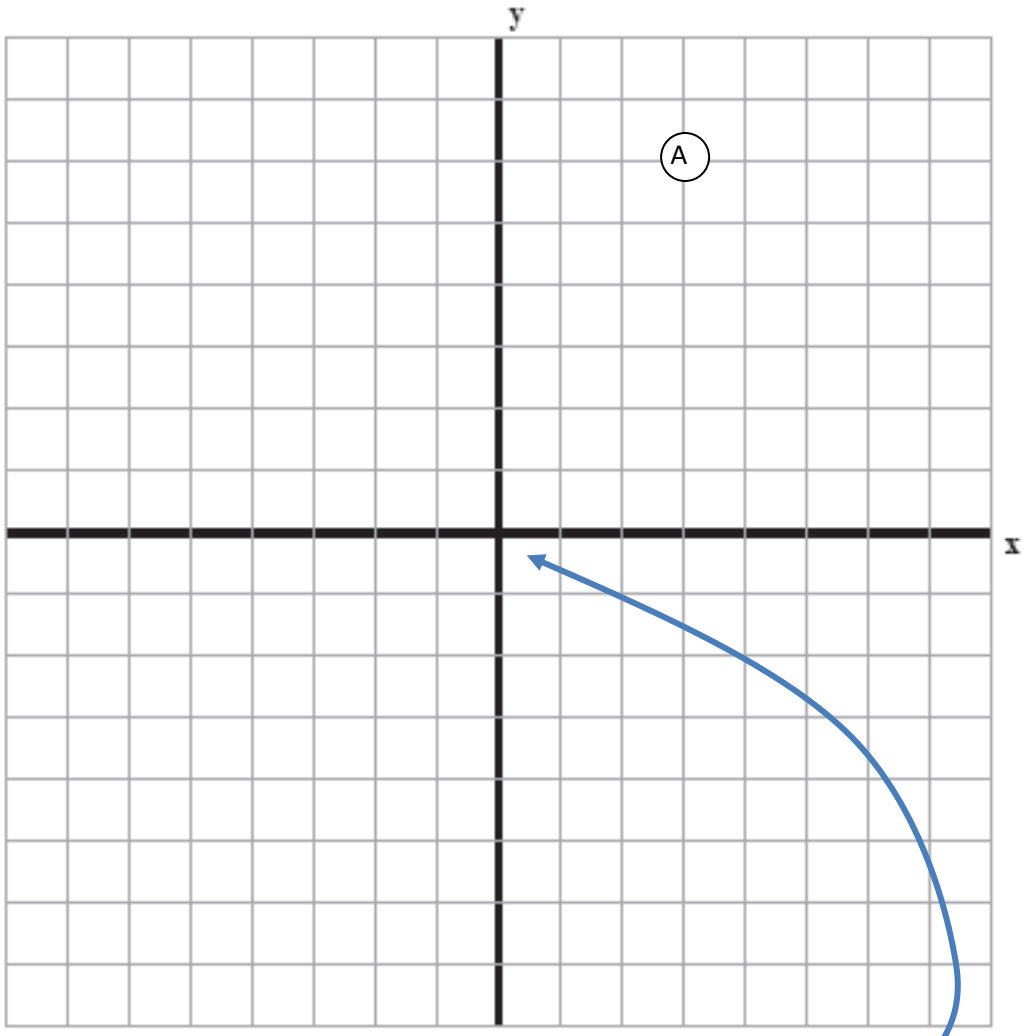
- *Lack* of change in spite of known interaction

Change of 'state' indicates interaction

Practice with Vectors

Practice with Vectors

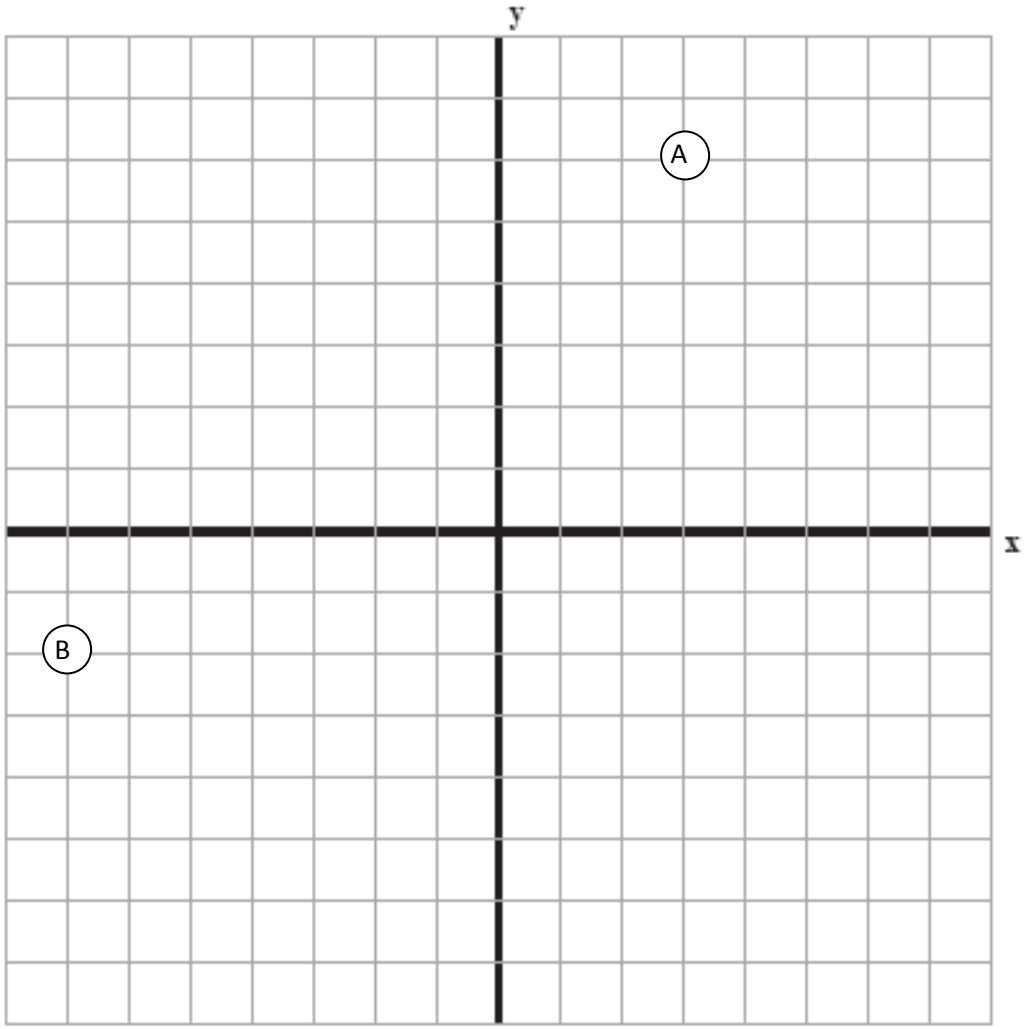
Component Representation: $\vec{r} = \langle r_x, r_y, r_z \rangle$



A's Position: <3,6,0>units (relative to the origin)

Practice with Vectors

Component Representation: $\vec{r} = \langle r_x, r_y, r_z \rangle$

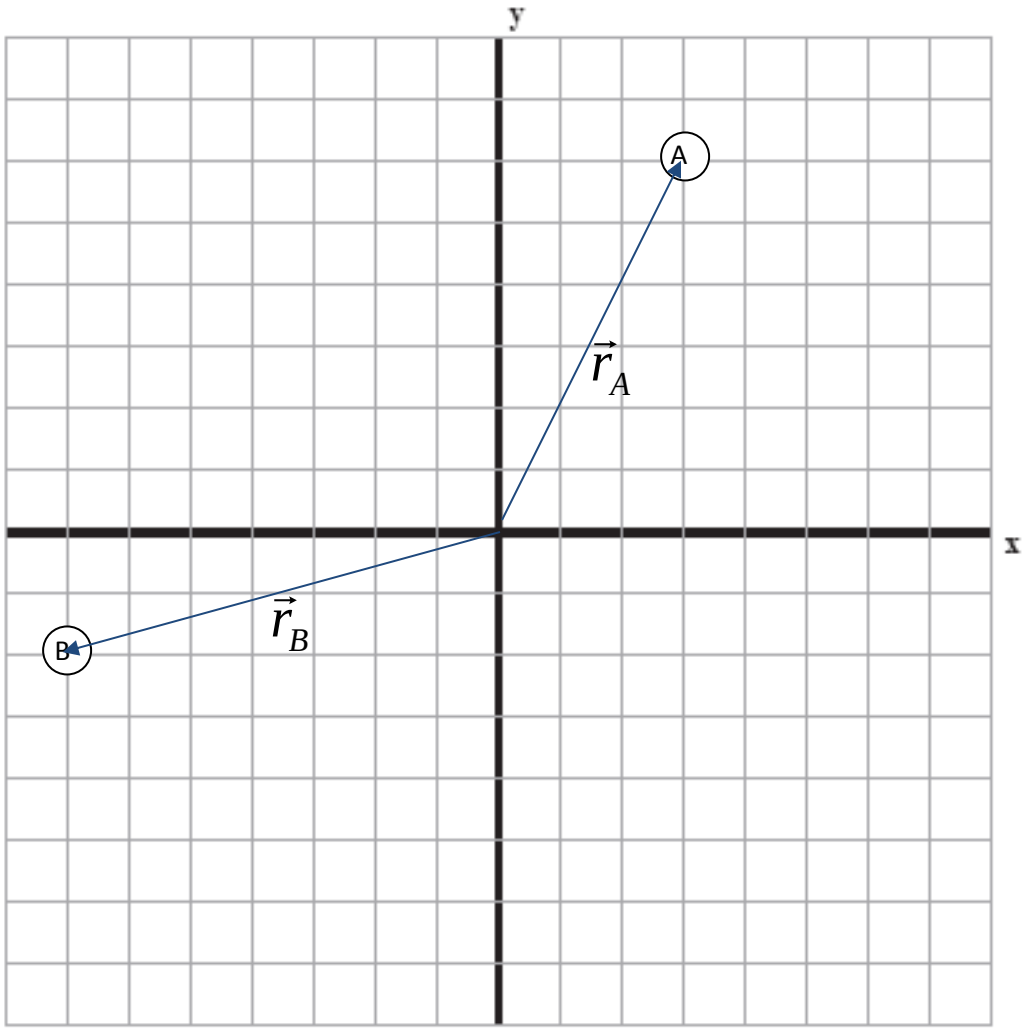


A's Position: <3,6,0>units

B's Position: <____,_____,0>units

Practice with Vectors

Graphical / Arrow Representation:

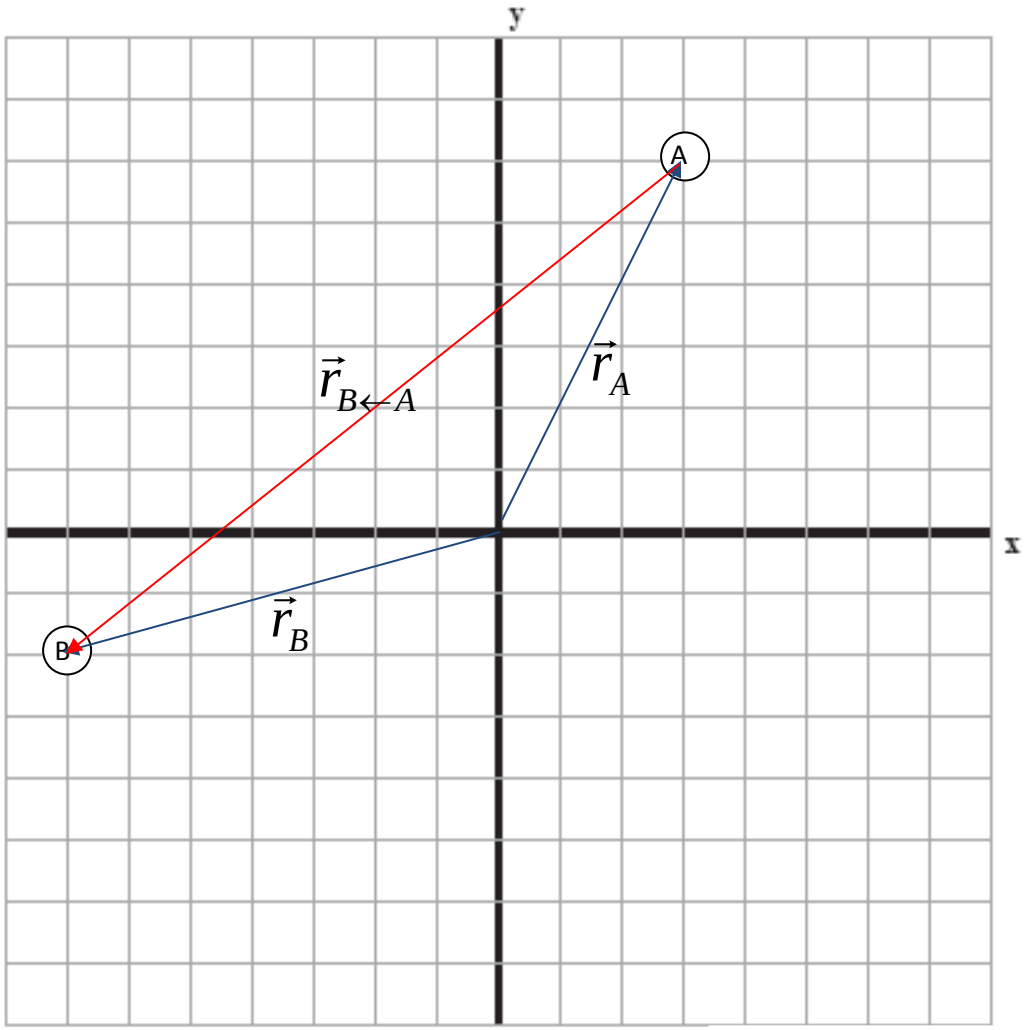


A's Position: <3,6,0>units

B's Position: <-7,-2,0>units

Practice with Vectors

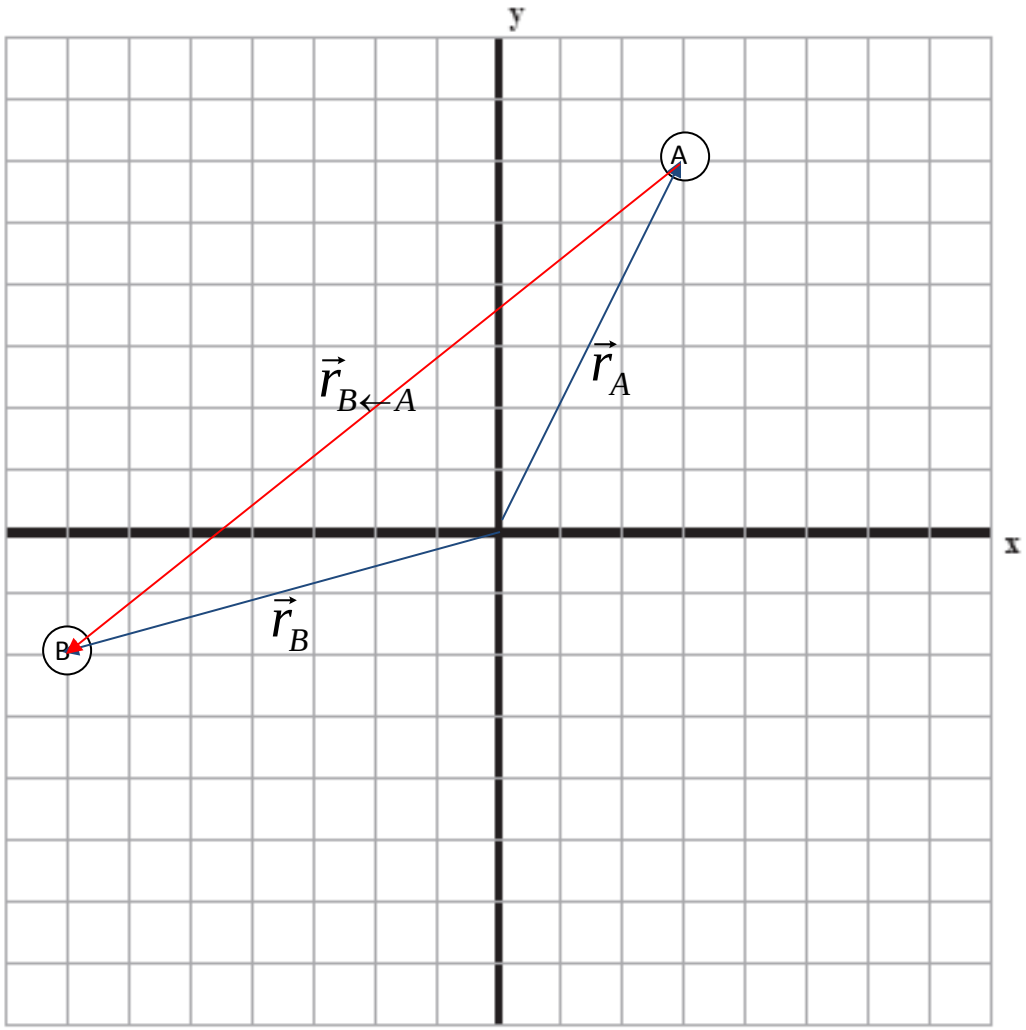
Subtraction: $\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A$



$$\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A = \langle (r_{B.x} - r_{A.x}), (r_{B.y} - r_{A.y}), (r_{B.z} - r_{A.z}) \rangle$$

Practice with Vectors

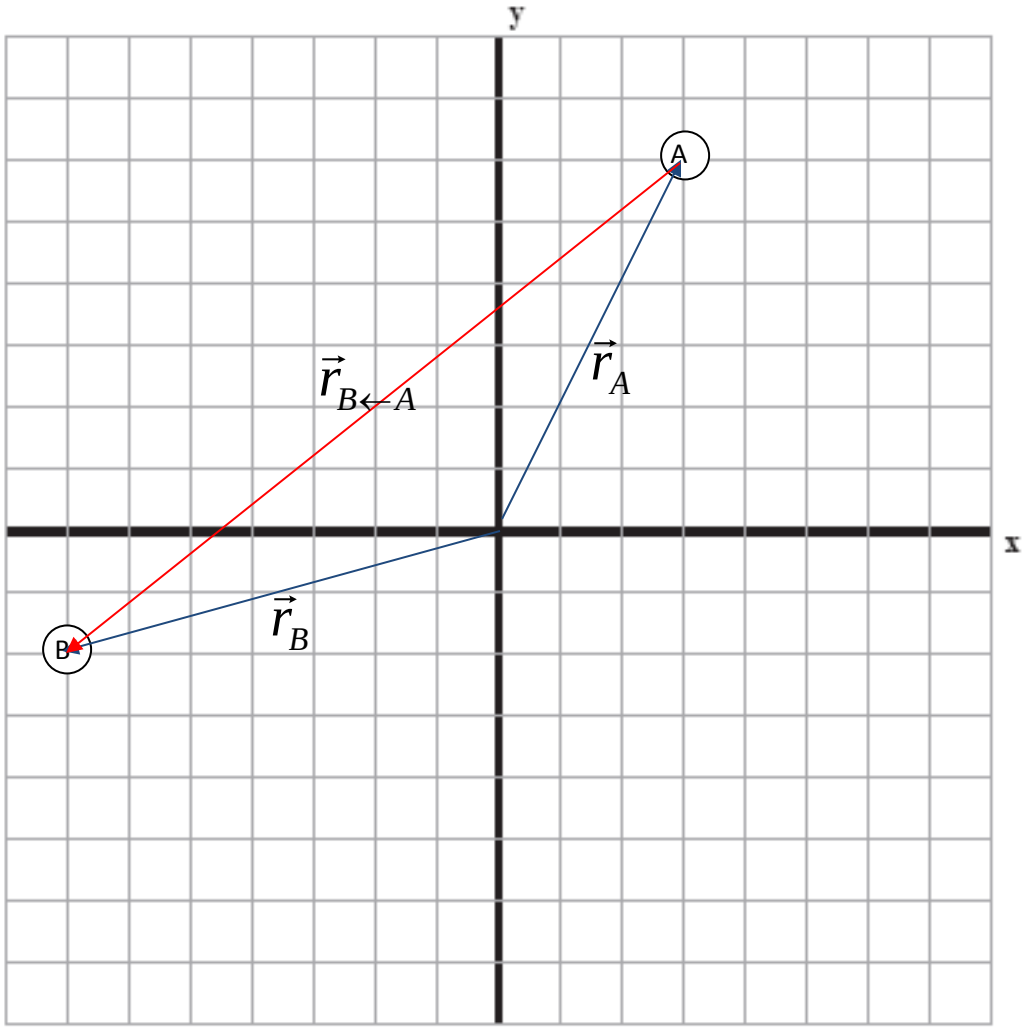
Subtraction: $\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A$



$$\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A = \langle (r_{B.x} - r_{A.x}), (r_{B.y} - r_{A.y}), (r_{B.z} - r_{A.z}) \rangle = \langle (((-7)-3), ((-2)-6), (0-0) \rangle units$$

Practice with Vectors

Subtraction: $\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A$



$$\vec{r}_{B\leftarrow A} = \vec{r}_B - \vec{r}_A = \langle (r_{B.x} - r_{A.x}), (r_{B.y} - r_{A.y}), (r_{B.z} - r_{A.z}) \rangle = \langle (((-7)-3), ((-2)-6), (0-0) \rangle units$$

$$= \langle -10, -8, 0 \rangle units$$

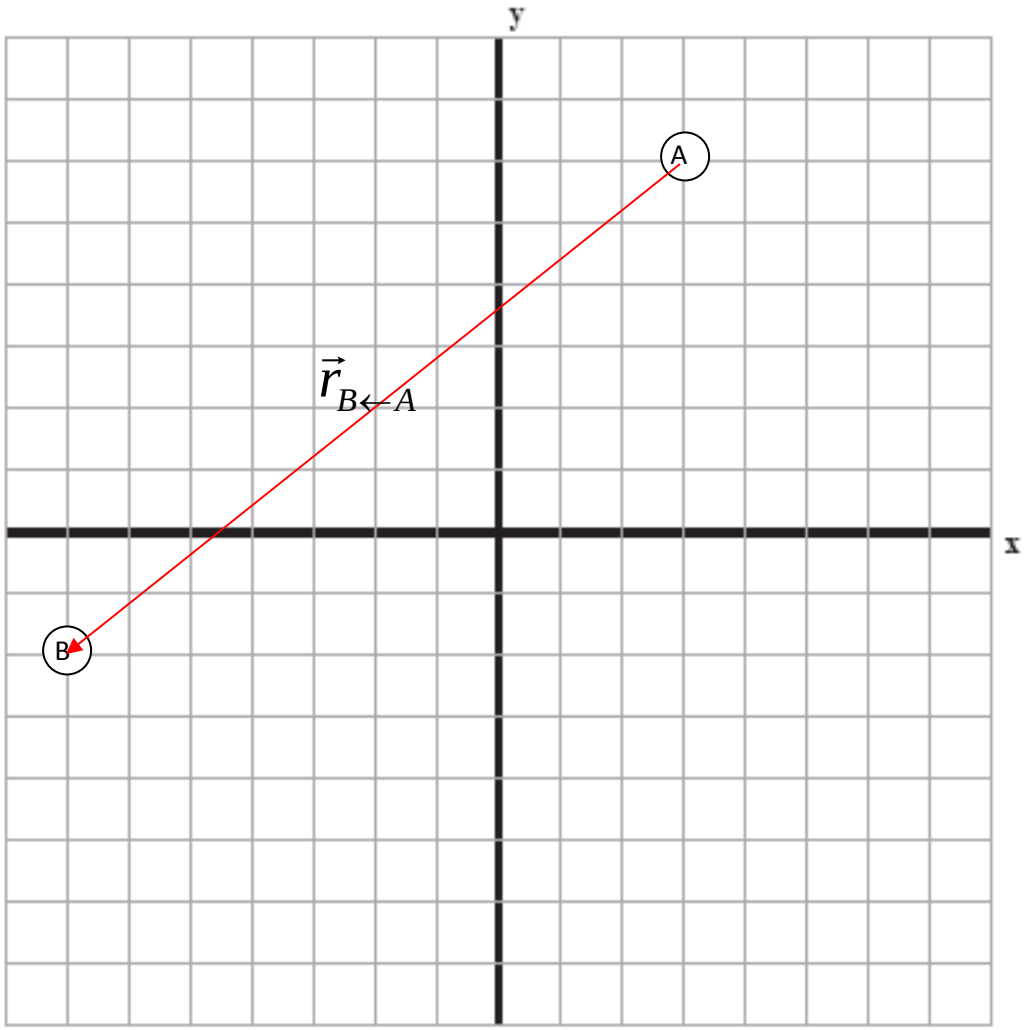
Q1.5.b

What is $\langle 10, 20, -15 \rangle - \langle 5, -8, 7 \rangle$?

a) 19
b) 38.7
c) $\langle 15, 12, 8 \rangle$
d) $\langle 5, 28, -22 \rangle$
e) $\langle 5, 12, -8 \rangle$

Practice with Vectors

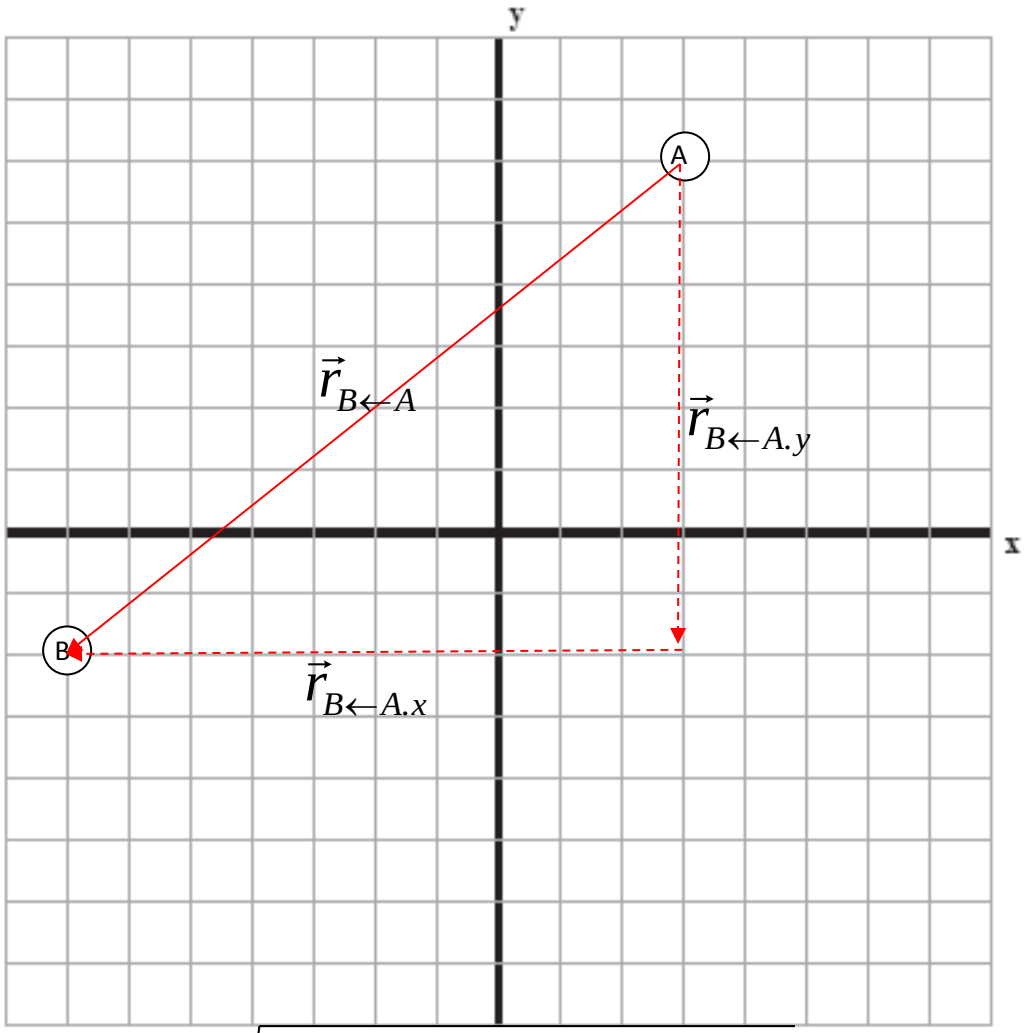
Magnitude: $\left|\vec{r}_{B\leftarrow A}\right|$



Practice with Vectors

Magnitude: $\left|\vec{r}_{B\leftarrow A}\right|$

Pythagorean's Theorem:

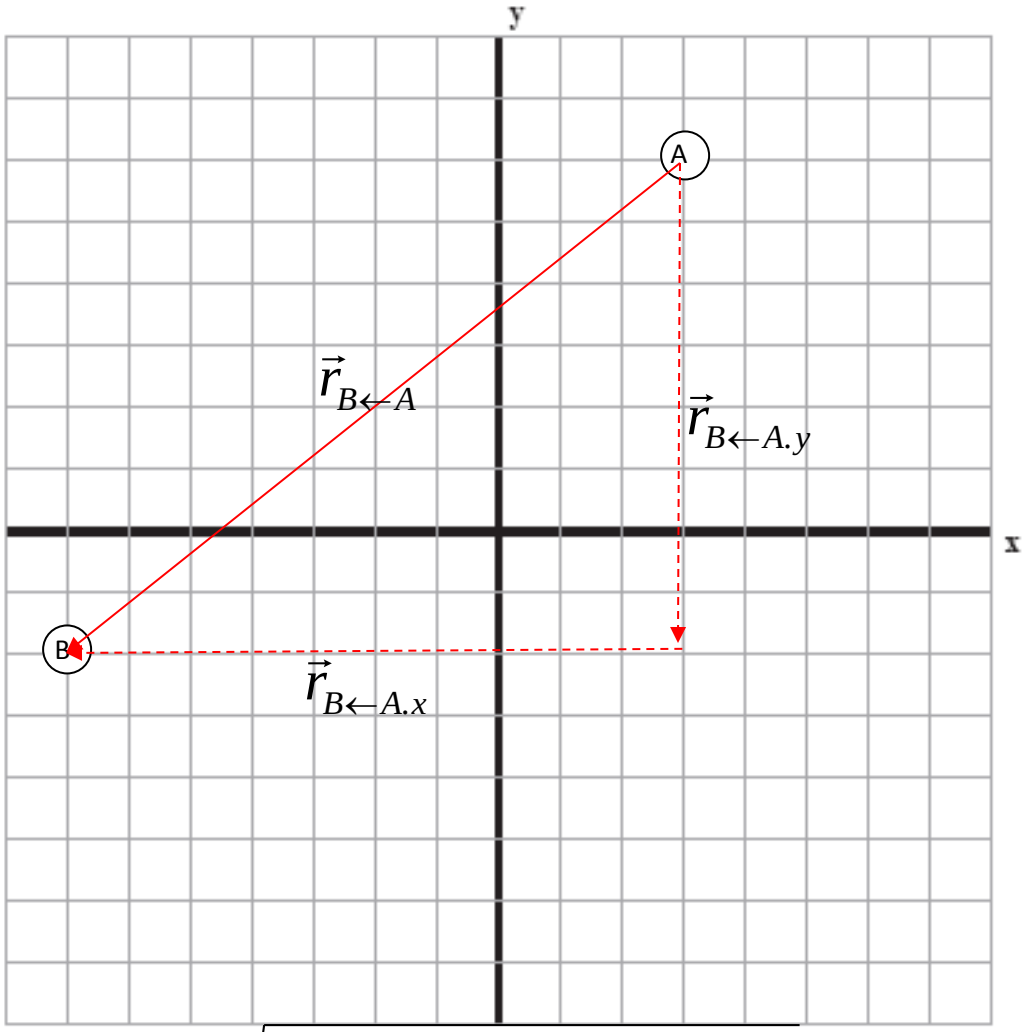


$$\left|\vec{r}_{B\leftarrow A}\right| = \sqrt{\left|\vec{r}_{B\leftarrow A.x}\right|^2 + \left|\vec{r}_{B\leftarrow A.y}\right|^2 + \left|\vec{r}_{B\leftarrow A.z}\right|^2}$$

Practice with Vectors

Magnitude: $\left|\vec{r}_{B\leftarrow A}\right|$

Pythagorean's Theorem:



$$\left|\vec{r}_{B\leftarrow A}\right| = \sqrt{\left|\vec{r}_{B\leftarrow A.x}\right|^2 + \left|\vec{r}_{B\leftarrow A.y}\right|^2 + \left|\vec{r}_{B\leftarrow A.z}\right|^2}$$

$$\left|\vec{r}_{B\leftarrow A}\right| = \sqrt{\left|-10\right|^2 + \left|-8\right|^2 + \left|0\right|^2}\,units = \sqrt{100+64}\,units = 12.8\,units$$

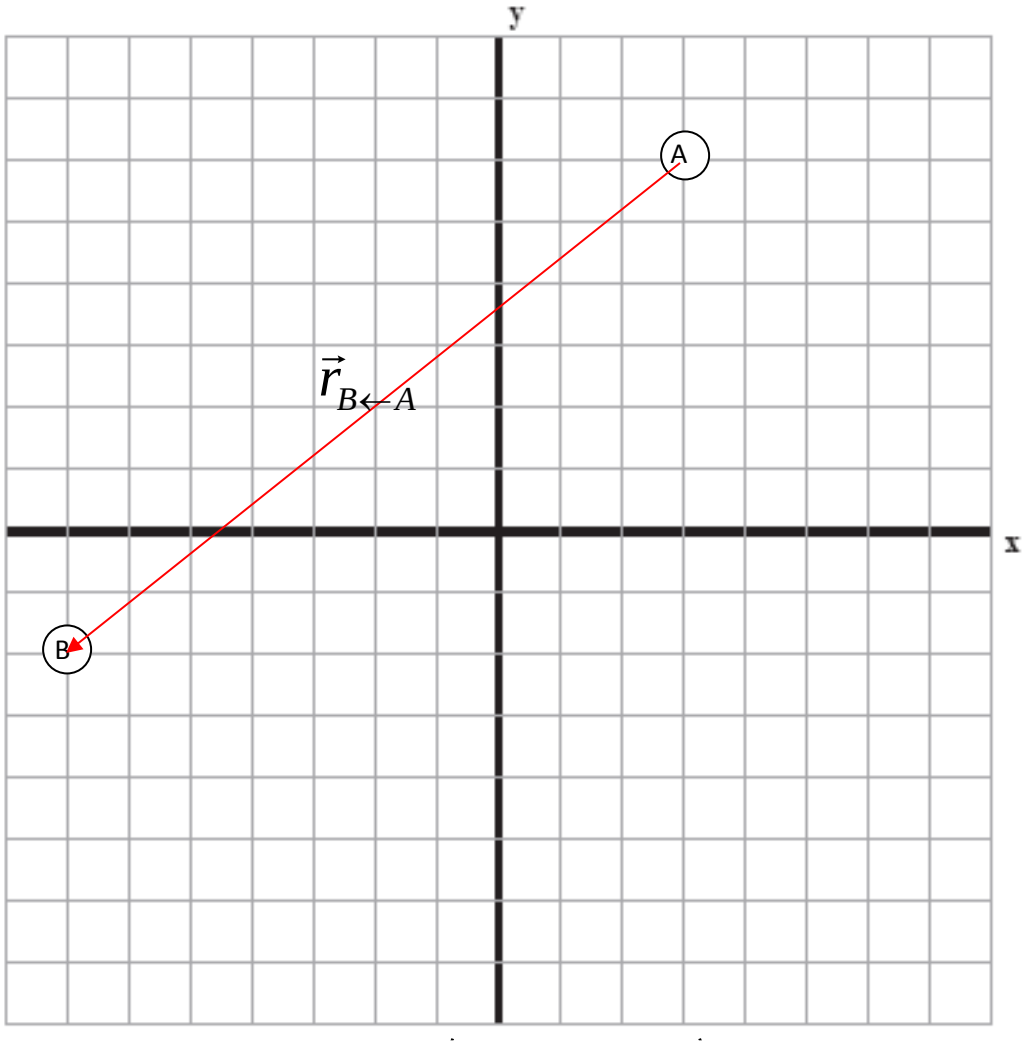
Q1.5.d

What is the magnitude of the vector < 3, 5, −2 >?

a. 5.48
b. 6.16
c. 6.00
d. 30.00
e. 38.00

Practice with Vectors

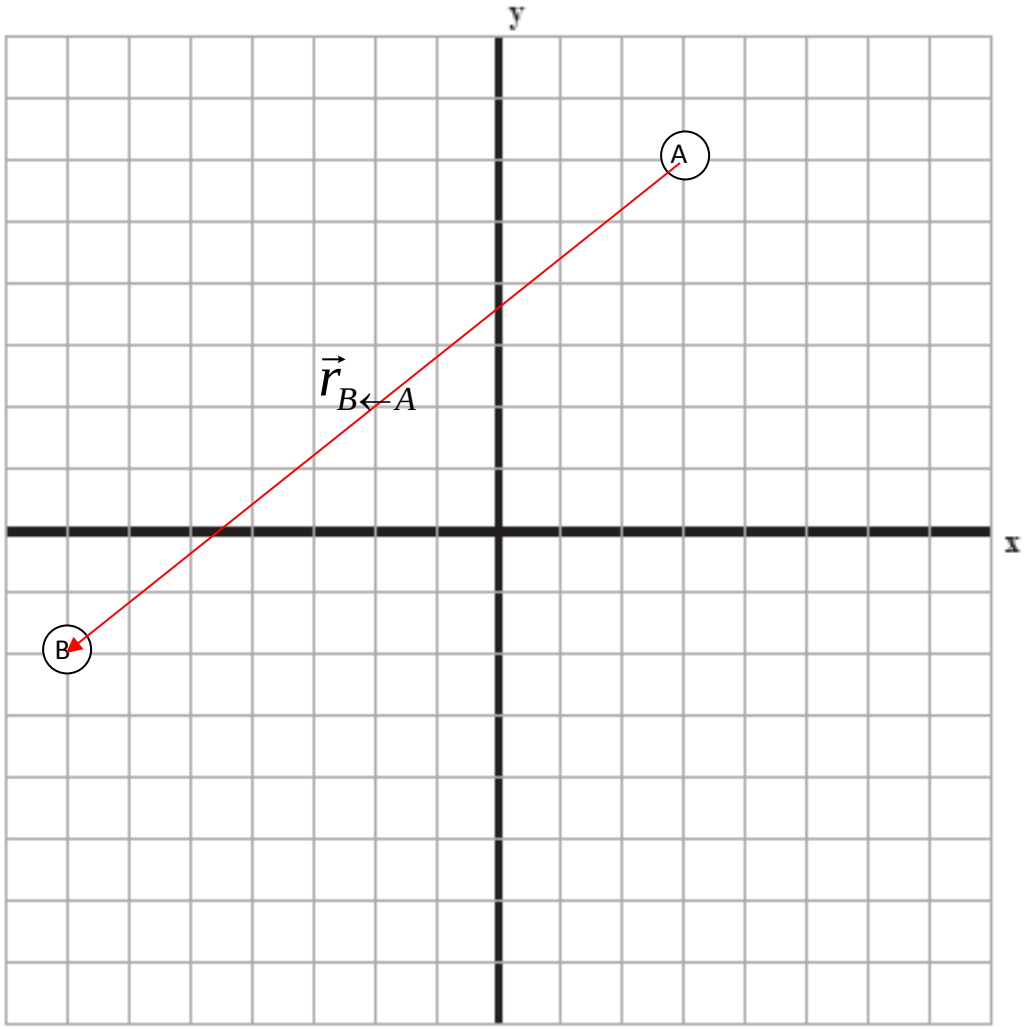
direction: $\hat{r}_{B\leftarrow A}$



$$\hat{r}_{B\leftarrow A} = \frac{\vec{r}_{B\leftarrow A}}{\left|\vec{r}_{B\leftarrow A}\right|}$$

Practice with Vectors

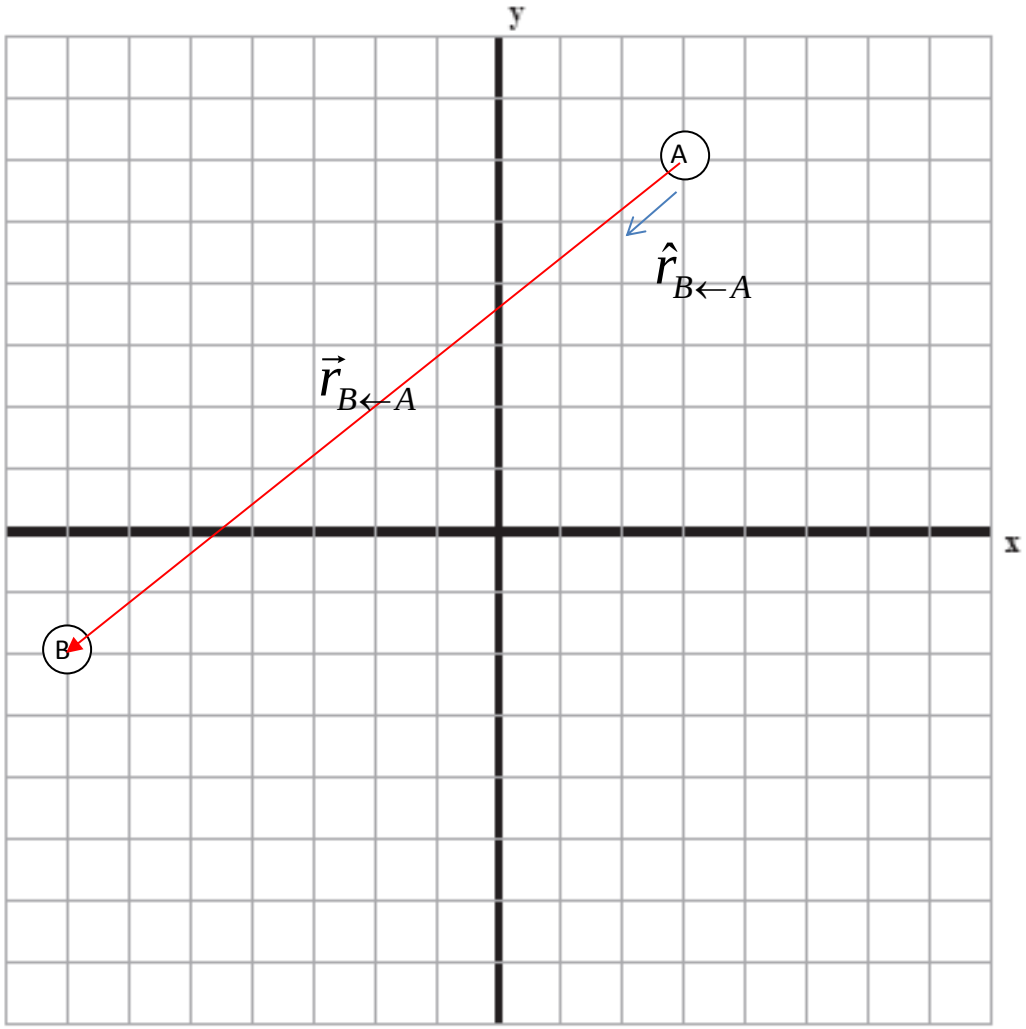
direction: $\hat{r}_{B\leftarrow A}$



$$\hat{r}_{B\leftarrow A} = \frac{\vec{r}_{B\leftarrow A}}{\left|\vec{r}_{B\leftarrow A}\right|} = \frac{\langle -10,-8,0\rangle units}{12.8 units}$$

Practice with Vectors

direction: $\hat{r}_{B\leftarrow A}$



$$\hat{r}_{B\leftarrow A} = \frac{\vec{r}_{B\leftarrow A}}{\left|\vec{r}_{B\leftarrow A}\right|} = \frac{\langle -10,-8,0\rangle units}{12.8 units} = \langle -0.78,-0.625,0\rangle$$

Q1.5.e

What is the unit vector in the direction of the vector $\langle 3, 5, -2 \rangle$?

a. $\langle 3, 5, -2 \rangle$
b. $\langle 1, 1, -1 \rangle$
c. $\langle 0.49, 0.81, 0.32 \rangle$
d. $\langle 0.49, 0.81, -0.32 \rangle$
e. $\langle 0.3, 0.5, -0.2 \rangle$

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Tues. Wed. Lab Fri.	1.1-.5 Matter, Interactions, & Vectors L1: VPython Intro. 1-D Motion 1.6-.10 Velocity & Momentum	RE0 (getting familiar with WebAssign) RE 1.a *bring laptop & headphones if you have* RE 1.b
Mon. Tues.	2.1-.3, (.9, .10) Momentum Principle & Examples	RE 2.a EP1, HW1: Ch 1 Pr.98

Motion is neither created nor destroyed, but transferred via interactions.