Physics 121:
Intro; Motion Diagrams; x vs. t

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Mesa Community College

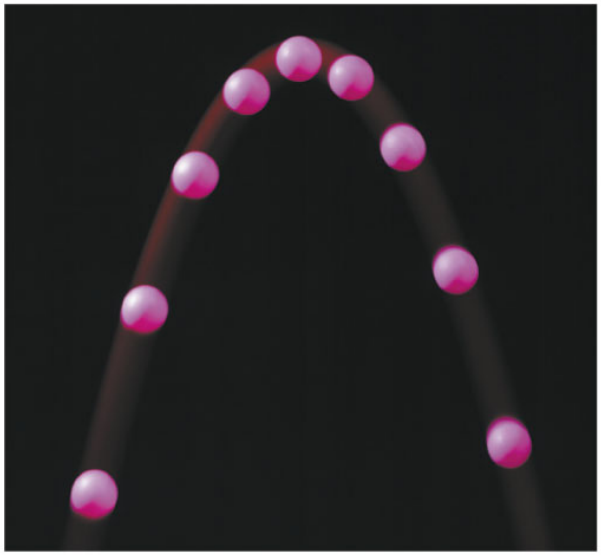
Motion Diagrams

- There are 4 types of motion that we are going to talk about. Can you name them (without looking at the book)?

Motion Diagrams

Linear motion

Circular motion



Projectile motion

Rotational motion

Motion Diagrams

- Before we start throwing around equations to talk about these types of motion lets figure out how to visualize physical situations in a useful way.

Motion Diagrams

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  - An rock sitting on the ground (just making sure you're awake)

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Car A

Car B

Which car is going faster assuming time intervals are the same between frames?

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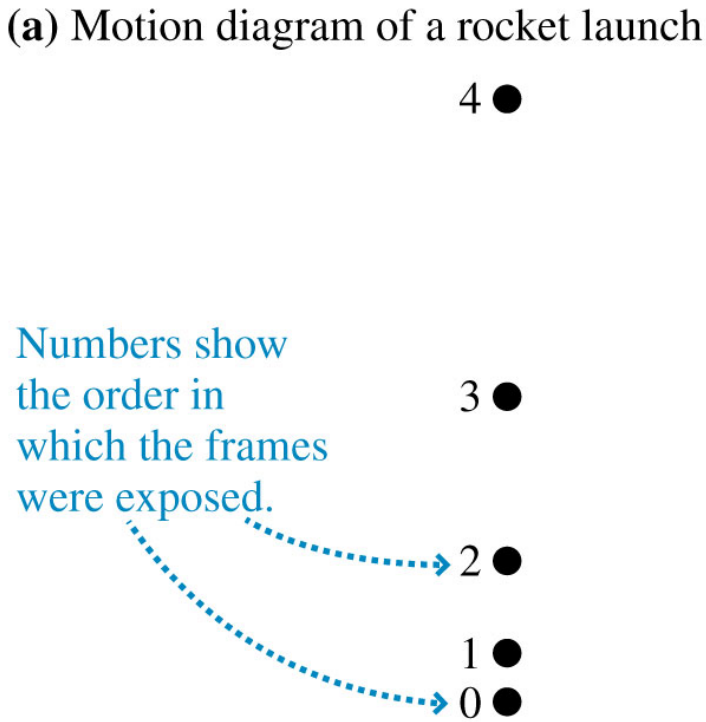
- This works as long as the pictures are simple, but what if they are really complicated?

The Particle Model

- For many objects their general motion isn't determined by shape of the object so we can treat the object as if it had the same mass but all at one point.
  - An object like this is called a **particle**.
- This is called a model since it doesn't exactly represent reality: The **particle model**.

The Particle Model



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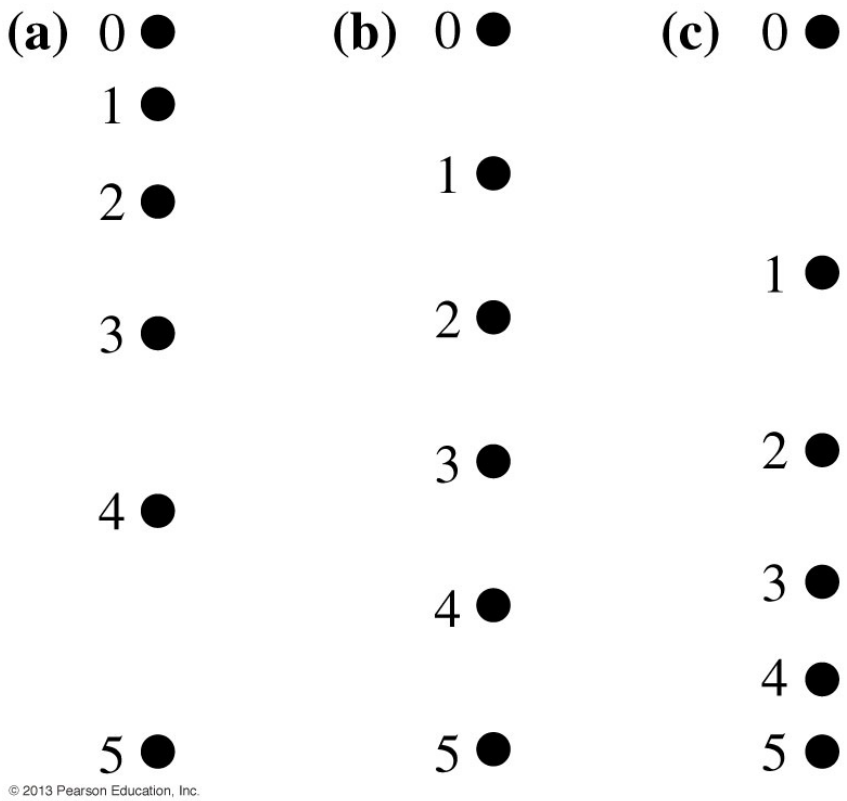

1. Dust particle settling ot the floor at constant speed.
2. Ball dropped from the roof of a building.
3. Descending rocket slowing to make a soft landing on Mars.

The Particle Model

- Can you think of a situation for which the particle model doesn't do a good job describing the motion.

The Particle Model

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  - Rotating gear: the center of mass of the gear doesn't move but each individual tooth moves differently.

Position and Time

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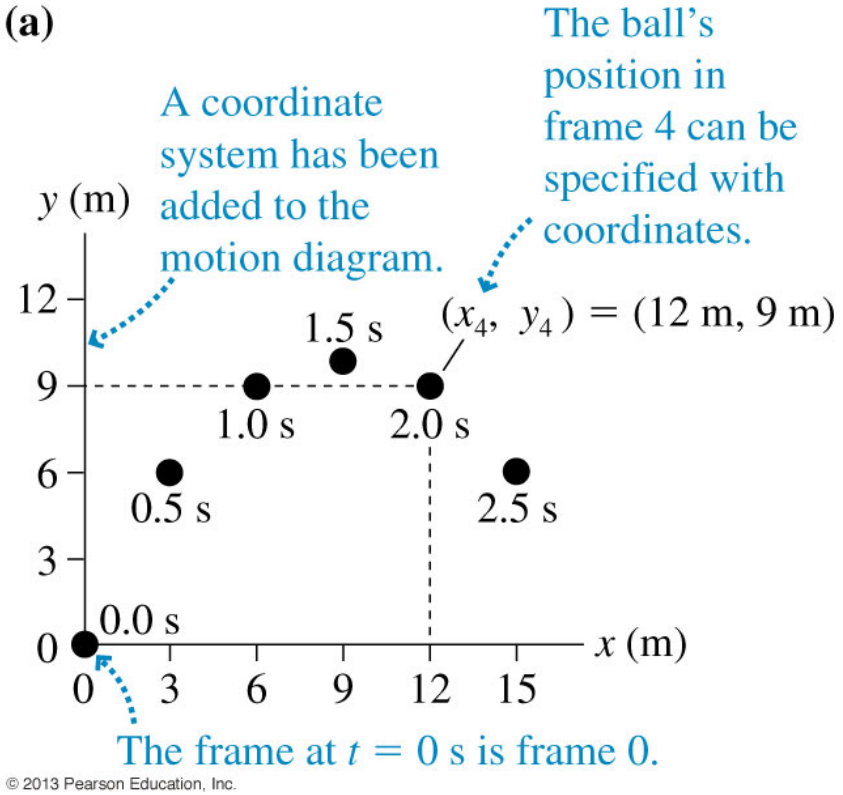
- Usually we think of x-y coordinate systems, but did you know that t could be a coordinate as well?



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- What is the "correct" origin for this room to describe the position of <insert item name>?

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- What is the "correct" origin for this room to describe the position of <insert item name>?
- What is the "best" origin for this room to describe the position of <insert item name>?

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- We give scalars symbols like m and vectors symbols like $\vec{r}$.
- What is the difference between r and $\vec{r}$ then?

Position and Time

- Somebody come up and draw this situation labeling $\vec{r_0}$, $\vec{r_1}$ and $\Delta\vec{r}$.
- Sam is standing 50 ft east of the corner of 12th Street and Vine. He then walks northeast for 100 ft to the second point. What is Sam's change in position?
  - This ($\Delta\vec{r}$) is called his **displacement**.

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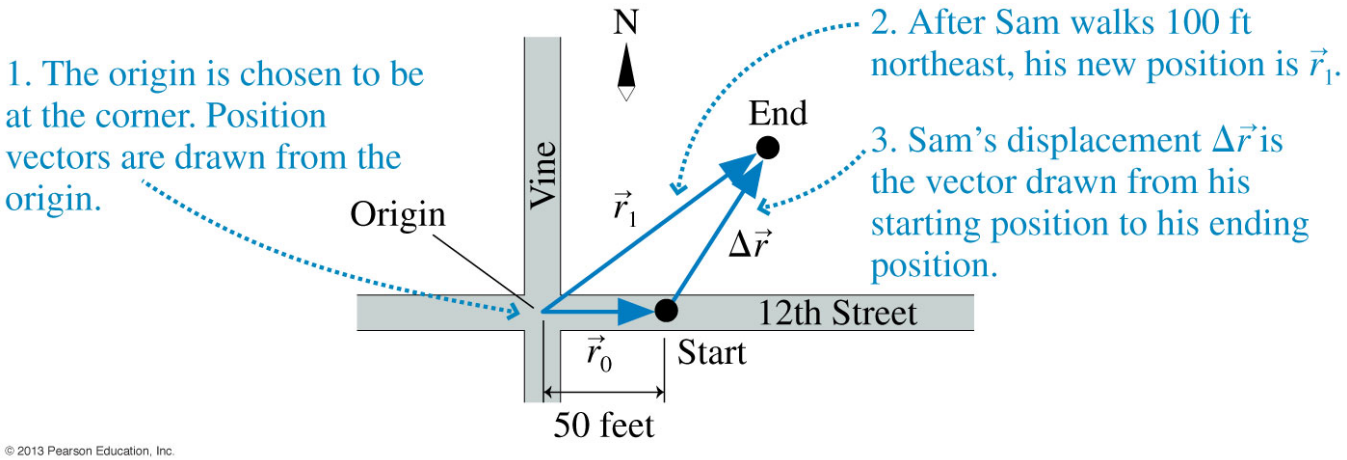

Position and Time

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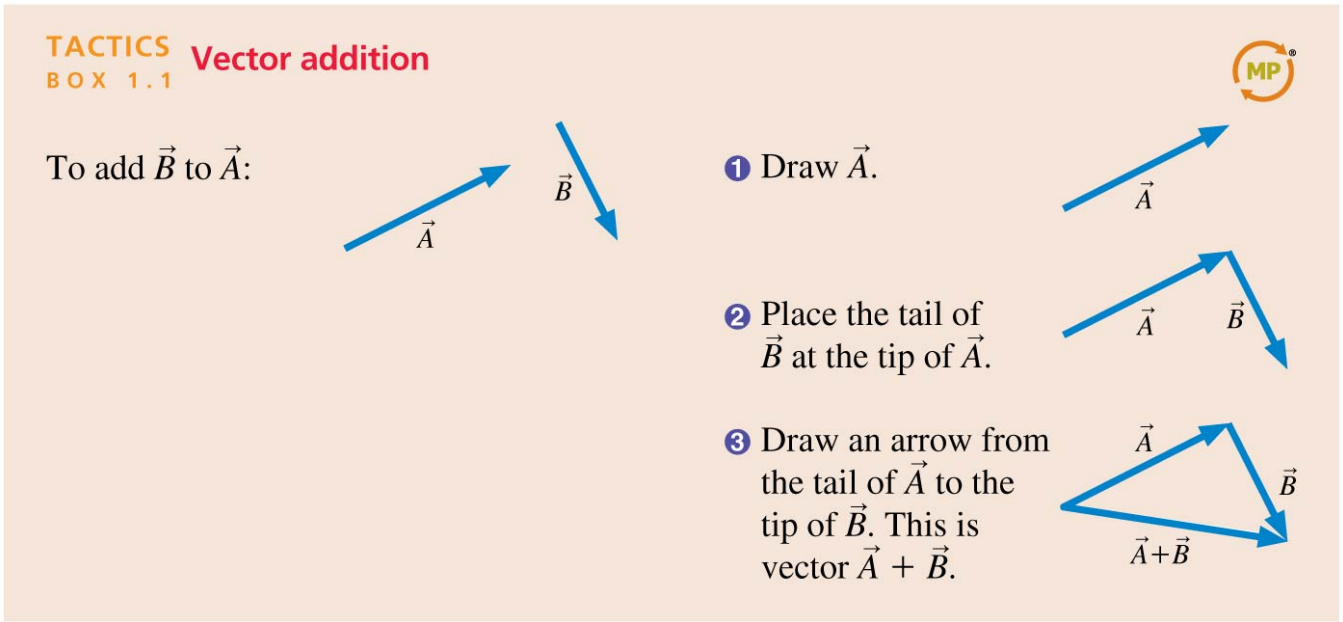
  - $\Delta\vec{r} = \vec{r}_f - \vec{r}_i$



Position and Time

- If that's how you add vectors, how would you subtract them?

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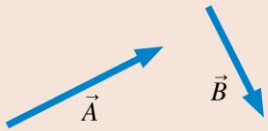
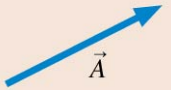
TACTICS BOX 1.2 Vector subtraction

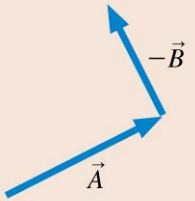
To subtract $\vec{B}$ from $\vec{A}$:



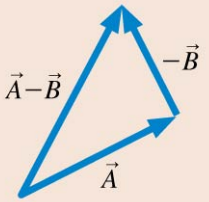
1. Draw $\vec{A}$.



2. Place the tail of $-\vec{B}$ at the tip of $\vec{A}$.



3. Draw an arrow from the tail of $\vec{A}$ to the tip of $-\vec{B}$. This is vector $\vec{A} - \vec{B}$.



Position and Time

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  - It's independent of coordinate system (and origin).
  - Show this by moving the coordinate system to the right of the starting place and drawing vectors $\vec{r}_0$ and $\vec{r}_1$ again and subtract them to get $\Delta\vec{r} = \vec{r}_1 - \vec{r}_0$.

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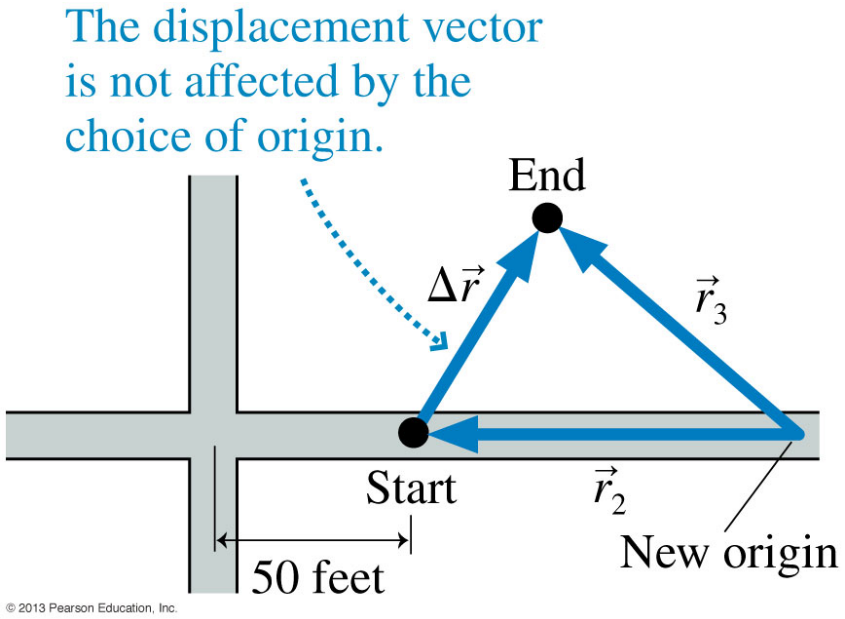
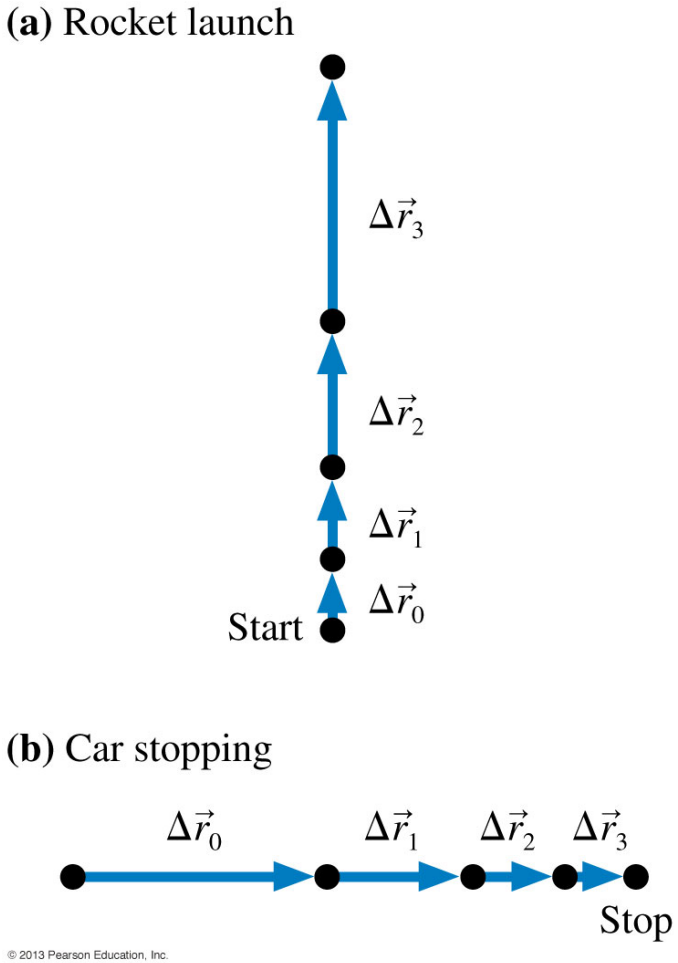


Position and Time

- Displacement vectors can be added to motion diagrams to give additional information.



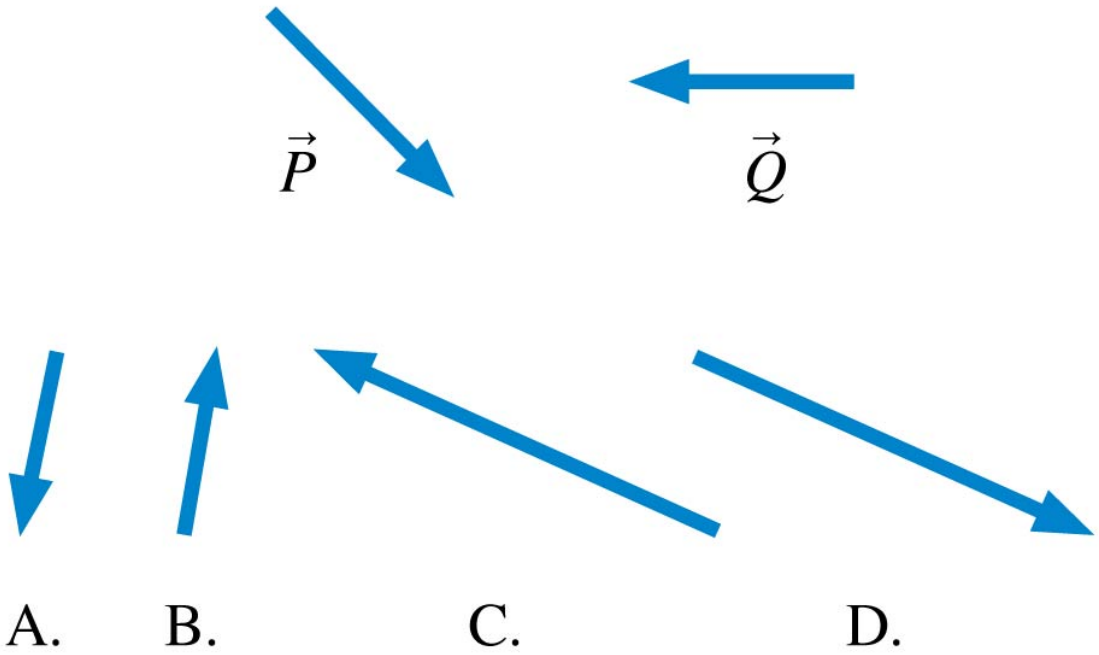
- Speeding up: displacement vectors increase in length.
- Slowing down: displacement vectors decrease in length.

Position and Time

- The time interval, Δt, is like the displacement
  - $\Delta t = t_f - t_i$
  - Also, it doesn't depend on the origin ($t = 0$)
- People may disagree on the time that something happened, but they will always agree on the time interval between two events (At least in physics 121 dun dun duuuuun).

Quick Check

Which of these is $\vec{P} + \vec{Q}$?



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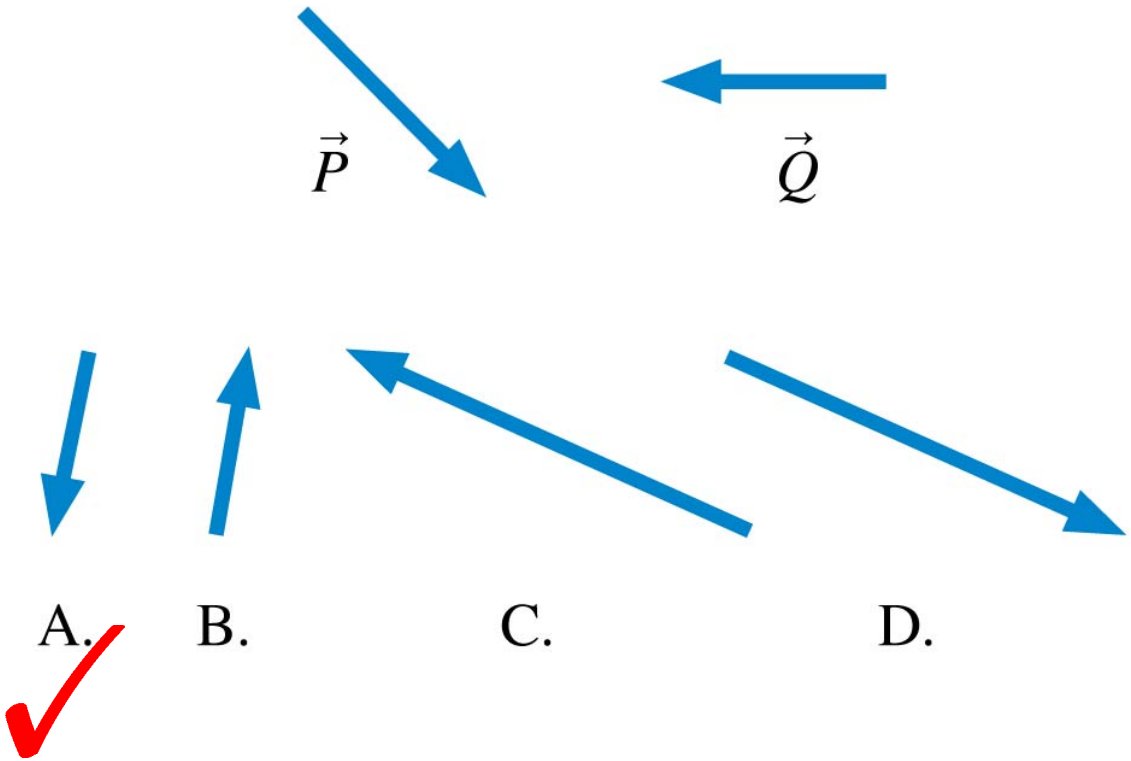

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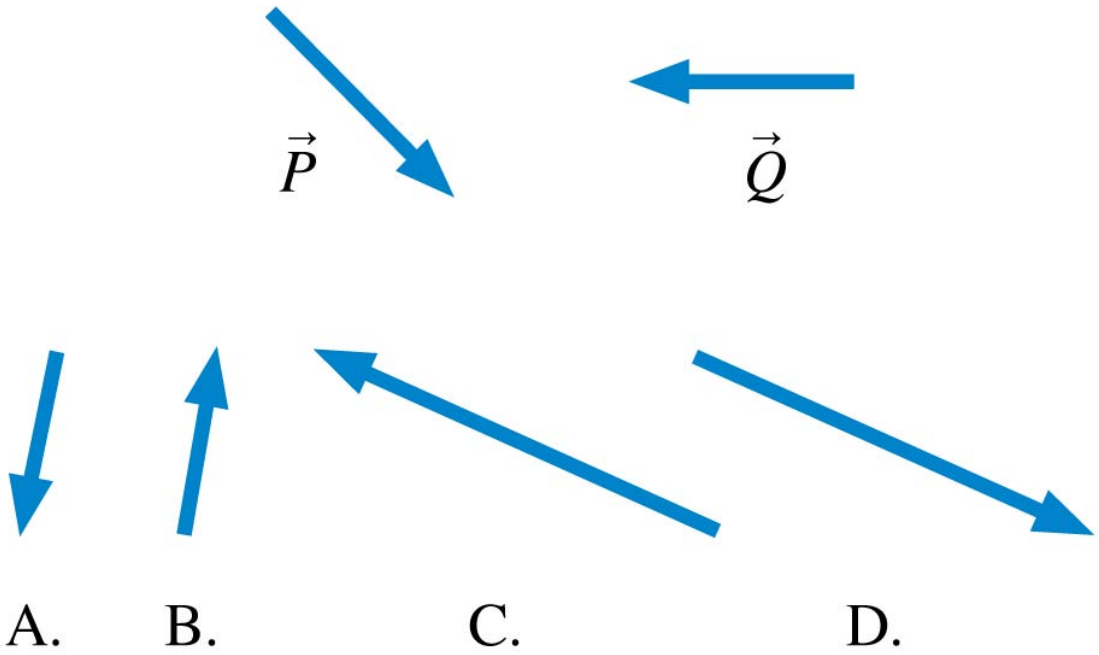

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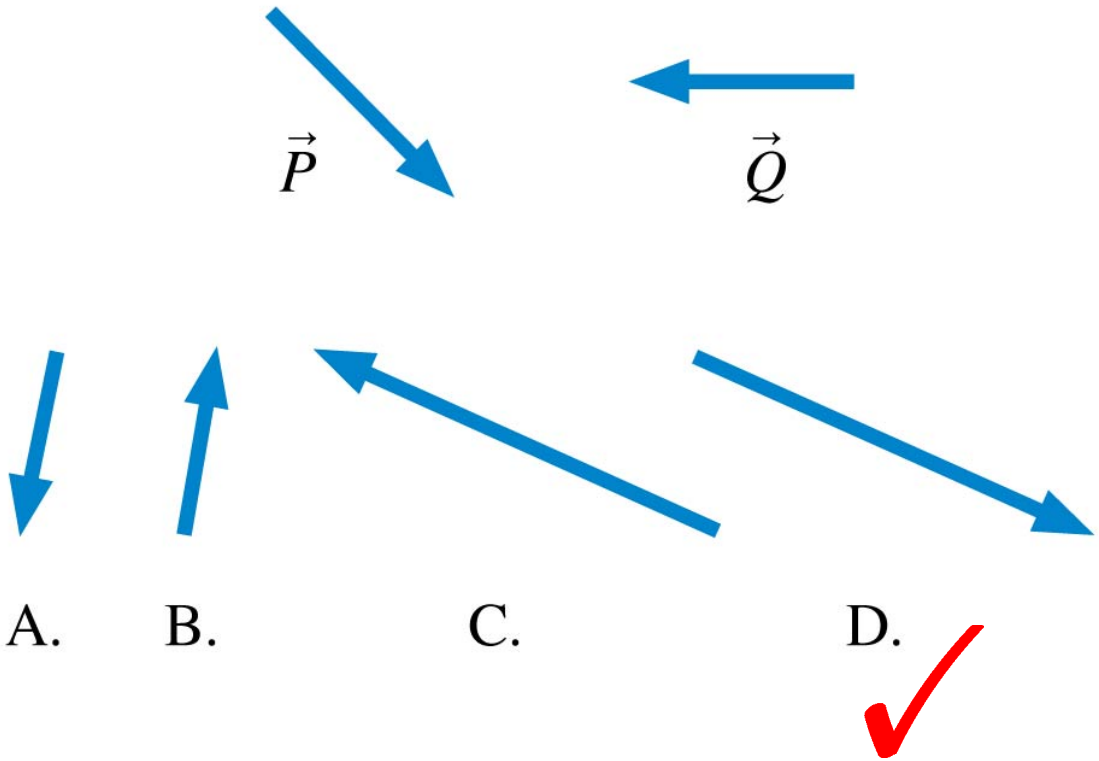

REMINDER

Just a reminder that we will have a quiz at the beginning of class on Thursday! It could be on what we have talked about or on the reading.