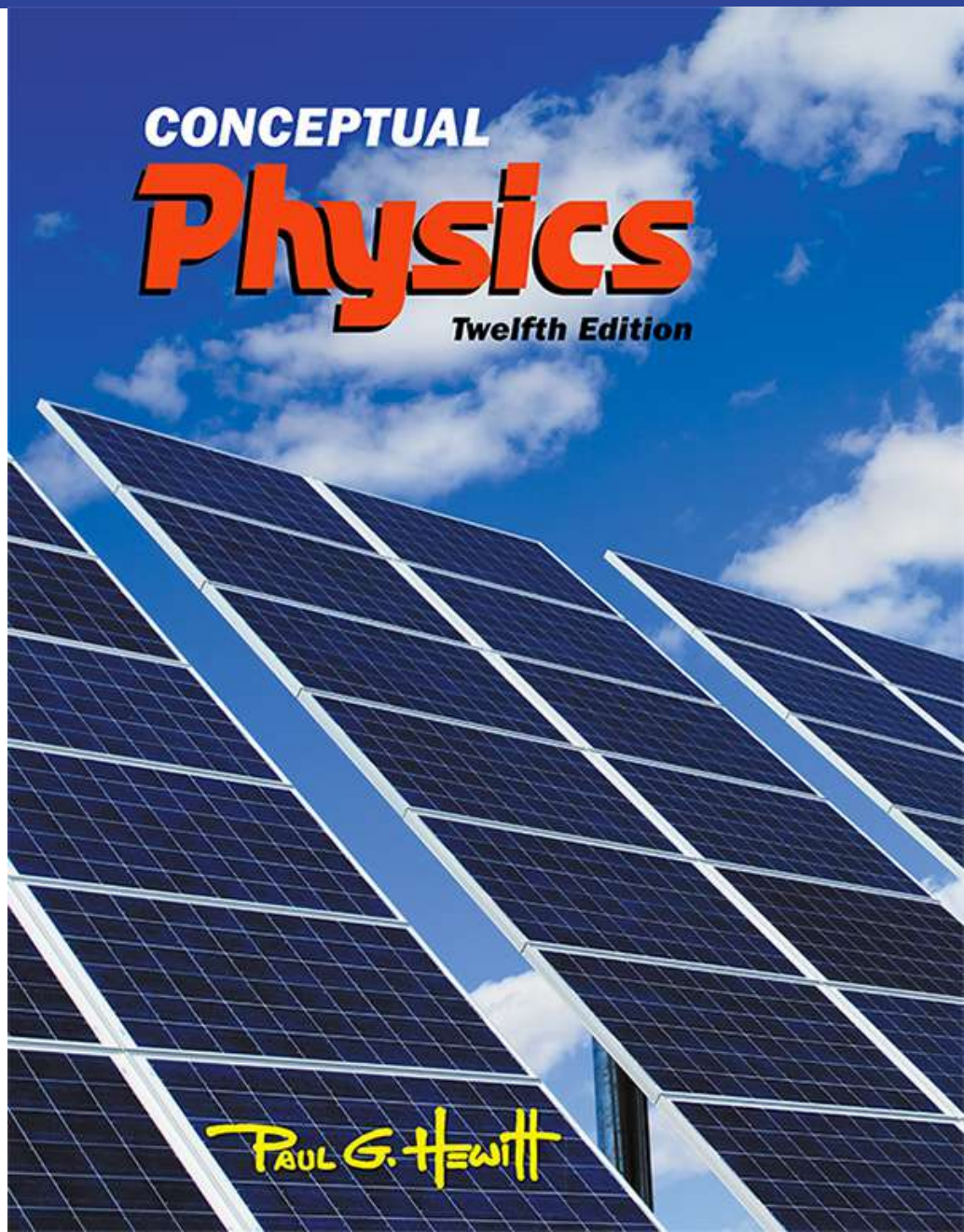
Lecture Outline

Chapter 5: Newton's Third Law of Motion



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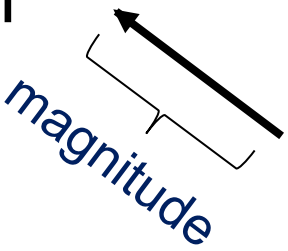
Review:

- *Vectors* (arrows): magnitude and direction



- *Scalars* – have magnitude (size) only
- Which are vectors and which are scalars?
  - Speed Scalar
  - Velocity vector
  - Time Scalar
  - Force vector
  - Acceleration vector
  - Distance Scalar

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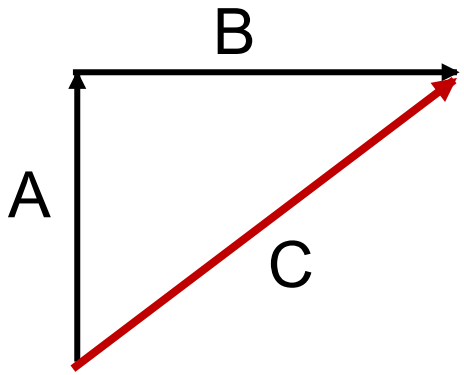
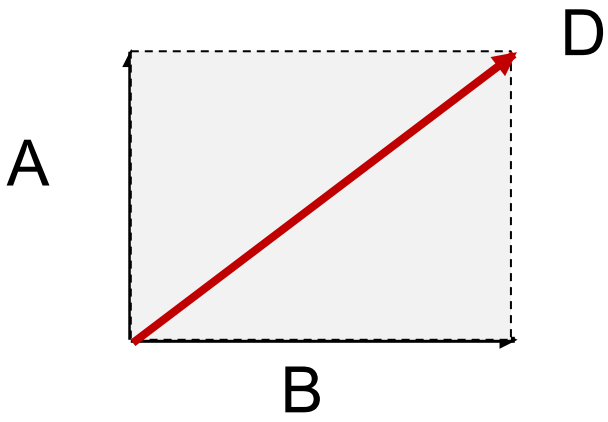
Review: 2 ways of adding vectors A and B:

head to tail:



A + B = C

parallelogram:



A + B = D

It isn't

How is C different from D?

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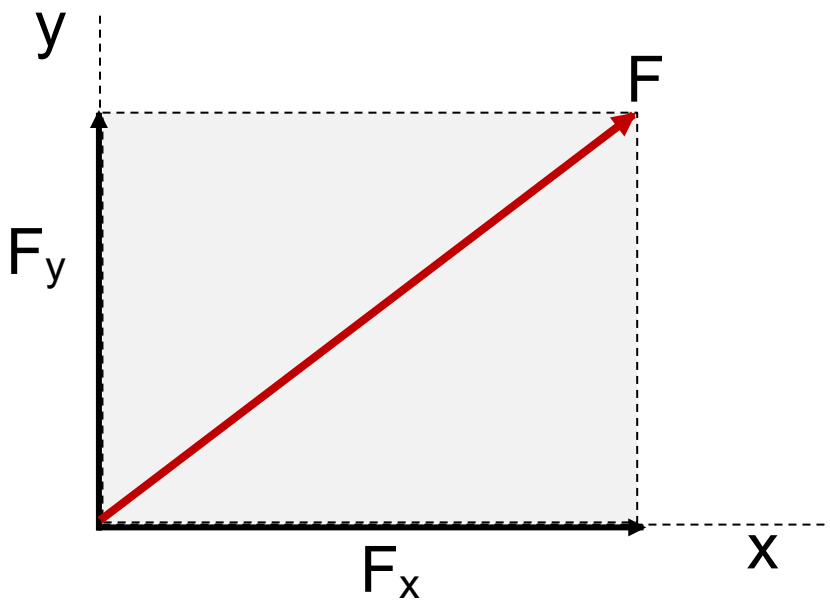
Resolving (breaking down) force vectors

Any vector can be *resolved* into 2 component vectors that are perpendicular to each other.

STEPS:

1. Draw force vector F
2. Draw x, y axes
3. Draw rectangle with vector as a diagonal
4. Use sides of rectangle for component vectors



F_x is called the x-component of F

F_y is called the y-component of F

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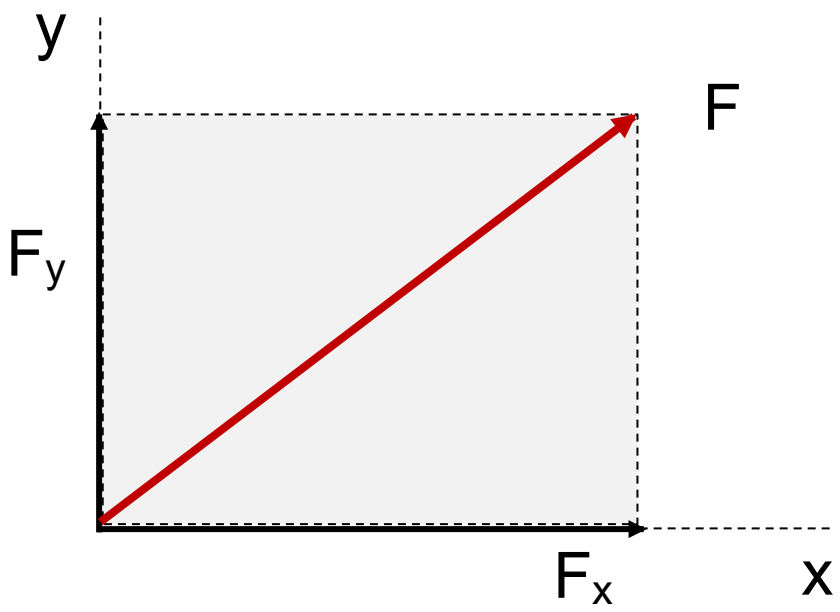
More about components:

Which component of F is greater? F_x

What do you get when you add: $F_x + F_y$?

F



If $F_x = 4$ and $F_y = 3$, what is the magnitude (size) of F?

$$F = \sqrt{F_x^2 + F_y^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5$$

Since $F = F_x + F_y$, you can replace F by F_x and F_y!

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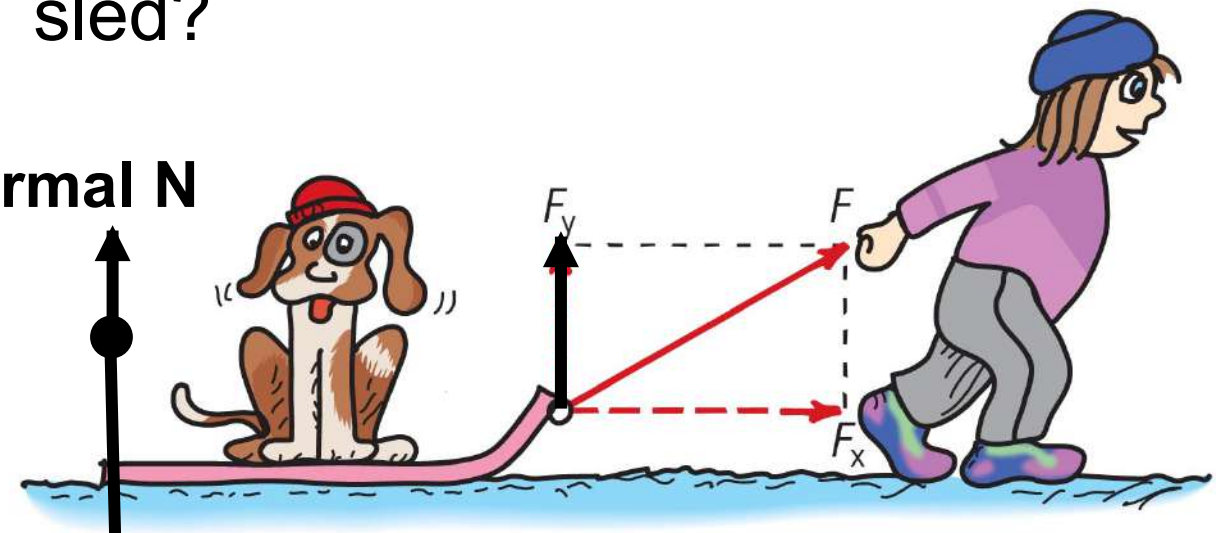
Vectors, Continued

- Nellie Newton pulls on the sled as shown.
  - Which component of her force *F* is greater?
    - **The horizontal component Fx**
  - What two other forces (not shown) act on the sled?



- **Normal N**
- **Weight mg**
- **Why isn't N = mg?**
- **Because:**

  $N + F_y = mg$

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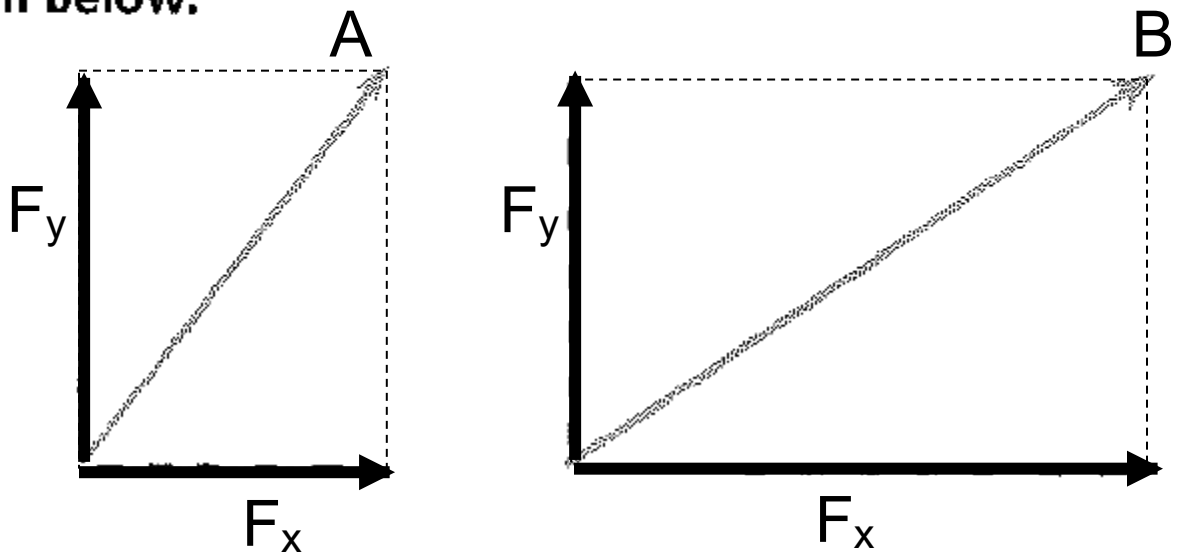
Do NOT write in your textbook!

CHECK POINT

With a ruler, draw the horizontal and vertical components of the two vectors shown. Measure the components and compare your findings with the answers given below.



Which vector, A or B, has a greater x component? B

For which vector has a greater y component? neither

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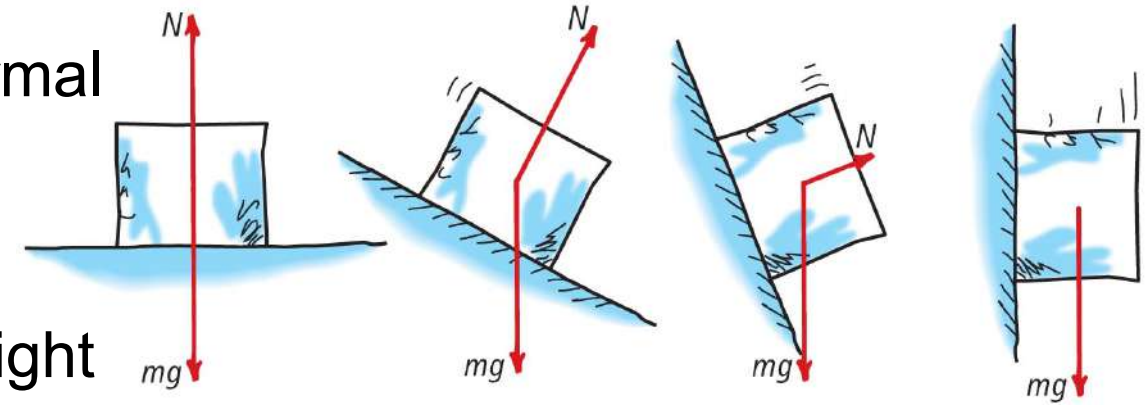
Ex: block of ice on an incline that gets tilted more and more.

1. Name the 2 forces mg and N.

normal

weight



2. As the ramp is raised, which force remains constant?

mg

3. As the ramp is raised, how does the magnitude of *N* change?

It decreases

4. When the ramp is raised 90 degrees (vertical) what is the net force on the block?

mg

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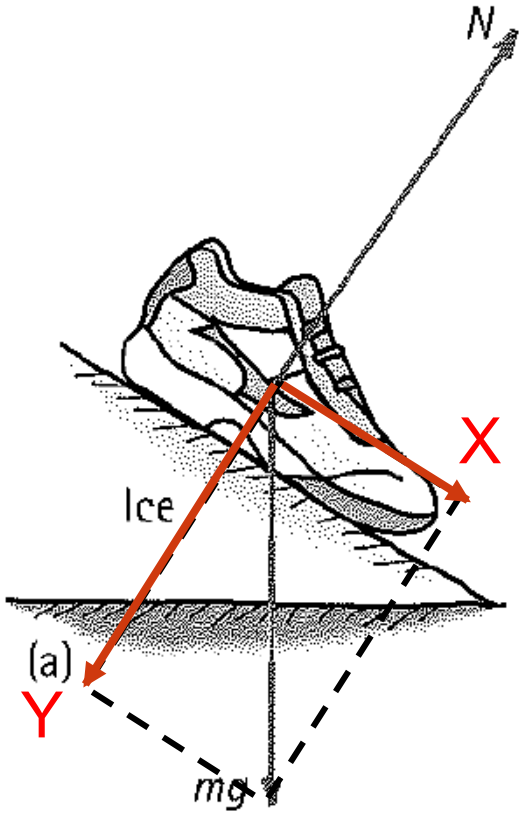
Shoe on ice on incline: No friction
Resolve mg into 2 components, X and Y:



Which component of mg balances the normal surface force N?

Y

Which component of mg is unbalanced and causes the shoe to accelerate down the incline?

X

Is the shoe in equilibrium?

No!

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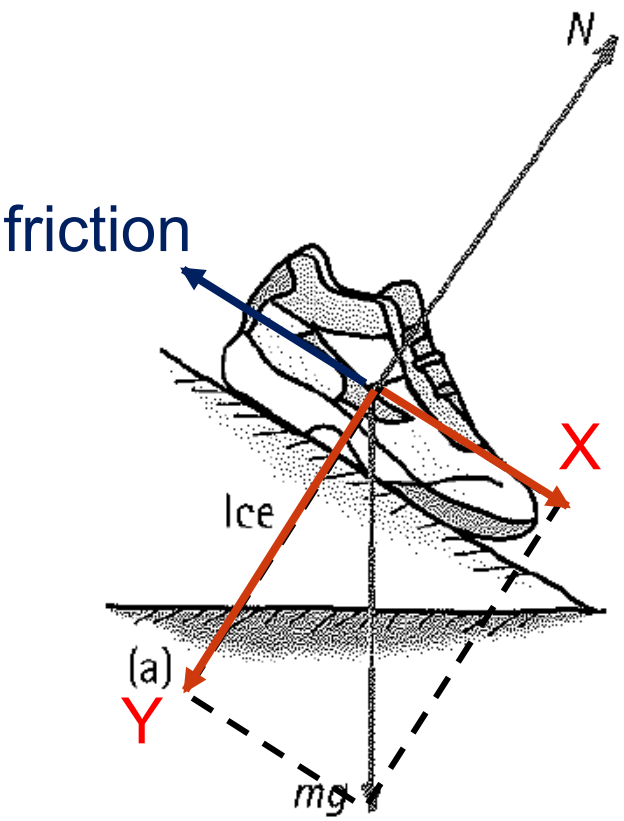
Shoe *at rest* on hill: Resolve mg into X and Y as before.

What is missing from the picture now?



Which component balances N?

Y

Which component is balanced by the force of friction?

X

Is the shoe in equilibrium?

Yes!

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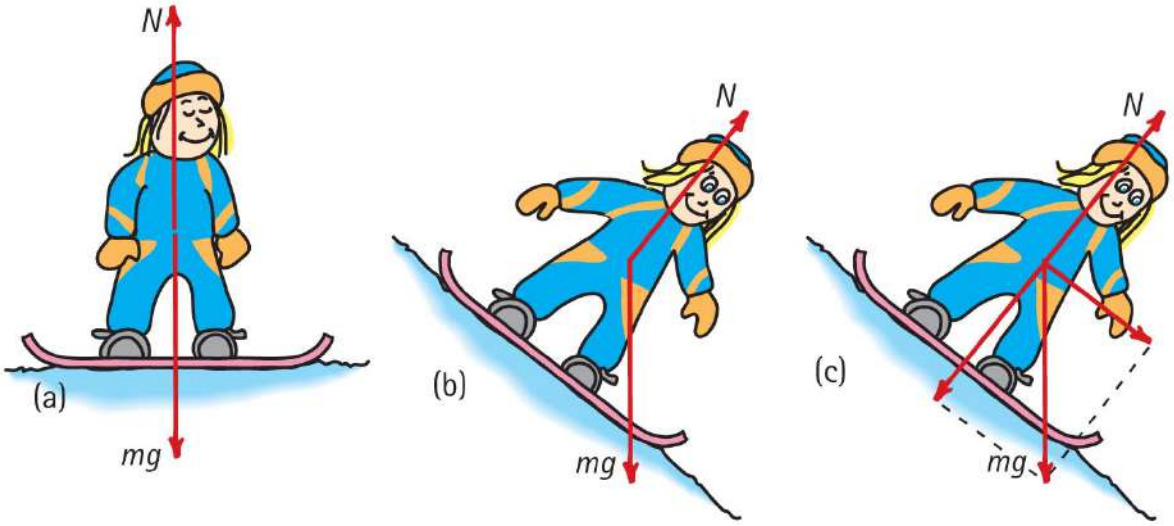
Vectors while skiing:

1. In which case below are N and mg equal and opposite? (a)
2. What happens to N as the incline gets steeper? decreases
3. Can you see that the resultant of *N* and *mg* is the force propelling Nellie down the hill?
4. And can you see which component of *mg* is equal and opposite to *N*?



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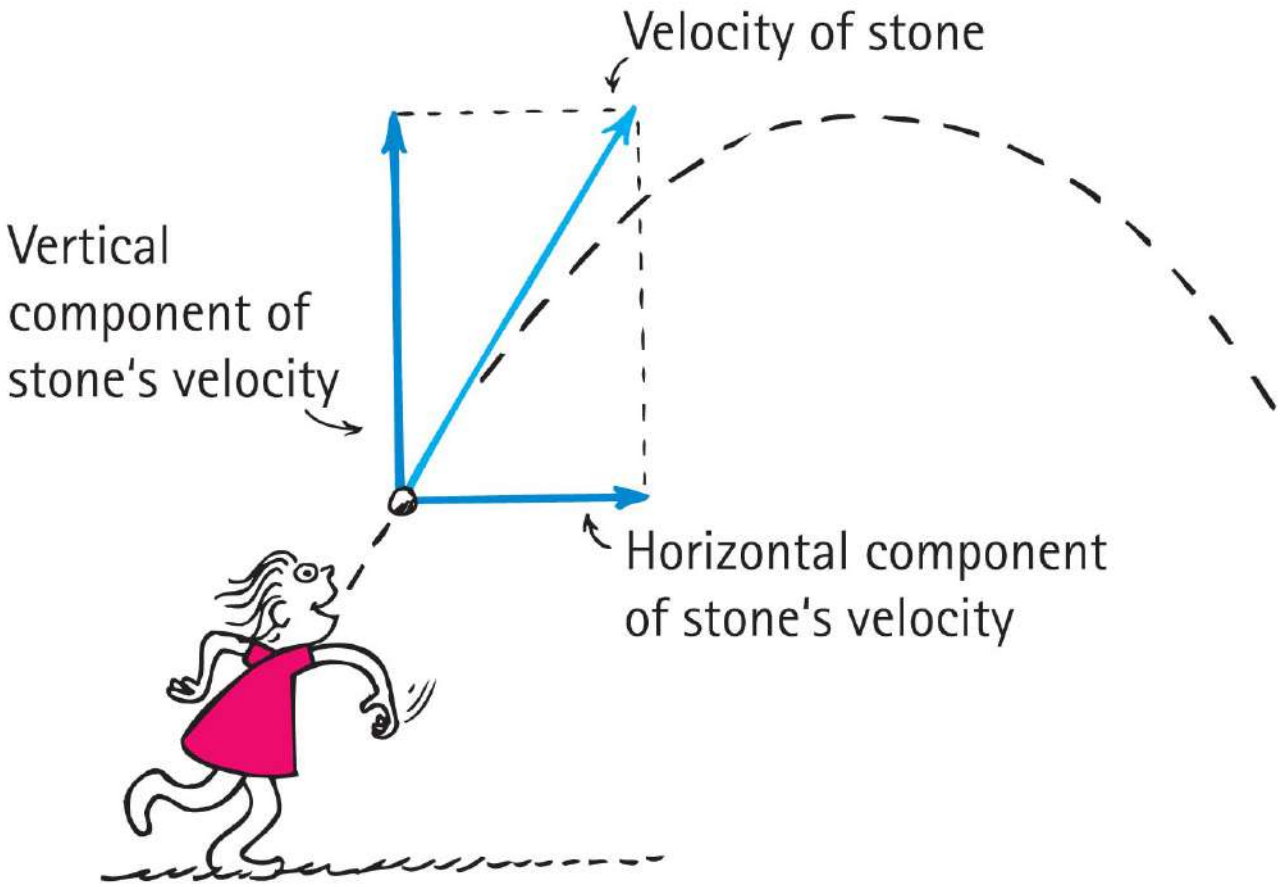
Later, we will use velocity vectors to understand how projectiles fly through the air:



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Now:

- Last 25 minutes is for the Quiz:
- 18 questions…1/2 point each = 9 points
- Points are “bonus”….will be added to Q1 totals

- Test Corrections on the last test are due by 7:00 pm.
- You will receive no credit on them if…

….they are late; or

….not completely done; or

…not done according to the instructions!

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