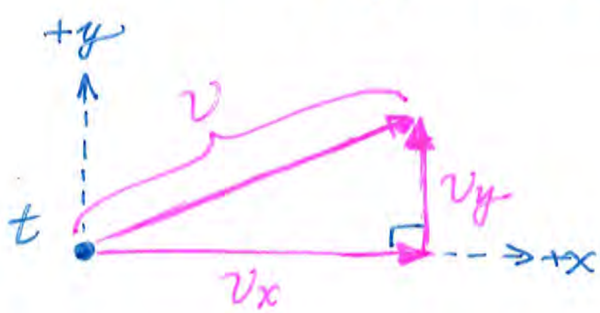
Title	(Instantaneous) speed

Ingredients

Sketch	
At/Through	$\boxed{t}$
Owner	System
Quantity	Instantaneous x-velocity; Instantaneous y-velocity; Instantaneous speed
Variable	$\boxed{v_x}$; $\boxed{v_y}$; $\boxed{v}$
Giver	

Recipe

Diagram the relationship	$\boxed{\lvert v_x \rvert} \rightarrow \boxed{v}$, $\boxed{\lvert v_y \rvert} \rightarrow \boxed{v}$
Graphically present quantities	Right triangle for applying Pythagoras's theorem 
Mathematical relationship	$v = \sqrt{v_x^2 + v_y^2}$

Recipe number **K12**: The **title** of this recipe sheet is "**(Instantaneous) speed**", with "Instantaneous" enclosed in parentheses to indicate that "(Instantaneous) speed" is often abbreviated as "speed".

The top half of this sheet consists of an "**Ingredients**" section with a row labeled "Sketch", a row labeled "At/Through", a row labeled "Owner", a row labeled "Quantity", a row labeled "Variable", and a row labeled "Giver." In this sheet, the row labeled "Giver" isn't used.

For the "Sketch", draw an overhead view showing one snapshot of a cart moving diagonally toward the upper right. Draw trailing motion-blur streaks or so-called "whooshies" to emphasize instantaneous motion in the snapshot. Draw a dashed bubble around the snapshot of the cart. Draw an arrow labeled +x to indicate that the positive-x direction points to the right. From the tail of the arrow you just drew, draw another arrow labeled +y to indicate that the positive-y direction points up the page.

In the rows of the "Ingredients" section other than the row for the sketch, document the following relationships, using flowchart paths, if helpful: The "Owner" is the "System". At time t, the "System" owns three quantities: the "Quantity" "Instantaneous x-velocity", denoted by the "Variable" v_x (v-sub-x), the "Quantity" "Instantaneous y-velocity" denoted by the "Variable" v_y (v-sub-y), and the "Quantity" "Instantaneous Speed" denoted by the "Variable" v.

The bottom half of this sheet consists of a "**Recipe**" section with a row labeled "Diagram the relationship", a row labeled "Graphically present quantities", and a row labeled "Mathematical relationship".

In the row labeled, "Diagram the relationship", draw a flowchart arrow showing that absolute value of the x-velocity v_x (v-sub-x) contributes to the instantaneous speed v. Draw another arrow showing that absolute value of the y-velocity v_y (v-sub-y) also contributes to the instantaneous speed v.

In the row labeled "Graphically present quantities", write the title "Right triangle for applying Pythagoras's theorem". Draw a dot to represent the cart using a point-like particle model. Label this dot with time t. Starting from that dot, draw an arrow pointing diagonally toward the upper right to represent the velocity vector. Use a brace to label the magnitude of the velocity arrow with the speed v. Using the slanted velocity arrow as a hypotenuse, draw a right triangle with a horizontal leg and a vertical leg. Add an arrowhead to make the horizontal leg become a rightward arrow. Label this horizontal arrow with x-velocity v_x (v-sub-x). Add an arrowhead to make the vertical leg become an upward arrow. Label this vertical arrow with y-velocity v_y (v-sub-y). Draw a perpendicular symbol in the interior right angle of the right triangle. Extend to the right a horizontal arrow collinear with the dot and labeled +x to indicate that the positive-x direction points toward the right. Extend upward a vertical arrow collinear with the dot and labeled +y to indicate that the positive-y direction points up the page.

In the row labeled, "Mathematical relationship", write $v = \sqrt{v_x^2 + v_y^2}$ (v = square root of the sum of the square of v-sub-x and the square of v-sub-y).