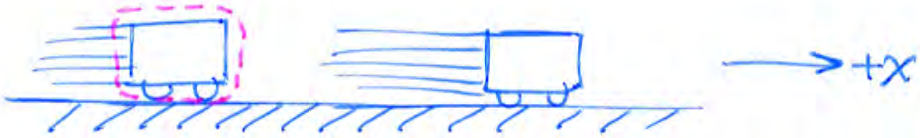
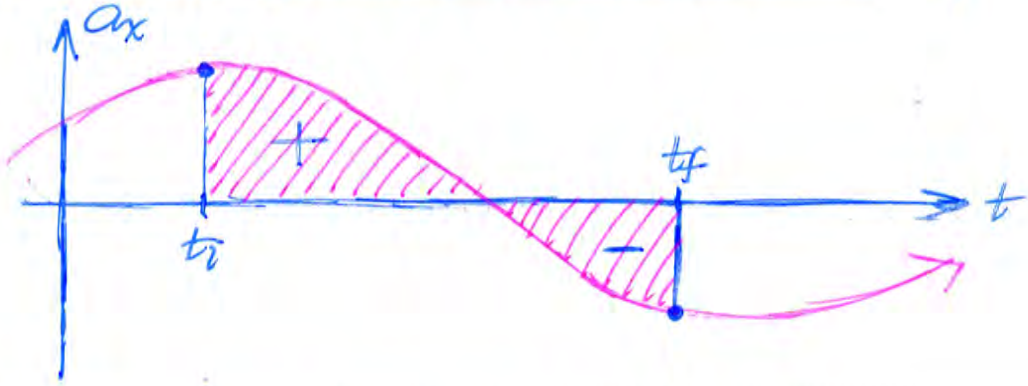
K7

Title Change in x-velocity as area under a_x-t plot

Ingredients

Sketch	
At/Through	t ; $[t_i, t_f]$
Owner	System
Quantity	x-acceleration ; change in x-velocity
Variable	a_x ; Δv_x
Giver	

Recipe

Diagram the relationship	Area under a_x-t plot → Δv_x
Graphically present quantities	On a_x-t plot: Shade the regions between the graph and the t axis 
Mathematical relationship	Signed area between a_x-t plot and t axis = Δv_x

Recipe number **K7**: The **title** of this recipe sheet is "**change in x-velocity as area under (a-sub-x-t) plot**".

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 two snapshots showing a cart moving toward the right across a firm surface. Draw trailing motion-blur streaks or so-called "whooshies" to emphasize instantaneous motion in each snapshot. Draw a dashed bubble around the earlier snapshot of the cart, at the left, to indicate that the cart is the so-called "System". Draw an arrow labeled +x to indicate that the positive-x direction points to the right.

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" has the "Quantity" called "x-acceleration" denoted a_x (a-sub-x). On the interval from initial time t_i (t-sub-i) to final time t_f (t-sub-f), the "System" accrues the "Quantity" called "change in x-velocity" denoted (Delta v-sub-x).

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 area under the (a-sub-x-t) plot contributes to the change in x-velocity (Delta v-sub-x).

In the row labeled "Graphically present quantities", write the title "On (a-sub-x-t) plot: Shade the regions between the graph and the t axis". Create an axis system with x-acceleration a_x (a-sub-x) on the vertical axis and time t on the horizontal axis. Draw a smooth plot with some variety of a_x (a-sub-x) values including positive and negative values (the exact shape isn't very important). Surrounding a portion of the plot with positive and negative values of x-acceleration a_x (a-sub-x), draw two tickmarks on the t axis, one at the left labeled with the initial time t_i (t-sub-i) and one at the right labeled with the final time t_f (t-sub-f). From the tickmark at the left, extend a vertical segment to reach the graph. Draw a dot where the vertical segment meets the graph. From the tickmark at the right, extend a vertical segment to reach the graph. Draw a dot where this vertical segment meets the graph. Between the vertical segments, shade the regions between the graph and the t axis. Mark each shaded region above the t axis with a plus, and mark each shaded region below the t axis with a minus

In the row labeled, "Mathematical relationship", write "Signed area between (a-sub-x-t) plot and t axis = (Delta v-sub-x)".