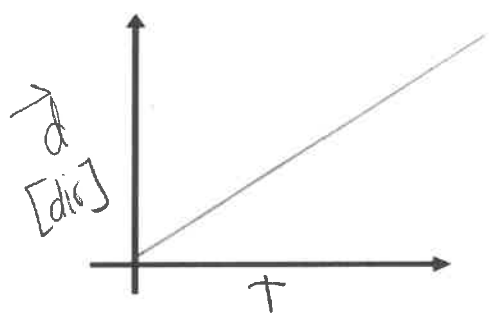
Graphing Motion

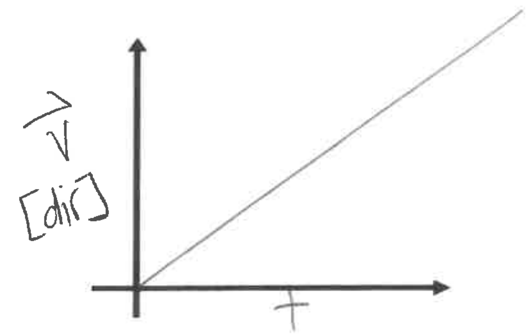
Position Vs Time Graph



slope = $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta \text{displacement}}{\Delta \text{time}}$ = velocity

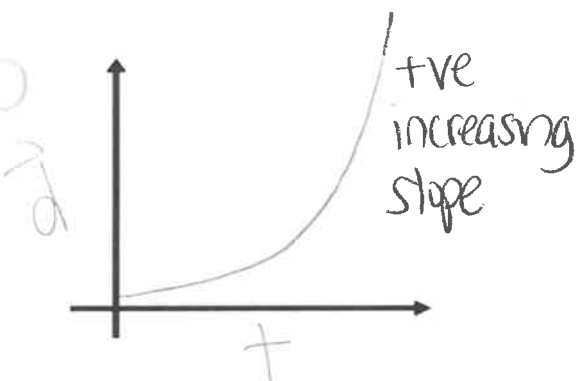
VS.

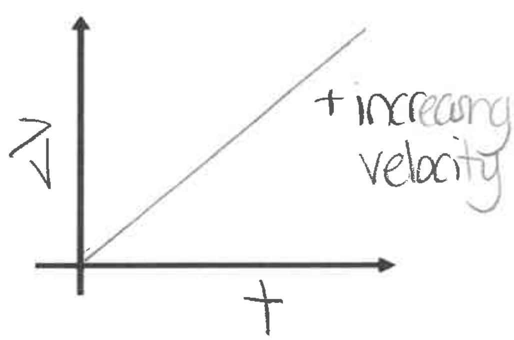
Velocity Vs Time Graph

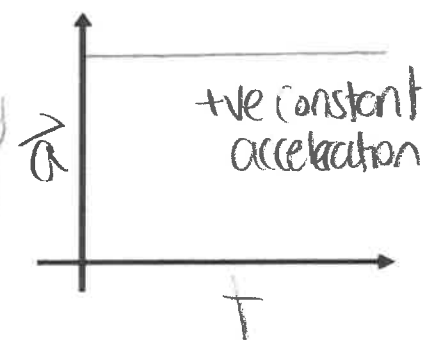


slope = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta \text{velocity}}{\Delta \text{time}}$ = acceleration

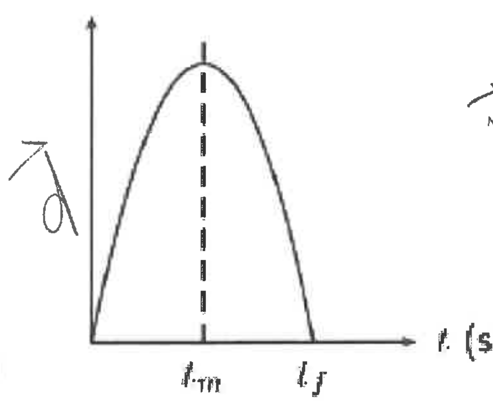
Imagine a car at a stop light. When the light turns green, the car moves forward, continually getting faster and faster at a constant rate.

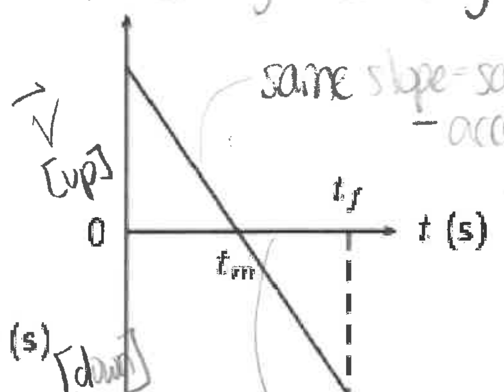


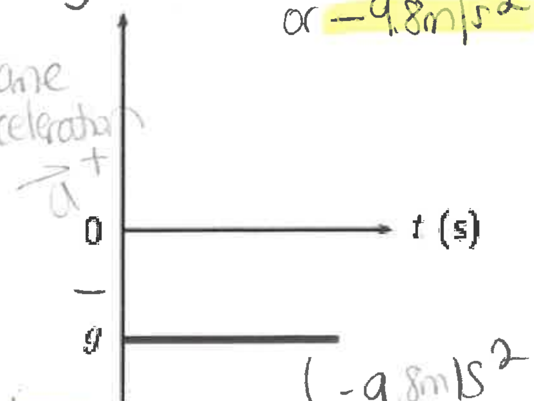




Imagine a ball tossed vertically. v slows down on way up, ball stops, v increases down but always due to gravity = acceleration of 9.8 m/s² or −9.8 m/s²



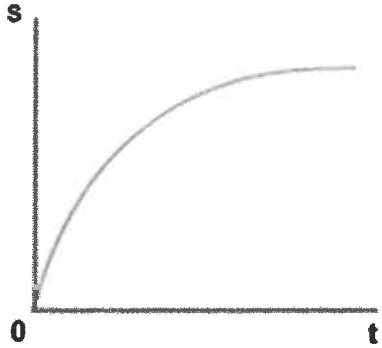




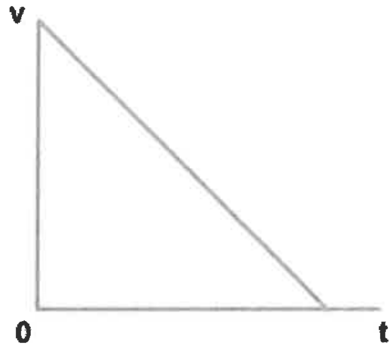
when the line crosses the x axis, motion occurs in the opp. direction

Other Examples:

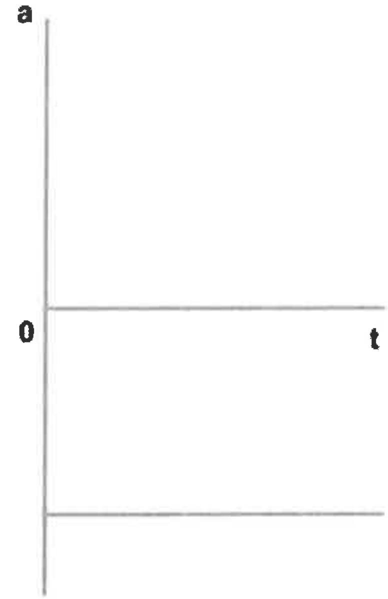
Constant negative acceleration



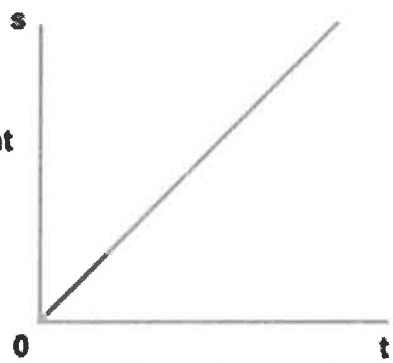
gradient of s-t graph (velocity) is positive and decreasing by the same amount each time



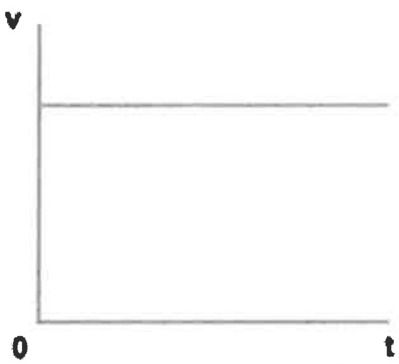
gradient of v-t graph (acceleration) is negative and constant



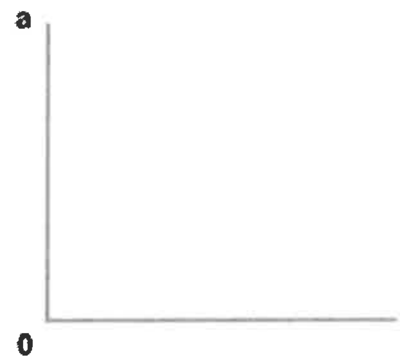
Constant positive velocity



gradient of s-t graph (velocity) is positive and constant

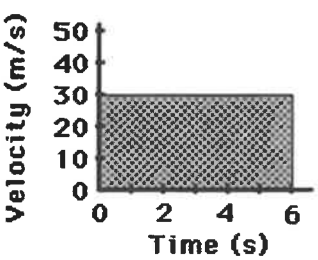


gradient of v-t graph (acceleration) is zero



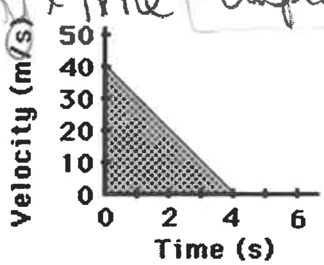
Velocity Vs Time Graphs

For velocity versus time graphs, the area under the curve gives us the displacement. area = length x width = velocity x time = displacement



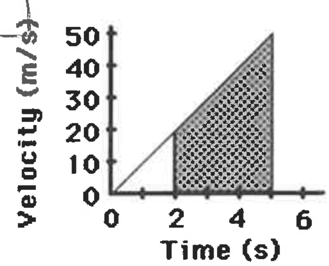
Rectangle

Area = b • h



Triangle

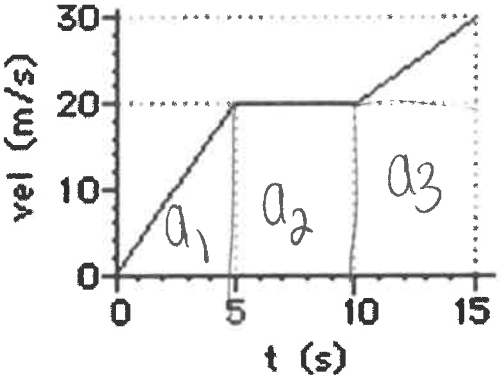
Area = ½ • b • h



Trapezoid

Area = ½ • b • $(h_1 + h_2)$

Example: The velocity-time graph below depicts the motion of a car. Assume a positive y axis represents West.



Calculate: a. the **acceleration** from 0.0 - 5.0 s

b. the car's **displacement** from 0.0 - 15.0 s

(b) $a_1 = \frac{1}{2} b \cdot h = \frac{1}{2}(5s \cdot \frac{20m}{s}) = 50m$ [W]

$a_2 = l \times w = 5s \cdot \frac{20m}{s} = 100m$ [W]

$a_3 = \frac{1}{2} b(h_1 + h_2) = \frac{1}{2} 5s\left(\frac{20m}{s} + \frac{30m}{s}\right) = 125m$ [W]

or split a_3 into □ + △

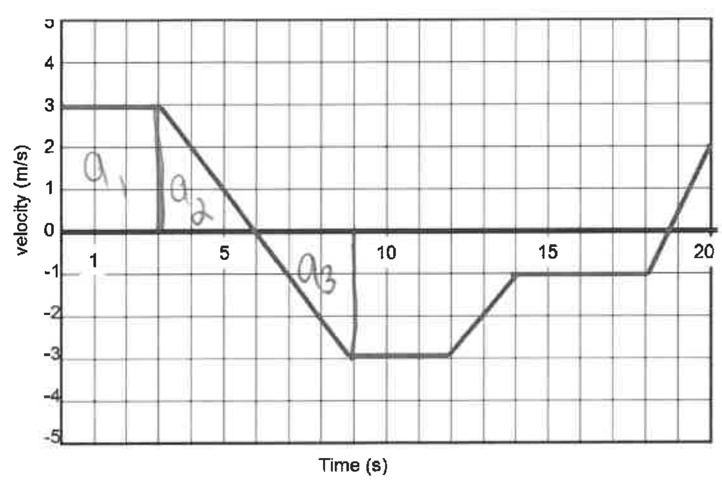
$a_T = a_1 + a_2 + a_3 = 275m$ [W]

(a) slope $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{20 - 0 m/s}{5 - 0 s} = 4 m/s^2$ [W]

Example: The velocity-time graph below depicts the motion of a dog. Assume a positive y axis represents North. Calculate the **displacement** from 0.0 - 9.0 s.

[N]

[S]



$a_1 = l \times w = 3s \cdot \frac{3m}{s} = 9m$ [N]

$a_2 = \frac{1}{2} b \cdot h = \frac{1}{2} 3s \cdot \frac{3m}{s} = 4.5m$ [N]

$a_3 = \frac{1}{2} b \cdot h = \frac{1}{2} 3s \cdot \frac{-3m}{s} = -4.5m$ [N]

or $4.5m$ [S]

$a_T = a_1 + a_2 + a_3 = 9m$ [N]