t (minutes)	0	2	5	8	12
$v_A(t)$ (meters/minute)	0	100	40	−120	−150

4. Train A runs back and forth on an east-west section of railroad track. Train A's velocity, measured in meters per minute, is given by a differentiable function $v_A(t)$, where time t is measured in minutes. Selected values for $v_A(t)$ are given in the table above.

(a) Find the average acceleration of train A over the interval $2 \le t \le 8$.

average accel = average rate of change of velocity. $\dfrac{V_A(8)-V_A(2)}{8-2} = \dfrac{-120-100}{6}$

$= -\dfrac{220}{6} = -\dfrac{110}{3}\ \text{m}/\text{min}^2$

(b) Do the data in the table support the conclusion that train A's velocity is -100 meters per minute at some time t with $5 < t < 8$? Give a reason for your answer.

yes! according to IVT, if -100 is between $V_A(5)$ and $V_A(8)$, and the fcn is continuous — which $V_A(t)$ is, because it is differentiable — then the t exists $5<t<8$ such that $V_A(t)=-100$

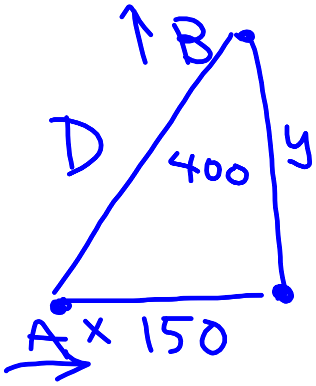
(d) A second train, train B, travels north from the Origin Station. At time t the velocity of train B is given by $v_B(t) = -5t^2 + 60t + 25$, and at time $t = 2$ the train is 400 meters north of the station. Find the rate, in meters per minute, at which the distance between train A and train B is changing at time $t = 2$.

$v_B(t) = -5t^2 + 60t + 25$

want rate of change of distance between train A and train B @ $t = 2$

$D^2 = x^2 + y^2$

$2D\frac{dD}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$



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$y' = 6(x+1)(x-2)^2$

c.p. $x = -1$ $\quad x = 2$

y': $(-)$ | -1 | $(+)$ | 2 | $(+)$

-1 min. $\quad$ 2 (plateau)

$u = x+1$
$u' = 1$
$v = (x-2)^2$
$v' = 2(x-2)$

$y'' = 6\left[(x-2)^2 + 2(x+1)(x-2)\right]$

$= 6\left[x^2 - 4x + 4 + 2(x^2 - x - 2)\right]$

$= 6\left(x^2 - 4x \cancel{+4} + 2x^2 - 2x \cancel{-4}\right)$

$= 6(3x^2 - 6x)$

$= 18x(x-2)$

$y'' = 0$ @ $x = 0,\ x = 2$

y'': $(+)$ | 0 | $(-)$ | 2 | $(+)$

0 infl pt $\quad$ 2 infl pt

#43 $a(t) = 20 \text{ m/sec}^2$

want: $v(1 \text{ min})$

$= v(60)$

$v(t) = 20t + C$

$v(0) = 20(0) + C$

$0 = 0 + C$

$C = 0$

$v(t) = 20t$

$v(60) = 1200 \text{ m/sec}$