1. You are given a displacement graph below. Draw the corresponding velocity graph on the blank grid. Label axes carefully!

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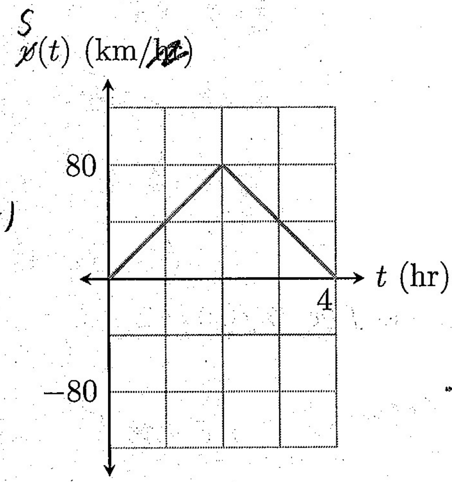
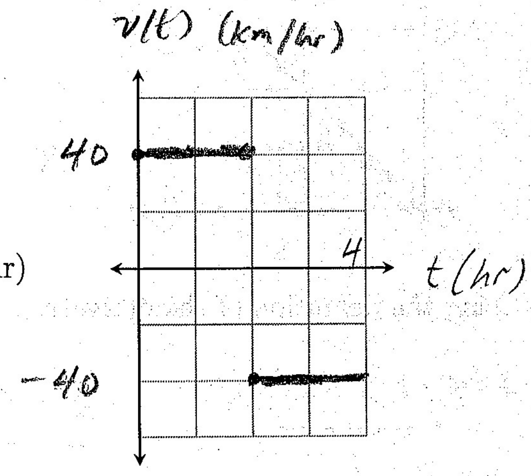
velocity is slope of s(t)

$\frac{80}{2} = 40$

$-\frac{80}{2} = -40$





Write a brief sentence describing this journey.

2. Below is a graph of the function $f(x) = 2x^2 - x^3$. Find an equation of the tangent line in the form $y = mx + b$ at $x = 1$. You can use the graph to verify your answer, but you have to use calculus to find the equation. You may use the fact that $f'(x) = 4x - 3x^2$.

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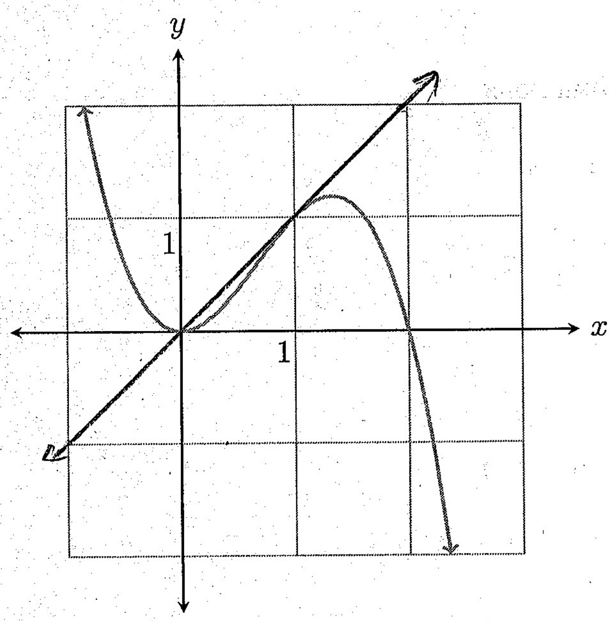

slope $= f'(1) = 4(1) - 3 \cdot 1^2$

$= 1$

$f(1) = 2 \cdot 1^2 - 1^3 = 1$

$y - 1 = 1 \cdot (x - 1)$

$y = x$

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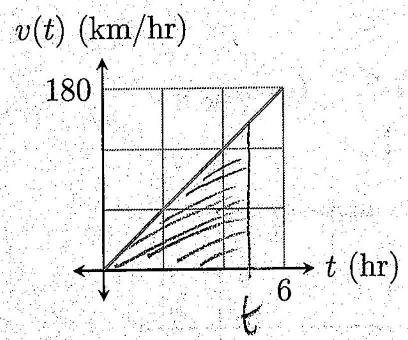
3. Below is a graph of a velocity curve. Find an equation for the displacement curve.



$v(t) = \frac{180}{6} t + 0 = 30t$

$s(t) = \text{Area under } v(t)$

$= \frac{1}{2} b h$

$= \frac{1}{2} \cdot t \cdot 30t = 15t^2$

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4. Using the definition of the derivative, find $f'(x)$ if $f(x) = 2 - x$.

$\frac{f(x+h) - f(x)}{h} = \frac{2 - (x+h) - (2-x)}{h}$

$= \frac{2 - x - h - 2 + x}{h} = \frac{-h}{h} = -1$

$f'(x) = \lim_{h \to 0} (-1) = -1$

5. Find the derivatives of the following functions.

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(a) $h(x) = x\sqrt{x}$ $= x^1 \cdot x^{\frac{1}{2}} = x^{\frac{3}{2}}$

$h'(x) = \frac{3}{2} x^{\frac{3}{2}-1} = \frac{3}{2} x^{\frac{1}{2}} = \frac{3}{2}\sqrt{x}$

(b) $h(x) = x\sin(x)$

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$f(x) = x$ $f'(x) = 1$

$g(x) = \sin(x)$ $g'(x) = \cos(x)$

$h'(x) = f(x)g'(x) + g(x)f'(x)$

$= x \cdot \cos(x) + \sin(x) \cdot 1$

$= x\cos(x) + \sin(x)$

+9

(c) $h(x) = \dfrac{\cos(x)}{x^2}$

$f(x) = \cos(x)$ $\quad f'(x) = -\sin(x)$

$g(x) = x^2$ $\quad g'(x) = 2x$

$$h'(x) = \frac{g(x)f'(x) - f(x)g'(x)}{g(x)^2}$$

$$= \frac{x^2(-\sin(x)) - \cos(x)\cdot 2x}{(x^2)^2}$$

$$= \frac{-x^2\sin(x) - 2x\cos(x)}{x^4} = \frac{x(-x\sin(x) - 2\cos(x))}{x^4}$$

$$= \frac{-x\sin(x) - 2\cos(x)}{x^3}$$

(d) $h(x) = \sin(x^2 - 1)$

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$f(x) = \sin(x)$ $\quad f'(x) = \cos(x)$

$g(x) = x^2 - 1$ $\quad g'(x) = 2x$

$$f'(g(x))g'(x) = \cos(g(x))\cdot 2x$$

$$= 2x\cos(x^2-1)$$

6. Suppose $f(x) = \cos(x) - x^5$. Find $f''(x)$.

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$f'(x) = -\sin(x) - 5x^4$

$f''(x) = -\cos(x) - 20x^3$

7. Below is a graph of $f(x) = x^4 - 2x^3$. You are given that $f'(x) = 4x^3 - 6x^2$ and $f''(x) = 12x^2 - 12x$. By making the appropriate sign chart, find all inflection points on this curve.

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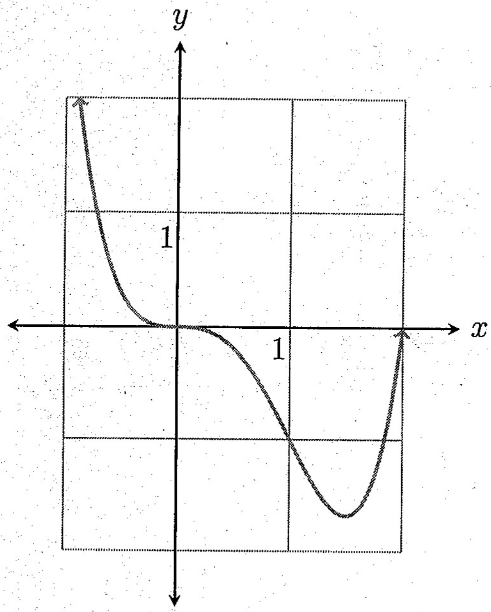

$f''(x) = 12x^2 - 12x = 0$
$12x(x-1) = 0$
$x = 0 \quad x = 1$

+ − +
−1 0 $\frac{1}{2}$ 1 2

Test points

$f''(-1) = 12(-1)^2 - 12(-1) = 24 > 0$
$f''(\frac{1}{2}) = 12(\frac{1}{2})^2 - 12(\frac{1}{2}) = -3 < 0$
$f''(2) = 12(2^2) - 12(2) = 24 > 0$

Concavity changes so inflection points at (0,0) and (1,−1).

For points
$f(0) = 0^4 - 2 \cdot 0^3 = 0$
$f(1) = 1^4 - 2(1^3) = -1$

8. Fill in the blanks with either $f(x)$, $f'(x)$, or $f''(x)$.

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(a) To make a sign chart to find inflection points, we use $f''(x)$.

(b) To find the y-value for a local minimum, we use $f(x)$.

(c) To find where a function is increasing or decreasing, we use $f'(x)$.