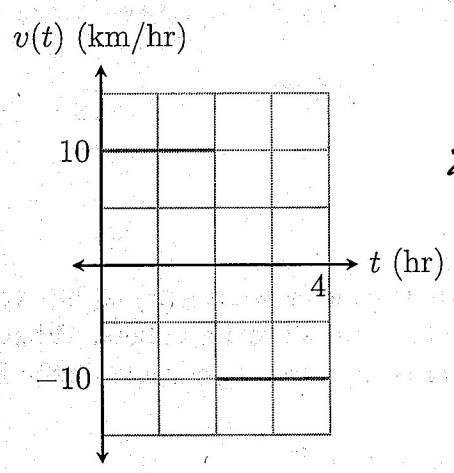
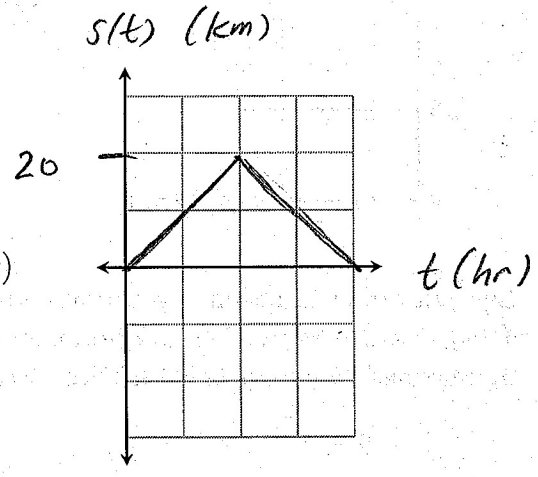
1. You are given a velocity graph below. Draw the corresponding displacement graph on the blank grid. Label axes carefully!

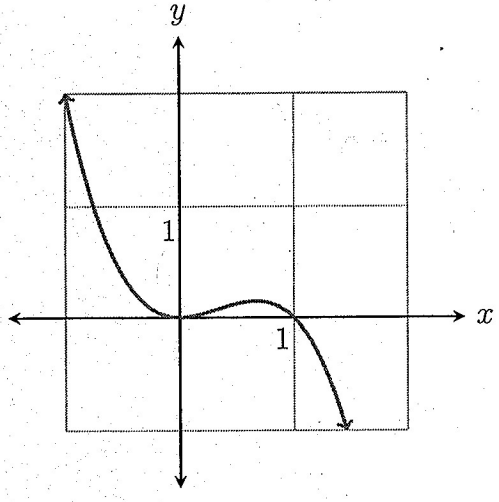




Write a brief sentence describing this journey.

You drive 2 hours east at 10 km/hr, then you turn around and drive 2 hours west at 10 km/hr

2. Below is a graph of the function $f(x) = x^2 - x^3$. 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.



$f'(x) = 2x - 3x^2$

$m = f'(1) = 2(1) - 3(1)^2 = -1$

point: $f(1) = 1^2 - 1^3 = 0$

$(1, 0)$

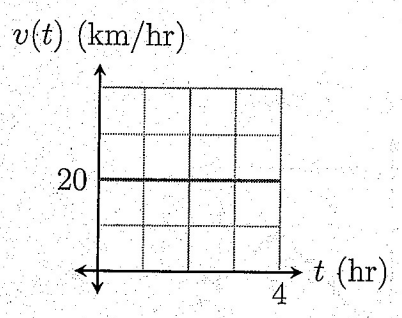
$y = mx + b$

$0 = -1(1) + b$

$b = 1$

$y = -x + 1$

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



$s(t)$ = area under $v(t)$

$= 20t$

4. Let $f(x)$ be a function – you don't know exactly what $f(x)$ is, but you are given that $f'(x) = x(3-2x)^2$. The function is defined on all real numbers. Where is this function increasing? Where is this function decreasing? Write your answers in interval notation.

$(3-2x)^2$ is always positive.

So $f'(x) < 0$ when $x < 0$, and $f'(x) > 0$ when $x > 0$

Increasing: $(0, \infty)$

Decreasing: $(-\infty, 0)$

5. Find the derivatives of the following functions.

(a) $h(x) = \frac{7}{x^2} = 7x^{-2}$

$h'(x) = 7(-2x^{-3}) = -14x^{-3}$

(b) $h(x) = 3x\cos(x)$

$f(x) = 3x \quad f'(x) = 3$

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

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

$3x(-\sin(x)) + \cos(x) \cdot 3$

$-3x\sin(x) + 3\cos(x)$

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

$f(x) = 2x \quad f'(x) = 2$

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

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

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

(d) $h(x) = \cos(5x^2)$

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

$g(x) = 5x^2 \quad g'(x) = 10x$

$$f'(g(x))\,g'(x)$$

$$-\sin(g(x))\cdot 10x$$

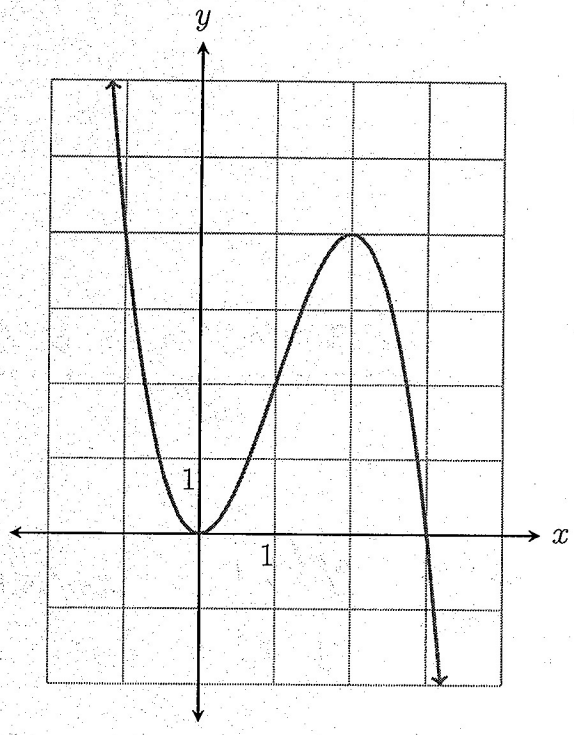
$$-10x\sin(5x^2)$$

6. Suppose $f(x) = 3x - \cos(x)$. Find $f''(x)$.

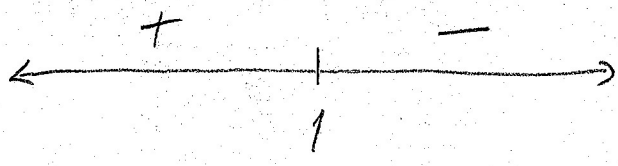
$$f'(x) = 3 - (-\sin(x))$$
$$= 3 + \sin(x)$$

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

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



$f''(x) = 6 - 6x = 0$



Test points:

$f''(-1) = 6 - 6(-1) = 12 > 0$

$f''(2) = 6 - 6 \cdot 2 = -6 < 0$

Since concavity changes at $x = 1$, there is an inflection point at $(1, 2)$.

8. Fill in the blank with the best answer. Write out words completely; do not use abbreviations.

(a) We use information about when $f'(x)$ is positive or negative to determine where the function is increasing or decreasing.

(b) We use information about when $f''(x)$ is positive or negative to determine where the function is concave up or concave down.

(c) An inflection point is a point on the graph where the concavity changes.