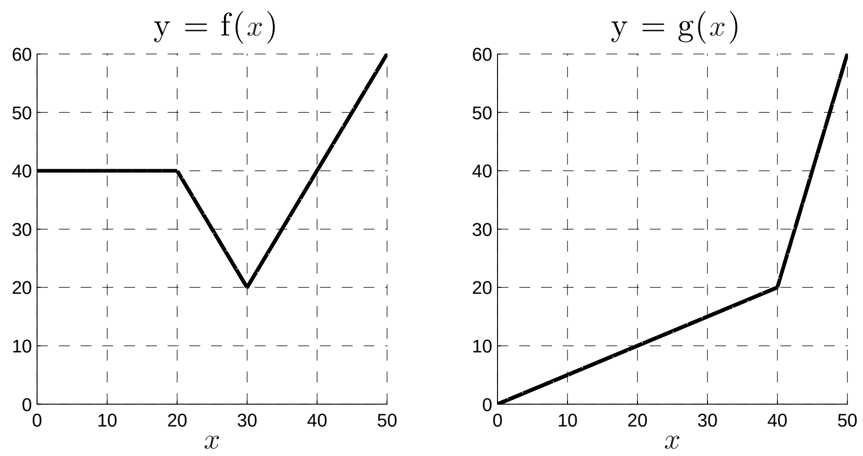
4. (10 points) Consider the graphs of $f(x)$ and $g(x)$ below. Let $h(x) = f(g(x))$.



(a) Evaluate $h'(30)$ exactly. Show your work.

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

At $x = 30$ we have $g(30) = 15$ and $g'(30) = 0.5$. Thus $h'(30) = f'(15)0.5$. However, $f'(15) = 0$, so

$$h'(30) = 0.$$

(b) Determine the range of values of x for which $h'(x) < 0$. Justify your answer.

Note, for $h'(x) < 0$ we need to be in the x range where $f'(x) < 0$, since $g'(x) > 0$ for all x.

We have $f'(x) < 0$ for $20 < x < 30$, so $g'(x)$ must be between 20 and 30. We have $g(40) = 20$ and the slope of g for $x > 40$ is 4. Thus, as $g(x)$ increases by 10, x increases by 2.5, so $g(42.5) = 30$.

Thus, the range of values of x such that $h'(x) < 0$ is $\boxed{40 < x < 42.5}$.

Note that f is not differentiable at $x = 20$ or $x = 30$, so the inequality does not include the endpoints.