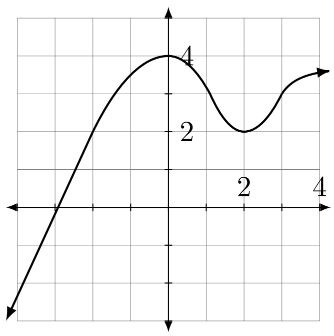
1. **(5 points)** *Find the maximum and minimum values of the function $f(x) = x^3 - 3x^2 - 9x + 2$ on the interval $[-2, 2]$.*

   $f'(x) = 3x^2 - 6x - 9 = 3(x-3)(x+1)$, so f' has critical points at $x = 3$ and $x = -1$. Since 3 is outside the interval of interest, we consider only $x = -1$ as an extremal candidate; we also consider the interval's endpoints $x = -2$ and $x = 2$. Since $f(-2) = 0$, $f(-1) = 7$, and $f(2) = -20$, the maximum and minimum values of $f(x)$ in this interval are 7 (achieved at $x = -1$) and -20 (achieved at $x = -20$) respectively.

2. **(6 points)** *Given the following graph of a function $f(x)$, find the following features, specifically saying so if a feature does not exist.*

   Intervals where the function is increasing: $(-\infty, 0)$ and $(2, \infty)$.
   Intervals where the function is decreasing: $(0, 2)$.
   Local maxima: $(0, 4)$.
   Local minima: $(2, 2)$.
   Global maxima: $(4, 4)$.
   Global minima: None: the function goes lower than the aforementioned local minimum.

3. **(9 points)** *Answer the following questions about the function $f(x) = x^6 - 6x^4 + 2$.*

   (a) **(3 points)** *On which intervals is it increasing, and on which intervals is it decreasing? Label which is which.*

   $f'(x) = 6x^5 - 24x^3 = 6x^3(x-2)(x+2)$, which yields critical points at $x = 0$, $x = 2$, and $x = -2$. Probing each interval, we see that $f'(x) < 0$ on $(-\infty, -2)$, so f is decreasing there; $f'(x) > 0$ on $(-2, 0)$, so f is increasing there, $f'(x) < 0$ on $(0, 2)$, so f is decreasing there, and $f'(x) > 0$ on $(2, \infty)$, so f is increasing there.

   (b) **(2 points)** *Identify the critical points of this function, and classify each as a local maximum, a local minimum, or a non-extremum.*

   From the above investigation, $x = -2$ is a transition from decrease to increase, and thus a local minimum, $x = 0$ is a transition from increase to decrease, and thus a local maximum, and $x = 2$ is a transition from decrease to increase, and thus a local minimum.

   (c) **(3 points)** *On which intervals is it concave up, and on which intervals is it concave down? Label which is which.*

   $f''(x) = 30x^4 - 72x^2 = 6x^2(5x^2 - 12x) = 30x^2\left(x - \sqrt{\frac{12}{5}}\right)\left(x + \sqrt{\frac{12}{5}}\right)$, so $f''(x)$ is zero when $x = 0$ or $x = \pm\sqrt{\frac{12}{5}}$. Probing among these shows that $f''(x)$ is positive, and thus $f(x)$ concave up, on $(-\infty, -\sqrt{\frac{12}{5}})$.

   (d) **(1 point)** *Where are its points of inflection? If it has none, say so explicitly.*