5. [4 points]
Let α and β be constants such that

- $\ln(\alpha) = 2$
- $\ln(\beta) = 5$

Find the value of $\ln(\alpha^6\beta^{-3}e^{25})$. Your answer should **not** include α, β, or ln.

Solution: Using log rules, we can write

$$\begin{aligned}\ln(\alpha^6\beta^{-3}e^{25}) &= \ln(\alpha^6) + \ln(\beta^{-3}) + \ln(e^{25})\\ &= 6\ln(\alpha) - 3\ln(\beta) + 25\\ &= 12 - 15 + 25 = 22\end{aligned}$$

$\ln(\alpha^6\beta^{-3}e^{25}) =$ 22

6. [6 points]
Let $P(x)$ be a polynomial with the following properties:

- $P(x)$ only has zeros at $x = -3, -1, 2$
- $P(x)$ has degree 4
- The graph of $P(x)$ passes through the points $(-4, -36)$ and $(-2, -8)$

Find a formula for $P(x)$. You do not need to simplify your answer.

Solution: $P(x)$ has degree 4 but only has three zeros, so one of them must be a double zero. Note that at $x = -4$ and $x = -2$, the outputs are both negative, yet there is a zero between them. This implies that $x = -3$ must be a double zero, so that our polynomial is of the form

$$P(x) = c(x+3)^2(x+1)(x-2)$$

where c is some constant. To find c, we can use one of the points, say $(-2, -8)$. Plugging it in, we get

$$-8 = c(-2+3)^2(-2+1)(-2-2) = 4c$$

Hence $c = -2$.

$P(x) =$ $-2(x+3)^2(x+1)(x-2)$

