

6. [6 points] The *Lambda* app team needs to set up an internet connection for their new office. They will utilize both fiber internet and wireless 5G. Due to some serious issues with the building, the team knows that 10% of the data transferred via fiber will be lost, and 30% of the data transferred via the wireless connection will be lost. Assume throughout this problem that, each month, the company loses exactly 15 gigabytes (GB) of transferred data.
- a. [2 points] If each month, the team transfers F GB of data via fiber and W GB via wireless, write a formula for F in terms of W .

Solution: We know that 10% of F and 30% of W will be lost, and that the company will lose 15 GB a month, so $15 = 0.1F + 0.3W$, or $\frac{15 - 0.3W}{0.1} = F$.

Answer: $F = \frac{15 - 0.3W}{0.1}$

However, the team also wants to consider the monthly energy consumption of the methods, which, in gigajoules (GJ), is given by

$$(W + 1)^4 + (F + 4)^2.$$

- b. [1 point] Write a formula for the energy $\mathcal{E}(W)$, in GJ, as a function of W only. *Your formula should not include the letter F .*

Solution: We substitute the answer to part **a.** into the given formula for energy:

Answer: $\mathcal{E}(W) = (W + 1)^4 + \left(\frac{15 - 0.3W}{0.1} + 4\right)^2$

- c. [3 points] Additionally, the team wants to ensure that $2W \geq F$. Including this additional constraint, what is the domain of the function $\mathcal{E}(W)$ in the context of this problem?

Solution: We must have $W > 0$, as well as $F = \frac{15 - 0.3W}{0.1} > 0$, or $W < \frac{15}{0.3} = 50$. Then we are also told $2W \geq F$, so

$$2W \geq \frac{15 - 0.3W}{0.1}$$

$$0.2W \geq 15 - 0.3W$$

$$0.5W \geq 15$$

$$W \geq 30$$

Answer: $[30, 50)$