

Name (please print): _____

UID: _____

Lecture Section, 3 (1PM) or 4 (3PM): _____

Instructions

- You will independently be given points for your reasoning, your mathematical work, and for correctness of answers, so make sure to **show your reasoning and work** even if you're not certain you can compute the correct answer. Try to **convey your solution strategy even if you can't execute it in time**.
- If on a given problem you need some space to do scratch work, do that scratch work elsewhere. **Only the work that is included on this test packet in the space provided will be graded.**
- Box any numerical or symbolic answers so that the grader can easily find them.
- Don't worry about significant figures or precision of final numerical answers. Don't worry about roundoff errors. As long as numerical answers are reasonably close to the correct answer and your process is correct, you will get full credit for numerical answers.

Academic Conduct Acknowledgement

I acknowledge that I have completed this quiz in the time allotted entirely on my own, without using anything but the exam, a writing utensil, eraser, and calculator. I have not posted the quiz question or an equivalent variant of it on the internet (for example on Chegg). I did not communicate with anyone about the quiz during the 24-hour submission period.

Please sign here: _____

Josh's electricity at home is provided by Southern California Edison, and in his area, his electricity bill has "tiers." This means that he is charged more for his electricity as he passes certain cutoffs, and it gives him an incentive to not over-consume electricity. His particular plan has three tiers as specified in the table below:

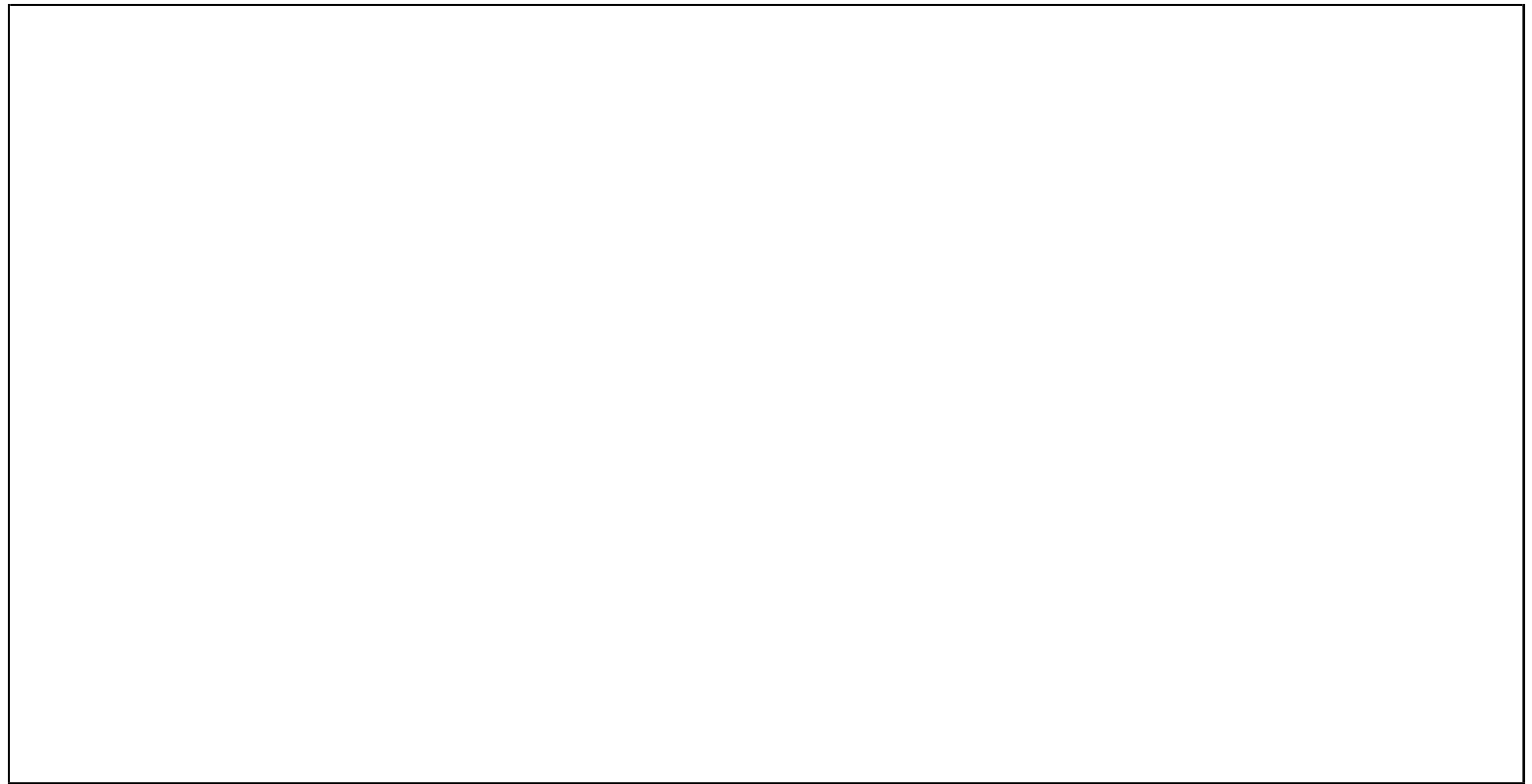
Tier Number	Monthly Energy Consumption Range	Price
Tier 1	less than or equal to 362 kWh	\$0.16/kWh
Tier 2	greater than 362 kWh and less than or equal to 1447 kWh	\$0.23/kWh
Tier 3	greater than 1447 kWh	\$0.31/kWh

For example, if Josh uses 450 kWh in a given month, then for the first 362 kWh his consumption falls in Tier 1, and he pays $(\$0.16/\text{kWh})(362 \text{ kWh}) = \57.92 . For the remaining $450 \text{ kWh} - 362 \text{ kWh} = 88 \text{ kWh}$ his consumption falls in Tier 2, and he pays $(\$0.23/\text{kWh})(88 \text{ kWh}) = \20.24 . His total bill for that month would therefore come to $\$57.92 + \$20.24 = \$78.16$.

In August of 2021, Josh decided to continuously keep his home's thermostat at 72°F. This means that his home's internal temperature can be approximated as having been a constant 72°F the whole month. The temperature of the air outside fluctuated quite a lot over time, but to good approximation we treat it as having been a constant 80°F. Josh's air conditioning system, which functions as a heat pump (a cooler), operated at roughly 15% of its theoretical maximum coefficient of performance during the month of August.

1. What was the theoretical maximum COP of Josh's air conditioning system in August of 2021? What was its actual COP?

2. If Josh paid \$342.57 for electricity in August of 2021, how much energy did his air conditioning system consume, and how much thermal energy did it remove from the inside of his home during that month?



3. If Josh's air conditioning system had an actual COP that was instead 30% of its theoretical maximum, what would his electricity bill have been?

