

1. A friend said the temperature inside a certain oven is 500 and the temperature inside a certain star is 50,000. You're unsure about whether your friend meant Celsius degrees or kelvins. How much difference does it make in each case?
2. The temperature of the sun's interior is about 10^7 degrees. Does it matter whether this is degrees Celsius or kelvins? Explain.
4. If you vigorously shake a can of liquid back and forth for more than a minute, will the temperature of the liquid increase? (Try it and see.)
5. When air is quickly compressed, why does its temperature increase?
6. When you pump a tire with a bicycle pump, the cylinder of the pump becomes hot. Give two reasons why this is so.
7. What happens to the gas pressure within a sealed gallon can when it is heated? Cooled? Why?
12. What is the ultimate source of energy in a hydroelectric power plant?
13. What is the ultimate source of energy in an OTEC power plant?
14. The combined molecular kinetic energies of molecules in a cool lake are greater than the combined molecular kinetic energies in a cup of hot tea. Pretend you partially immerse the teacup in the lake and that the tea *absorbs* 10 calories from the water and becomes hotter, while the water that gives up 10 calories becomes cooler. Would this energy transfer violate the first law of thermodynamics? The second law of thermodynamics? Defend your answers.
15. Why is *thermal pollution* a relative term?
17. Why is it advantageous to use steam as hot as possible in a steam-driven turbine?
18. How does the ideal efficiency of an automobile relate to the temperature of the engine and the temperature of the environment in which it runs? Be specific.
19. Will the efficiency of a car engine increase, decrease, or remain the same if the muffler is removed? If driven on a very cold day? Defend your answers.
20. What happens to the efficiency of a heat engine when the temperature of the reservoir into which thermal energy is transferred is lowered?
9. Why do diesel engines need no spark plugs?
10. Everybody knows that warm air rises. So it might seem that the air temperature should be higher at the top of mountains than down below. But the opposite is most often the case. Why?
11. What is the ultimate source of energy in coal, oil, and wood? Why do we call energy from wood renewable but energy from coal and oil non-renewable?
22. Under what conditions would a heat engine be 100 percent efficient?
23. Could you cool a kitchen by leaving the refrigerator door open and closing the kitchen door and windows? Explain.
24. Could you warm a kitchen by leaving the hot oven door open? Explain.
25. An electric fan not only doesn't decrease the temperature of air, but actually increases air temperature. How, then, are you cooled by a fan on a hot day?
27. The efficiency of an OTEC power plant is very small compared with the efficiency of fossil fuel and nuclear power plants. Why isn't this a serious shortcoming?
28. In buildings that are being electrically heated, is it at all wasteful to turn all the lights on? Is turning all the lights
31. A wet bathing suit spontaneously chills itself (and its occupant). How can this happen without violating the second law of thermodynamics? (Hint: Is the bathing suit just transforming heat to its warmer surroundings, or is it doing more than that?)
32. Is the total energy of the universe becoming more unavailable with time? Explain.
33. Comment on this statement: The second law of thermodynamics is one of the most fundamental laws of nature yet it is not an exact law at all.
34. Water evaporates from a salt solution and leaves behind salt crystals that have a higher degree of molecular order than the more randomly moving molecules in the salt water. Has the entropy principle been violated? Why or why not?
35. Water put into a freezer compartment in your refrigerator goes to a state of less molecular disorder when it freezes. Is this an exception to the entropy principle? Explain.
36. As a chicken grows from an egg, it becomes more ordered with time. Does this violate the principle of entropy? Explain.
37. The Patent Office rejects claims for perpetual motion machines (in which the energy out is as great or greater than the energy in) without even studying them. Why is this?
38. (a) If you spent ten minutes repeatedly shaking and throwing down a pair of coins, would you expect to see two heads come up at least once? (b) If you spent an hour shaking a handful of ten coins and throwing them down, would you expect to see all ten come up heads at least once? (c) If you stirred a box of 10,000 coins and dumped them repeatedly on the floor all day long, would you expect to see all 10,000 come up heads at least once?
39. In your bedroom are probably some 10^{27} air molecules. If they all happened to congregate on one side of the room, you could suffocate. But this is unlikely. Is such a circumstance less likely, more likely, or the same if there are many times fewer molecules in the room?
3. When you step out of a swimming pool on a hot, dry day in the Southwest, you feel quite chilly. Why?
4. Why is sweating an efficient mechanism for cooling off on a hot day?
5. Why does blowing over hot soup cool the soup?
6. Can you give two reasons why pouring a cup of hot coffee into a saucer results in faster cooling?
7. A covered glass of water sits for days with no drop in water level. Strictly speaking, can you say that nothing has happened, that no evaporation or condensation has taken place? Explain.
8. How might water be desalinated by freezing?
9. Pretend that all the molecules in a liquid have the same speed, not random speeds. Would evaporation of this liquid cause the remaining liquid to be cooled? Explain.
14. What is the ultimate source of energy in coal, oil, and wood? Why do we call energy from wood renewable but energy from coal and oil nonrenewable?
40. The ocean possesses enormous numbers of molecules, all with kinetic energy. Can this energy be extracted and used as a power source? Defend your answer.
23. A great amount of water vapor changes phase to become water in the clouds that form a thunderstorm. Does this release thermal energy or absorb it?
24. When can you add heat to something without raising its temperature?
25. When can you withdraw heat from something without lowering its temperature?
26. Why does the temperature of boiling water remain the same as long as the heating and boiling continue?
16. The combined molecular kinetic energies of molecules in a cool lake are greater than the combined molecular kinetic energies of molecules in a cup of hot tea. Pretend you partially immerse the teacup in the lake and that the tea *absorbs* 10 calories from the water and becomes hotter, while the water that gives up 10 calories becomes cooler. Would this energy transfer violate the first law of thermodynamics? The second law of thermodynamics? Defend your answers.