

Heat & Thermodynamics Test Review (Ch. 9-10)

Formulas you'll be given:

Heat Capacity: $Q = m \cdot c_p \cdot \Delta T$

1st Law of Thermodynamics: $\Delta U = Q + W_{\text{on the system}}$ or $\Delta U = Q - W_{\text{by the system}}$

Heat Engines: $W = Q_h - Q_c$

Temperature: $T_F = 1.8T_C + 32$, $T_K = T_C + 273$

Heat Engine Efficiency: $Eff. = 1 - T_c/T_h$ or $Eff. = 1 - Q_c/Q_h$

Practice Problems:

1. What is the difference between heat and temperature? What are the units of each?
2. What is the difference between temperature and internal energy? Which one depends on how many molecules the system has?
3. Define absolute zero. What temperature is this on the Kelvin and Celsius scale?
4. What is wrong with saying that 20°C is twice as hot as 10°C?
5. What does it mean to say that a substance has a high specific heat capacity?
6. How much heat is required to raise the temperature of 25 g of gold by 150°C? ($c_{p, \text{gold}} = 0.129 \text{ J/g}\cdot^\circ\text{C}$)
7. Suppose a newly minted coin at 115°C is dropped into an equal mass of water at 20°C to cool it. If the final temperature of the mixture is 25°C, then what is the specific heat capacity of the coin? Use p. 314 in your book to determine the type of metal the coin is made of. ($c_{p, \text{H}_2\text{O}} = 4186 \text{ J/kg}\cdot^\circ\text{C}$)
8. Identify the type of heat transfer in the following situations:
 - a. Toasting a piece of bread in the toaster
 - b. Feeling cold tiles when you walk barefoot on them
 - c. Putting potatoes in water and making the water boil to cook them.
9. If 300 J of work is done on a system of gas molecules and 1000 J of heat are also added to the system, how much is the change in internal energy of the system?
10. If a system of gas molecules receives 225 J of heat and does 100 J of work, how much is the change in internal energy of the system?
11. If a system of gas molecules loses 4000 J of energy in the form of heat, but there is 1500 J of work done on it, how much will the internal energy of the system change by?
12. If a gasoline engine has a heat input of 1200 J and a heat output of 980 J during each cycle, how much work does it do during each cycle? What is the efficiency of the engine?
13. If a heat engine takes in 3000 J of heat and does 1300 J of work during each cycle, how much heat does it put out during each cycle?
14. In one cycle, suppose a refrigerator compressor does 180 J of work to remove 370 J of heat from the inside of the refrigerator (the low temperature reservoir). How much heat does the refrigerator therefore put into the room (the high temperature reservoir)? Hint: a refrigerator is a "heat engine in reverse."

15. A child puts together a puzzle. Has the entropy of the puzzle pieces increased or decreased?
 16. Water can exist in three forms: solid, liquid and gas. What form has the highest entropy? Lowest entropy? Explain.
 17. When H₂O molecules crystallize into ice, does the entropy of the molecules increase or decrease?
 18. Bonus: Calculate the ideal (maximum possible) efficiency of an automobile whose engine operates at 360. °C and whose exhaust is 95 °C. (Remember: you can only multiply and divide by temperature when using an absolute temperature scale like Kelvin.)
- 19. From the book: p. 364 #1, 3-8, p. 326 #1-6**

Answers to Multiple Choice
p. 364 1.B 2.H 3.A 4.G 5.C 6.J 7.B 8.F
p. 326 1.D 2.F 3.C 4.G 5.C 6.J 7.B