

Student Response Sheet - Answer Sheet

School: _____ V JV1 JV2 JV3

Student Names: _____

For each answer, fill in the blank or circle the correct response. For numerical answers, values should be written with the correct number of significant figures and units. Only answers written on this answer sheet will be graded.

Tiebreakers - 12, 10, 21, 18, 17, 15, 6, 7, 8, 23, 2, 5,

1. _____

15. _____

2. A B C D

3. _____

4. _____

16. A B C

17. A B C D E

18. A B C D E

19. _____

5. A B C D E

6. _____

20. A B C D

7. _____

21. _____

8. _____

22. A B C D

9. _____

23. _____

10. A B C D

24. A B C

11. _____

25. A B C

12. _____

13. A B C D E

14. _____

Thermodynamics Written Test

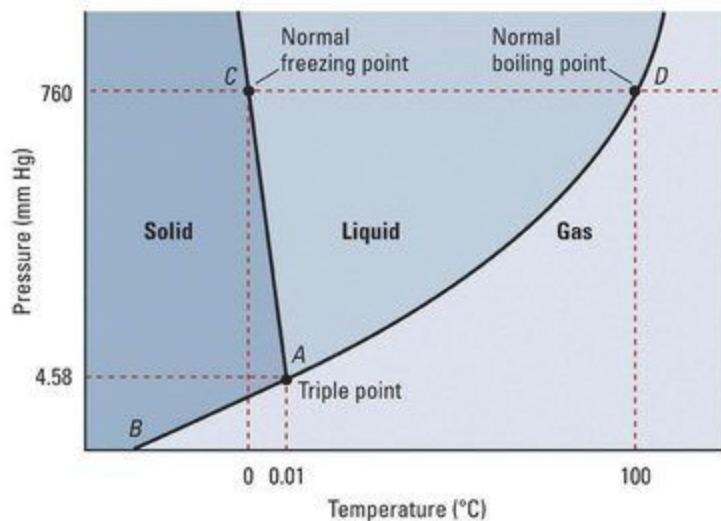
Note: Answer all questions on the provided **Answer Sheet**. Do not write on these exams.

1. Who is regarded as the “Father of Thermodynamics”?
2. All of the following pairings EXCEPT ONE identifies a scientist and their contribution to the field of thermodynamics. Which one is incorrect?
 - A. Joule - mechanical equivalent of heat
 - B. Carnot - useful effect of a motor (work)
 - C. Boltzmann - the connection between entropy and molecular motion
 - D. Clausius - identified enthalpy as a heat function for constant pressure
3. Which scientist is famous for experimentally finding the mechanical equivalent of heat?
- 4.(2pts) Assume the average human consumes 2.00×10^3 Kilocalories a day, and the average light bulb requires 86,400,000 Joules of energy per day. How much more energy does the lightbulb consume per day?
5. Aluminum particles are placed in a vacuum. Which of the following temperatures could be achieved by the particles in this vacuum?
 - A. 34 K
 - B. -400 F
 - C. 1,000,000 C
 - D. None of the above
 - E. All of the above

Questions 6-8 refer to the paragraph below:

A scientist in a lab creates a brand-new temperature scale called the Wolfie scale. The Wolfie scale is based around absolute zero and the melting point of gold (1948 degrees Fahrenheit). 0 degrees Wolfie is set at absolute zero, and 100 degrees Wolfie is set at the melting point of gold.

6. (2 pts) A change in temperature of 2.0 degrees Wolfie is equal to how many Kelvin?
7. (2 pts) The specific heat of water is $4.19 \text{ J}/(\text{g} \cdot \text{K})$. How much energy, in Joules, is required to heat up 1.00 liters of water by 1.00 degree Wolfie?
8. (2 pts) What is the specific heat of water in Joules per gram Wolfie?
9. The burning of a sample of propane generated 104.6 kJ of heat. All of this heat was used to heat 500.0 g of water that had an initial temperature of 20.0 C. What was the final temperature of the water?
10. The pressure is increased on a sample of water at 0 °C from 0 mmHg to 800 mmHg. In order, what changes occur?



- A. deposition, melting
B. condensation, freezing
C. sublimation, melting
D. deposition, freezing

11. (2 pts) A student must use 445 mL of hot water in a lab procedure. Calculate the amount of heat required to raise the temperature of 445 mL of water from 23.0 °C to 100.0 °C.

12. (3 pts) 25.00 grams of H_2 and 10.00 grams of O_2 are placed in a container at 300.0 K and 101.325 kPa. The mixture is ignited to form gaseous water. The container is cooled back to 300.0 K after the reaction. Determine the total pressure in the container at this point.

13. A student opens the top window and the bottom window in a hot room. Warmer air goes out of the top window, while cooler air comes in the bottom window. Which best explains why the room becomes cooler?

- A. Reflection
- B. Diffraction
- C. Conduction
- D. Radiation
- E. Convection

14. (2 pts) If it takes 105 calories to warm 100.0 g of a sample from 20.0 °C to 25 °C, what is the specific heat of the sample?

15. (2 pts) A copper cylinder has a mass of 76.8 g and a specific heat of 0.092 cal/(g·K). It is heated to 86.5 °C and then put in 68.7 g of oil which has a temperature of 19.5° C. The final temperature of the mixture is 31.9° C. What is the specific heat of the oil?

16. The specific heat of mercury is 0.140 cal/(g · K). The specific heat of water is 1.00 cal/(g · K). When 40 J of heat is added to an equal mass of each substance at STP, the sample of mercury expands _____ the sample of water does.

- A. More than
- B. Equally as much as
- C. Less than

17. Which of two rods has the greater thermal conductivity?

- A. A rod with electrons that are more free to move from atom to atom than are the electrons in another rod
- B. A rod with greater specific heat than another rod
- C. A rod with greater cross-sectional area than another rod
- D. A rod with greater length than another rod
- E. A rod with the greatest insulative properties

18. Which of the following statements are true for an isothermal process? Circle ALL that apply.

- A. During an isothermal process, the work done by the gas equals the heat added to the gas.
- B. During an isothermal process, the internal energy of the system changes.
- C. An isothermal process is carried out at constant temperature.
- D. An isothermal process is carried out at constant pressure.
- E. An isothermal process is carried out at constant volume.

19. What is the maximum theoretical efficiency possible for an engine operating between 100.0 °C and 400.0 °C? (Give a percentage)

20. A _____ is an example of a reversed heat engine.

- A. heat pump
- B. refrigerator
- C. both of the above
- D. Neither of the above

21.(2 pts) Consider the following scenario: 0.300 moles of a diatomic gas is placed in a perfectly insulating piston at 203,000 Pa of pressure. The piston is a cylinder in shape and has a radius of 10.0 cm and a height of 20.0 cm. Note that the gas constant R is 8.314 J/(mol · K).

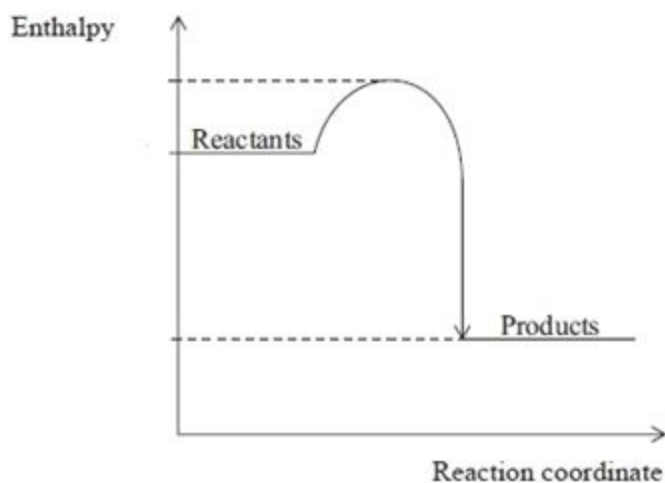
What is the temperature of the gas in the piston?

22. According to the second law of thermodynamics, Gibbs free energy will always _____ in a closed system that is *not* in equilibrium:

- A. Increase
- B. Decrease
- C. Stay Constant
- D. Change proportionally to the change in enthalpy

23.(2pts) A surface is measured to have an emissivity of $\varepsilon = 0.986$. Calculate the radiant exitance (in W/m^2) of this surface when it is at 285.0 K.

24. Consider the diagram below, representing a chemical reaction:



The reaction is:

- A. Exothermic
- B. Endothermic
- C. Isothermic

25. Consider the solid compound $KClO_3$. When it dissolves in distilled water, the enthalpy has increased. Furthermore, the entropy has _____ and the Gibbs free energy has decreased.

- A. Increased
- B. Decreased
- C. Remained Constant

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- | | |
|--|---------------------------------|
| 1. Carnot | 15. 0.45 cal/(g·K)(2pts) |
| 2. D | 16. A |
| 3. Joule | 17. A |
| 4. 7.803 x 10⁷ J(2pts) | 18. A, C |
| 5. E | 19. 44.57% |
| 6. 27 (2 pts) | 20. B |
| 7. 56,600 J(2pts) | 21. 511K (2pts) |
| 8. 56.6 J/(g G) (2 pts) | 22. B |
| 9. 70.0 C (2pts) | 23. 369 W/m ² (2pts) |
| 10. A | 24. A |
| 11. 143 kJ (2pts) | 25. A |
| 12. 98.83 (3 pts) | |
| 13. E | |
| 14. 0.21 cal/(g K)(2pts) | |

