Student Response Sheet -Answer Sheet

School: _____ V JV1 JV2 JV3 JV4

Student Names: _____

For each answer, fill in the blank or circle the correct response.

1. _____302°F_____

2. _____445 K_____

3. Solid A- Butter Coconut Oil Palm Oil Shortening

   Solid B- Butter Coconut Oil Palm Oil Shortening

   Solid C- Butter Coconut Oil Palm Oil Shortening

4. A B C D

5. A B C D E

6. A B C D E

7. A B C D

8. A B C D E

9. _____Gold_____

10. ___Aluminum_____

11. _____75 kJ_____

12. A B C D

13. True False

14. A B D D

15. A B C D

16. _____67%_____

17. A B C

18. A B C D

19. A B C D

20. A B C D

21. _____phlogiston_____

22. ___canon boring___

Thermodynamics Written Test

Answer all questions on the Student Response Sheet. Be sure all answers include the appropriate units. Any answers written on this test will NOT be scored.

Temperature Scales and Conversions

1. William wants to make homemade candy to give to his mom for her birthday. He is using a recipe that instructs him to heat the sugar mixture to boiling at a temperature of 150°C. William's candy thermometer, however, only reads temperatures in Fahrenheit. To what temperature, in °F, should William heat the sugar mixture?

2. As William was heating the sugar mixture, he noticed it beginning to turn brown. He Rimmediately took the temperature of the mixture and found it to be 342°F. At this temperature, the sugar was beginning to carmelize. What temperature is this in Kelvin?

3. There are three containers of solid fats. The melting point of each of the fats was determined and the temperatures are found in the table below. Use the table of known fats and their melting points to determine the identity of the unknown fat solids.

Fat	Melting Point	Unknown Fat Solid	Melting Point
Butter	32°C	A	95°F
Coconut Oil	298K	B	115°F
Palm Oil	35°C	C	77°F
Shortening	574 °Ra		

4. There are several different units that can be used to measure heat. Which of the following lists the heat unit with its correct definition?

    a. Calorie - the quantity of heat required to raise the temperature of 1 gram of water 1°C at atm
    b. Joule - SI unit of energy - equivalent to 4.18 calories
    c. BTU - the quantity of heat required to raise the temperature of 1 pound of water 1°F at 1 atm
    d. calorie -the quantity of heat required to raise the temperature of 1 gram of water 1°F at 1 atm

5. Which of the following temperature scales is based on the melting and boiling points of water?

    a. Celsius
    b. Fahrenheit
    c. Kelvin
    d. Celsius and Kelvin
    e. Celsius, Fahrenheit, Kelvin

Thermal Conductivity, Heat Capacity, Specific Heat, Latent Heat, Phases of Matter, Entropy, Enthalpy

6. Janelle is tasked with identifying an unknown metal by her Chemistry teacher. She uses her knowledge of calorimetry to aid her in her task. She places the metal in a beaker of water and heats it to a temperature of 85°C. Then, she places 100 mL of water in a coffee cup calorimeter, adds the metal, and measures the temperature of the water over time. The temperature measurements she made are found below. The metal has a mass of 80 grams. The initial temperature of the water was 20°C.

Time Elapsed	2 min	4 min	6 min	8 min	10 min	12 min	14 min	16 min
Temp (°C)	21°C	23°C	24°C	24°C	25°C	26°C	26°C	25°C

Identify the metal

a. Aluminum, 0.91 J/g°C
b. Lead, 0.13 J/g°C
c. Silver, 0.23 J/g°C
d. Titanium, 0.54 J/g°C
e. Zinc, 0.39 J/g°C

7. If 27.00 kJ of energy is transferred to an 35.0 g ice cube at 0°C, what will be the temperature and state of the water at 1 atm?

a. 29.5 g liquid water and 5.5 g steam at 100°C
b. 34.5g liquid water and 0.49 g steam at 100°C
c. 35.0 g steam at 185°C
d. 34.9 g ice at 0°C and 0.081 g liquid water at 0°C

8. Which of the following shows the correct change of state as energy is removed from water at 398K and 1 atm until it reaches 250K and 1 atm?

   a. Solid water, melting, liquid water, boiling, gaseous water

   b. Solid water, freezing, liquid water, boiling, gaseous water

   c. Gaseous water, boiling, liquid water, freezing, solid water

   d. Gaseous water, condensing, liquid water, freezing, solid water

   e. Liquid water, freezing, solid water

Use the following table for questions 9-11.

Substance	Melting point	Specific Heat	$\triangle H_{fus}$
Aluminum	660°C	0.90 J/g°C	398 J/g
Gold	1064°C	0.126 J/g°C	63 J/g
Lead	328°C	0.128 J/g°C	23 J/g
Polystyrene	240°C	1.13 J/g°C	96.1 J/g
Water	0°C	4.18 J/g°C	334 J/g

9. Identify the substance that would be the best thermal conductor at 20°C.

10. Identify the substance that would be the best thermal insulator at its melting point.

11. If 150.0g of ice was placed in an aluminum container with a mass of 400.0g, how much energy, in kilojoules, would need to be added to raise the temperature of the container and water from 0°C to 25°C?

12. Which of the following changes results in the largest increase in entropy, assume the temperature of each sample is constant?

   a. $S_{(s)} \rightarrow S_{(l)}$

   b. $H_2O_{(l)} \rightarrow H_2O_{(g)}$

   c. $NaCl_{(s)} \rightarrow NaCl_{(aq)}$

   d. $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$

Thermodynamic Laws and Processes

13. True or False In an isothermal process, all heat added to the system is used to do work.

14. Identify the thermodynamic law below that is correct.
    a. Zeroth Law - When two systems are in equilibrium with a third system, then the first two systems are in equilibrium with each other.
    b. First Law - The internal energy change for a system is equal to the sum of the heat added to the system from the surroundings and the work done by the system on the surroundings.
    c. Second Law - The entropy of a perfect crystal of an element in its most stable form tends to zero as the temperature approaches absolute zero.
    d. Third Law - Heat at a given temperature cannot be completely converted into work.

15. The working substance in a Carnot cycle undergoes four successive changes. Determine the order of the changes.

    I. Compression by cooling at a constant low temperature
    II. Expansion by heating at a constant high temperature
    III. Reversible adiabatic compression
    IV. Reversible adiabatic expansion

    a. II, III, I, IV
    b. II, IV, I, III
    c. I, III, II, IV
    d. IV, II, III, I

16. In an automobile engine, the temperature of the gas at combustion is 650°C and the temperature of the gas at exhaust is 35°C. Calculate the Carnot efficiency of the engine.

17. What would happen to the efficiency of the automobile engine described above (question 16) if the temperature of the gas at exhaust was increased?
    a. The efficiency would increase.
    b. The efficiency would decrease.
    c. The efficiency would stay the same.

History of Thermodynamics

18. The first ice-calorimeter was used to calculate heat changes in chemical reactions by
    a. Joseph Black
    b. William Thomson
    c. James Prescott Joule
    d. Antoine Lavoisier

19. Which of the following areas of scientific research gave birth to the development of the field of thermodynamics?
    a. Heat of chemical reactions
    b. Latent Heat
    c. Steam engines
    d. Water wheels

20. 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. Boltzman - the connection between entropy and molecular motion
    d. Clausius - identified enthalpy as a heat function for constant pressure

21. Prior to the modern understanding of heat, scientists believed that heat was a material substance. What name was given to the first known description of the substance of heat?

22. The first observation of heat as energy was made by Count Rumford. Rumford observations led him to the conclusion that the amount of heat that could be generated was infinite and the amount of heat generated was proportional to the amount of work done. What was Rumford observing that led to this conclusion?