



SCIENCE OLYMPIAD
— AT THE —
UNIVERSITY OF FLORIDA

Northern Regional: January 19th, 2019

Thermodynamics B Test

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

Rank: _____

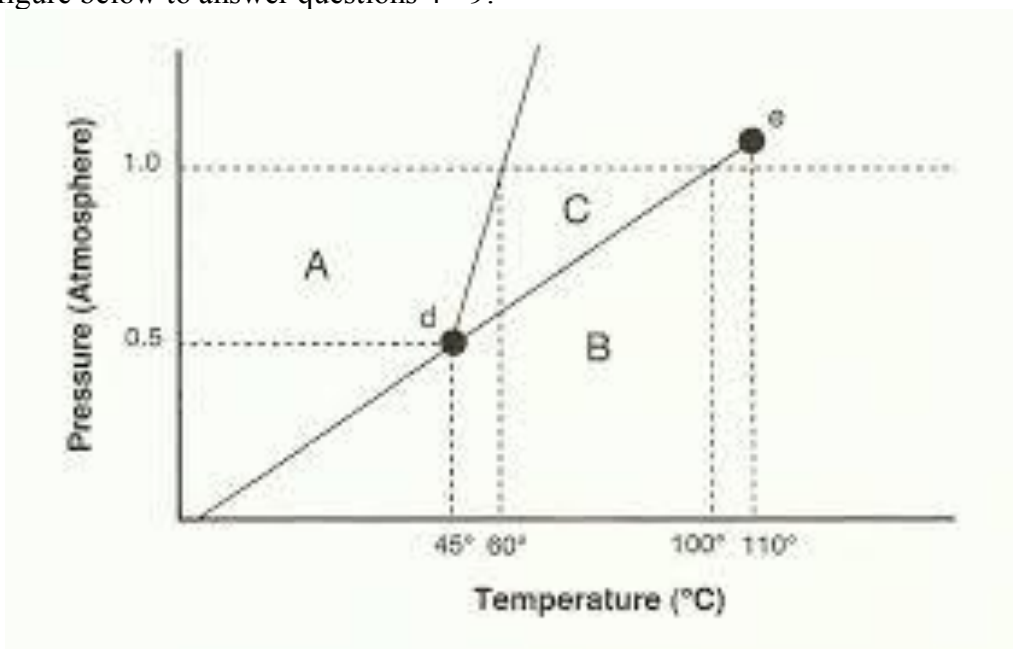
Score: _____

Science Olympiad North Florida Regional at the University of Florida
Thermodynamics Division B Written Test 2019

Section 1: Multiple Choice (2 points each)

1. Who is considered to be the father of thermodynamics?
 - A. Sadi Carnot
 - B. James Watt
 - C. J. Willard Gibbs
 - D. Isaac Newton
 - E. James Joule
2. When was the first thermometer created?
 - A. 1597
 - B. 1654
 - C. 1724
 - D. 1856
3. Which one of these is no longer supported and has been replaced?
 - A. Kinetic Theory
 - B. Principle of Conservation of Mass
 - C. Caloric Theory
 - D. Principle of Conservation of Energy

Use the figure below to answer questions 4 - 9:



- Which of the following letters corresponds to the triple point of the substance?
 - C
 - D
 - B
 - E
- Which of the following letters corresponds to the gas phase of the substance?
 - A
 - B
 - C
 - D
- What is the normal boiling point of the substance?
 - 1 atmosphere
 - 100 °C
 - 60 °C
 - 0.5 atmosphere
- What is the normal melting point of the substance?
 - 0.5 atmosphere
 - 1 atmosphere
 - 60 °C
 - 100 °C

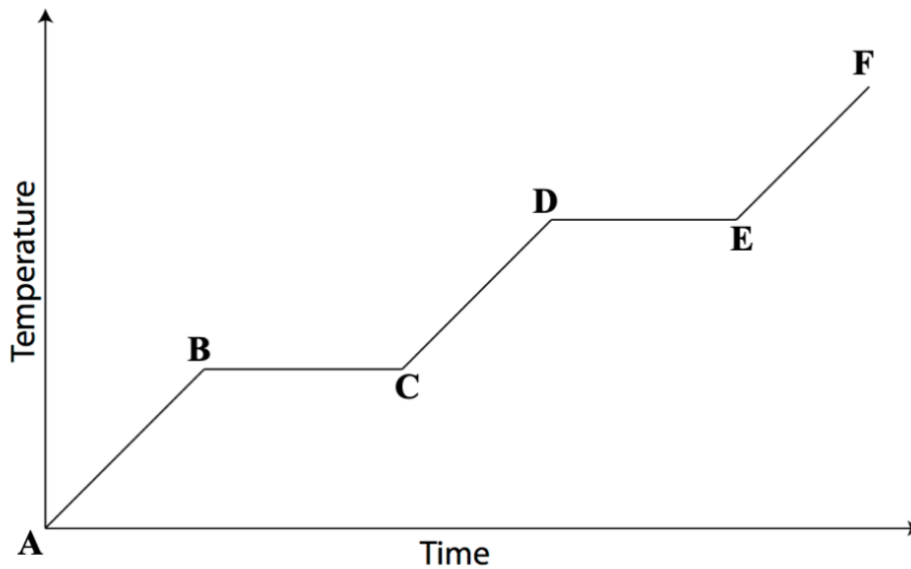
8. What process occurs when the substance moves from region A to region B?

- A. Melting/ Fusion
- B. Vaporization
- C. Deposition
- D. Sublimation

9. What process occurs when the substance moves from region B to C?

- A. Melting/ fusion
- B. Vaporization
- C. Condensation
- D. Freezing

Use the figure below to answer questions 10 - 12:



10. Which of the following segments corresponds to the liquid phase?

- A. DE
- B. BC
- C. AB
- D. CD

11. Which of the following segments corresponds to the process of freezing?

- A. B to C
- B. C to B
- C. E to D
- D. D to E

12. Which of the following phases are easily compressible?
- A. Gases
 - B. Liquids
 - C. Solids
 - D. A and B
13. Which of the following kinds of heat transfer occurs when there is direct contact involved?
- A. Conduction
 - B. Convection
 - C. Radiation
 - D. More than one of the above
14. Which of the following kinds of heat transfer relies on heat rising?
- A. Radiation
 - B. Conduction
 - C. Convection
 - D. More than one of the above
15. What is the heat flux for a 6 m x 12 m sheet of glass that is 2 cm thick and is 20 °C on one side and 60 °C on the other side? Use 0.96 W/ (m K) for the thermal conductivity constant for glass.
- A. 1920 W/ m²
 - B. 55.296 W
 - C. 0.533 W/ m³
 - D. 0.768 W/ m²
16. Which one of these is not one of the steps of the Carnot Cycle?
- A. Adiabatic compression
 - B. Isothermal expansion
 - C. Isovolumetric expansion
 - D. None of the above
17. What is the efficiency of a Carnot Cycle that has temperatures of 37 °C and 63°C?
- A. 70.3%
 - B. 26.0 %
 - C. 58.7%
 - D. 41.3%
18. Which one of the following is described by a constant volume?
- A. Isovolumetric
 - B. Isobaric
 - C. Isochoric
 - D. More than one of the above

19. Which of the following statements is not part of the laws of thermodynamics?
- A. Two systems in thermal equilibrium with a third are in equilibrium with each other.
 - B. The entropy of a system approaches a constant as temperature approaches absolute zero.
 - C. Mass can neither be created nor destroyed.
 - D. The entropy of an isolated system always increases.
20. Which of the following is equal to 1 kilocalorie?
- A. 4,184 kJ
 - B. 4.184 J
 - C. 4,184 J
 - D. 1000 Calories
21. 300 °C is equal to which of the following?
- A. 557.14 Romer
 - B. 26.85 Kelvin
 - C. 148.89 Fahrenheit
 - D. 1031.67 Rankine

Section 2: Free Response (7 points each)

Show all equations and calculations used to receive full credit.

22. 102.5 g of water at 65.6 °C is mixed with 102.5 g of water, already in the coffee cup calorimeter, at 18.5 °C. The final temperature of the water is 35.0 °C. Calculate the heat capacity of the calorimeter in J/ K.
23. 139 g of an unknown sample was heated to 96.4 °C and placed into a calorimeter containing 70.9 g of water at 20.0 °C. The heat capacity of the calorimeter was 12.6 J/ K. The final temperature in the calorimeter was 23.7 °C. What is the specific heat (in J/ (g °C)) of the sample?
24. In a bomb calorimeter compartment surrounded by 1.357 kg of water, the combustion of 1.351 g of benzene C_6H_6 (l) raised the temperature of the water from 23.640 °C to 32.692 °C. The heat capacity of the calorimeter is 0.885 kJ/ °C. What is ΔE for the reaction in kJ/ mol of C_6H_6 (l)?