

Seminole Science Charter School 2017 Invitational.

Thermodynamics

Division B

Written Test

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

School Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Total Points: \_\_\_\_\_\_\_/30

**Section 1: Multiple Choice (19 Points) .**

**Direction: For each question, there exists only one correct answer choice. Indicate the choice that best answers or complete the statement.**

1. Convert 2 calories into **kilojoules.** (1 Point)
2. 8.273 kJ
3. 8.273$×$ 10-3 kJ
4. 10 kJ
5. 20 kJ
6. Convert the temperature of 30 degrees Fahrenheit to degrees Kelvin. (1 Point)
7. 257 K
8. 272 K
9. 297 K
10. 267 K
11. Substance **A** has a higher specific heat than substance **B**. Substance **B** would \_\_\_\_\_\_\_\_ than substance **A**. (1 Point)
12. Heats up slower
13. Cools down slower
14. Heats faster
15. Boil more rapidly
16. The specific heat of Substance **Q** is $3.54 J/g℃$. How many kilojoules of energy are required to heat 75 grams of substance **Q** from $-42.0℃ $to $78℃$? (1 Point)
17. 31.7 kJ
18. 31.8 kJ
19. 31.86 kJ
20. 31.9 kJ
21. A 20 grams object has a heat capacity of 32J/C. What is the specific heat of that object? (All units are in $J/g℃$) (1 Point)
22. 32
23. 1.60
24. 0.625
25. 2.60
26. The Carnot cycle was first proposed by (state the nationality) (1 Point)
27. French
28. German
29. English
30. Italian
31. Who discovered the mechanical equivalent of heat? (1 Point)
32. Sadi Carnot
33. James Joule
34. Rudolf Clausius
35. William Thomson
36. When was the Carnot cycle proposed? (1 Point)
37. 1821
38. 1822
39. 1823
40. 1824
41. **True or False.** Changes in Entropy in the universe can never decrease. (1 Point)
42. True
43. False
44. The Carnot cycle consists of how many isothermal processes? (1 Point)
45. 1
46. 2
47. 3
48. 4
49. Which thermodynamics law states that energy cannot be destroyed or created? (1 Point)
50. 0th
51. 1st
52. 2nd
53. 3rd
54. Which thermodynamics law states that randomness in systems tends to increase in an isolated system? (If equilibrium, stays the same) (1 Point)
55. 0th
56. 1st
57. 2nd
58. 3rd
59. The combustion of a substance in a lawnmower engine releases 54.0 J of energy per cycle. Of that 28.4 J are lost to warming the body of the engine and the surrounding air. Determine the efficiency of the engine. (1 Points)
60. 47.4%
61. 52.6%
62. 53%
63. 47%
64. A 1.50-kg block of ice initially at a temperature of $0℃$ is placed inside an experimental apparatus that allows 220 kJ of heat to flow into the ice. Determine the percent of the ice that melts. ($L\_{F} of water=334 kJ/kg$) (3 Points)
65. 65.9%
66. 43.9%
67. 56.1%
68. 14.7%
69. A 1.0-gram sample of substance A at 100 degrees Celsius is added to 100 mL of H2O at 25 degree Celsius. Using separate 100 mL portions of H2O, the procedures is repeated with substance B and then with substance C. How will the final temperatures of the water compare? (3 Points)

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| --- | --- |
| Substance  | Specific Heat |
| A | $$0.40 Jg^{-1}℃^{-1}$$ |
| B | 0.20 $Jg^{-1}°C^{-1}$ |
| C | $$0.60 Jg^{-1}℃^{-1}$$ |

1. $T\_{b}>T\_{a}>T\_{c}$
2. $T\_{c}>T\_{a}>T\_{b}$
3. $T\_{b}=T\_{a}=T\_{c}$
4. $T\_{c}>T\_{b}>T\_{a}$

**Section 2: Short Answer Questions (11 Points):**

1. Charles and James are discussing a thermodynamics concept of heat and temperature. Charles is arguing that heat and temperature is the same thing while James says they are not.
2. Determine who is correct. (1 point)
3. Explain your answer. You must be **detailed** in your explanation. (2 points)
4. An automotive engine is designed to operate between 230 K and 380 K. The engine produces $2.50 ×10^{2} J $of mechanical energy for every $5.00×10^{2}J$ of heat absorbed from the combustion of fuel.
5. Determine the actual efficiency of this engine. (2 Points)
6. Calculate the theoretical maximum efficiency of a Carnot engine operating between these temperatures. (3 Points)