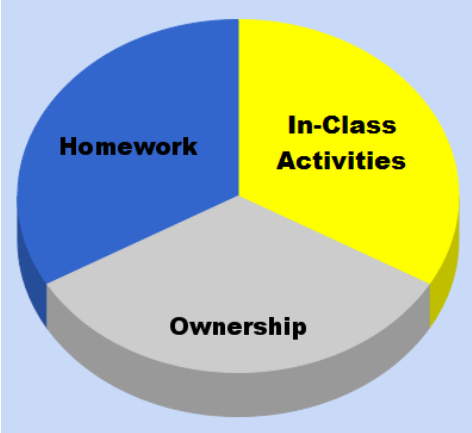
Worksheet 26 – CHEM 121 – Fall 2015

Monday Name: _____

Wednesday Name: _____



You had an early breakfast at the South Fork Mountain Lodge before you began your backpacking trek in the Bighorn Mountains of north central Wyoming in late July. It's been a long day and you are exhausted after climbing up from Hunter Creek Trailhead through Triangle Park to the west shore of Elk Lake. Your tent is set up and you want to take a comfortable (or as comfortable as you can get at 9200 ft on a late July evening) **95°F** shower to get the day's grime off. The water temperature in the lake is **48°F**, which is tooooooo cold to shower in. You have your Jetboil™ with you. You have your solar shower with you, however, the sun is behind the building thunderheads. At 9200 ft, water boils at approximately **197.6°F**. The specific heat capacity of water is **4.169 J/K/g**. The density of water is **1.00 g/mL**.

____1. What is the lake water temperature in °C?

A. 48
B. 321
C. 273
D. 9
E. 282

____2. What is the temperature of the lake water in Kelvins?

A. 48
B. 321
C. 273
D. 9
E. 282

____3. What is the boiling temperature of water in °C at 9200 ft?

A. 48
B. 365
C. 273
D. 92
E. 282

____4. What is the boiling temperature of water in Kelvins at 9200 ft?

A. 48
B. 365
C. 273
D. 92
E. 282

____5. What is the temperature of the shower you wish to take in °C at 9200 ft?

A. 95
B. 21
C. 35
D. -178
E. 294

____6. What is the temperature of the shower you wish to take in Kelvins at 9200 ft?

A. 95
B. 21
C. 308
D. -178
E. 294

____7. Using your newly acquired knowledge of thermochemistry of two systems, you determine that the hot water temperature difference to make your shower water temperature is:

A. 57°C
B. 57 K
C. 28 K
D. A and B
E. A and C

____8. Using your newly acquired knowledge of thermochemistry of two systems, you determine that the cold water temperature difference to make your shower water temperature is:

A. 57°C
B. 57 K
C. 26 K
D. A and B
E. A and C

____9. Using your newly acquired knowledge of thermochemistry of two systems, you determine that the ratio of **hot water to cold water (H→C)** to make your comfortable shower water is:

A. 1→1
B. 2.2→1
C. 0.45→1
D. 1→0.45
E. 0.5 →1

____10. Using your calculated **hot water to cold water (H→C)** ratios, if you put 1 L of lake water in your solar shower bag, how many L of boiling water must you add for your shower?

A. 1
B. 2.2
C. 0.5
D. 0.45
E. None of the above

____11. Using your results from Question 10, the final total volume of water at 95°F you would have in your solar shower bag is:

A. 1 L
B. 2.2 L
C. 0.5 L
D. 0.45 L
E. 3.20 L

____12. Assuming that only 10% of the water from your solar shower remains on your body after showering and that all of that water is soaked up by your towel when you dry off, how much water does this represent (**ignore the evaporation rate**)?

A. 0.1 L
B. 0.22 L
C. 0.05 L
D. 0.045 L
E. 0.32 L

____13. Using the density of water in the original description of this scenario, and using your results from Question 12, how many **grams** of water are soaked into your towel?

A. 100
B. 220
C. 50
D. 45
E. 320

____14. If the rate of evaporation at Elk Lake is 9 g H_2O/hour, will your towel in Question 13 be dry in the morning (in 11 hours)?

A. Yes
B. No

____15. Using the specific heat capacity of water as given above, and assuming that you will have to boil 450 mL of water for your shower, how much energy will be required to raise the temperature 57 Kelvins for your shower?

A. 106,935 J
B. 237.6 kJ
C. 106.9 kJ
D. A and B
E. A and C

____16. Using your response from Question 15, if the fuel mixture in a Jetboil canister of isobutane/propane has a specific heat capacity of 2.08 J/g/K/minute, how long will it take to boil the 450 mL of water for your shower?

A. 2.00 minutes
B. 0.02 minutes
C. 20.00 minutes
D. All of the above are correct
E. None of the above are correct

____17. According to Jetboil's PR, a 100 g canister of isobutane/propane fuel mixture will boil 10 L of water. Using your results in Question 16, how long will the canister last?

A. 4.44 minutes
B. 2.25 minutes
C. 60 minutes
D. 44.4 minutes
E. 75 minutes

____18. Using your results from Question 17, and assuming you were to eat 2 hot meals a day of dehydrated food that are each rehydrated by 450 mL boiling H_2O, **approximately** how many days will your cannister of fuel mix last?

A. 5
B. 10
C. 15
D. 20
E. 25

____19. A 100 g cannister of Jetboil's fuel mix costs $4.00 at REI. Using your results from earlier calculations, **approximately** how much does it cost to heat water for one meal?

A. $0.20
B. $2.00
C. $5.25
D. $0.55
E. None are correct

____20. A 100 g cannister of Jetboil's isobutane/propane mixture is about how many lbs?

A. 1
B. 4.5
C. 2.2
D. 0.22
E. 0.5

You snow-shoed to Hobart Reservoir (**elevation ~7600 feet**). The reservoir was frozen over and the campground was covered with 3-4 feet of snow (there is no measureable impact on the freezing temperature of water at this altitude compared to that of sea level). You brought your Mini-Trangia 28-T Backpacking Stove with you. The stove burns ethyl alcohol (EtOH). The stove has a **fuel capacity of 75 g (ρ_{EtOH} = 0.789 g/mL)**. Empty, the stove weighs **5.75 oz**. You also brought along some Armour Classic Hot Dogs, buns and condiments with you for a snack. Each hot dog weighs **1.50 oz** and is kept at **36°F** in your backpack prior to cooking. The specific heat capacity of water **(c_{Water}) is 4.169 J/K/g**. The density of water (ρ_{H2O}) is 1.00 g/mL.

____21. Approximately how many grams is the 1.50 oz hot dog?

A. 43 g
B. 454 g
C. 1000 g
D. 1.50 g
E. 0.023 g

____22. The hot dog is stored at 36°F. Approximately what is the temperature of the hot dog in °C?

A. 0°C
B. 122°C
C. 6°C
D. 2°C
E. 36°C

____23. For every **500 feet increase in elevation away from sea level**, the **boiling point of water decreases 1°F**. Hobart Reservoir is at 7600 feet elevation above sea level, approximately what is the boiling point of water at Hobart in °F?

A. 220°F
B. 197°F
C. 212°F
D. 10°F
E. 100°F

____24. What is the boiling point of water (using your result from #3) in °C?

A. 104°C
B. 92°C
C. 100°C
D. -12°C
E. 38°C

____25. At what temperature is the hot dog (from #22) in K?

A. 273K
B. 395K
C. 279K
D. 275K
E. 309K

____26. What is the boiling temperature of water at Hobart(from #24) in K?

A. 273K
B. 395K
C. 279K
D. 275K
E. 365K

____27. A properly cooked hot dog is considered done by the USDA when the internal temperature of the hot dog is 170°F. Approximately what is this temperature in °C?

A. 100°C
B. 170°C
C. 112°C
D. 35°C
E. 77 °C

____28. At what temperature is the properly cooked hot dog in K (from #27)?

A. 373K
B. 443K
C. 385K
D. 308K
E. 350K

____29. Two (2) cups of water from Hobart are placed in a thermally non-reactive cooking pot and heated to boiling. How many grams of H_2O is this (disregard temperature effects)?

A. 473 g
B. 454 g
C. 16 g
D. 1000 g
E. 946 g

____30. The water in question #29 is heated from lake temperature to its boiling point (per #6). About how much energy does this require?

A. 181,418 J
B. 181.4 J
C. 9.172 kJ
D. A and B
E. B and C

____31. To the boiling water from Question #9, one hot dog (from #21 and #22) is added and cooked properly (from #28). What is the specific heat capacity of the hot dog if the final temperature of these two systems is 170°F (using #28)?

A. 4.169 J/K/g
B. 0.554 J/K/g
C. 0.00 J/K/g
D. 9.172 J/K/g
E. 4.184 J/K/g

____32. 100 g of ethyl alcohol boils 2.9 L of 70**°F** water. At Hobart's elevation, about how many **Joules** does this water require to increase the temperature from 70 **°F** to boiling at Hobart (from #23) ?

A. 858,400 J
B. 858.4 kJ
C. 643,800 J
D. A and B
E. A and C

____33. Using the energy required to boil the 70°F water in question #32, what is the specific heat capacity of 100 g of ethyl alcohol, assuming 100% efficiency and identical temperature change per question #12?

A. 120.9 J/K/g
B. 4.169 J/K/g
C. 858.4 J/K/g
D. 4.184 J/K/g
E. 643.8 J/K/g

____34. Using your response to question #33, what is the energy available in 75 g of ethyl alcohol following a 71K change in temperature?

A. 120.9 kJ
B. 4.169 kJ
C. 858.4 kJ
D. 4.184 kJ
E. 643.8 kJ

____35. Approximate burn time at maximum flame in your Mini-Trangia 28-T is 26.78 minutes. Using your calculations from question #14, determine the energy in the alcohol that is available in J/min.

A. 4.169 J/min
B. 24040 J/min
C. 4.184 J/min
D. 12090 J/min
E. 0.447 J/min

____36. Using the specific heat capacity of the hot dog (from #31), the mass of the hot dog (from #21) and a 75K change in temperature, about how long will it take to cook the hot dog properly at Hobart after you drop the cold hot dog into the boiling water?

A. 30 seconds (0.5 minute)
B. 45 seconds (0.75 minute)
C. 60 seconds (1.0 minute)
D. 75 seconds (1.25 minute)
E. 90 seconds (1.50 minute)

____37. While you were cooking your hot dog, you accidentally boiled over 25 mL of the boiling water onto your fleece jacket. If the evaporation rate of water at Hobart is 6 g H_2O per hour, will your jacket dry out on 2 hours?

A. Yes
B. No

____38. If the evaporation rate of water at Hobart is 6 g H_2O/hour, will your jacket dry out on 5 hours if you boiled 25 g water over onto your fleece jacket?

A. Yes
B. No

____39. Your Mini-Trangia 28-T weighs 5.75 oz empty. This is how many kg?

A. 4.3 kg
B. 45.4 kg
C. 1 kg
D. 0.163 kg
E. 0.0575 kg

____40. The hike from Lakeview Trailhead to Hobart reservoir and back is approximately 9.2 miles. About how many km is this?

A. 14.81 km
B. 14.72 km
C. 14.82 km
D. All are correct depending on which conversion factor you use ←
E. None are correct

You and your dog snow-shoed up to Rock Lake, above Davis Creek, in Washoe Valley, before Spring Break. Once you got there, you decided that you had sweated so much that you wanted to take a shower to clean off before you trekked back down to Davis Creek. You took along your hand-dandy Coleman Exponent Feather 442 Dual Fuel Backpacking Stove that runs on either white gas or on unleaded gas. The lake water is 0°C. You wish to take your shower at 35°C. Water boils at Rock Lake at 96°C. The specific heat capacity of water is 4.169 J/K/g. The density of water (ρ_{H2O}) is 1.00 g/mL.

41) What is the temperature of the lake water in °F?

42) What is the desired temperature of your shower in °F?

43) What is the temperature of the boiling water in °F?

44) What is the lake water temperature in K?

45) What is the desired shower water temperature in K?

46) What is the boiling water temperature in K?

47) Using the specific heat capacity of water, how much energy does it take to raise 1 L of water from lake temperature to 93°C?

48) Using the specific heat capacity of water, how much energy does it take to raise 1 L of water from lake temperature to 35°C?

49) If 100 g of unleaded gasoline will heat 6.9 L of water at 70°F to 212°F in 25.9 minutes, what is the specific heat capacity of the unleaded gasoline?

50) What is the specific heat capacity of the unleaded gasoline per minute?