Jonathan Lam
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H. Chem. per. 7
10 / 13 / 15

Chapters 16 and 17 Review Practice

Terminology and Concepts to know:

- **Calorie**
  - British thermal unit
  - unit of heat energy
  - $\frac{1cal}{g^oC}$ is the specific heat (C_p) of water
  - 1 cal = 4.184 J
  - a dietary calorie (or kilocalorie, or Calorie) is 1000 cal
- **Calorimeter**
  - an insulated tool used to measure the heat gained or released in a chemical or physical reaction
  - bomb calorimeter:
    - more scientific and exact
  - foam-cup calorimeter
    - ones we used in class: simple and functional
  - measure initial and final temperature of water and sample, the mass of water and sample, and using the specific heat of water ($\frac{4.184J}{g^oC}$), calculate the heat ($q = m \times C_p \times \Delta H$, $q_{gained} = -q_{lost}$)
- **Condensation**
  - the phase change turning from gas to liquid (e.g. steam to liquid water)
- **Endothermic**
  - a reaction that absorbs energy
  - heated, absorbs, takes in, raises temperature, gains, feels cool, +q
- **Energy**
  - the ability to do work or produce heat
  - kinetic is energy of motion, such as the vibration of particles (temperature)
  - potential is stored energy, such as that in the bonds in compounds (chemical potential energy)
- **Enthalpy**
  - the total heat content of a system
  - usually only change in enthalpy of a reaction (ΔH_{rxn}) is used because it can be calculated while the enthalpy of a solution cannot (there are many variables unknown to us today)
- **Exothermic**
  - a reaction that releases energy
  - -q, evolves, liberates, gives off, releases, lowers temperature, feels hot
- **Freezing point**
  - physical property of a substance
  - temperature at which a substance freezes / solidifies
  - same as melting / fusion point
- **Heat**
  - energy in the process of traveling between an area of hotter to cooler
- **Heating Curve**
  - a plot of the temperature as a function of the time of heating with a constant heat input
  - can be used to show phase change: “plateaus” are phase changes, absorbing potential energy
  - slopes are absorbing kinetic energy and increasing in temperature
  - the higher the specific heat, the shallower the slopes
  - the higher the heat of (phase) change, the longer the plateaus
- **Joule**

    - SI unit of energy (not calorie)
- **Melting Point**
    - the temperature at which a solid goes through fusion
    - (see freezing point; is the opposite)
- **Specific Heat**
    - the amount of heat required to raise the temperature of a certain amount of a substance by a certain temperature
    - usually expressed in $\frac{J}{g^oC}$
- **Surroundings**
    - anything in the universe that is not being studied, can interact with the system
- **System**
    - the part of the universe that is being studied (where the reaction is taking place)
- **Temperature**
    - a measure of the average intensity of the kinetic energy of the particles of a substance, which is an average measure of the heat of a substance
- **Thermochemistry**
    - the study of the relationships between different forms of energy, and the transfer of energy, especially in a chemical or physical reaction
- **Universe**
    - the system and its surroundings
- **Vaporization**
    - the phase change from a liquid to a gas
    - (see condensation; is the opposite)

Circle the correct answer.

1. The specific heat of substance X is 0.900 J/gC while substance Y has a specific heat of 0.450 J/gC. Which sample will have the higher final temperature (given that the samples are the same mass and there is the same amount of heat input)?
b) sample X
c) **sample Y** — it has a lower specific heat, therefore needs less energy to change temperature (changes more temperature with the same amount of heat input)
d) both will be the same
e) none of the above

2. A liquid's freezing point is -27C and its boiling point is 323C. How many phase changes occur (from -52ºC to 523ºC)?
A. 0 **C. 2** — fusion and then vaporization
B. 3 D. 1

3. Burning of coal is
A. exothermic — it releases heat
B. endothermic
C. ergothermic
D. unknown

4. A 100-g sample of gold is warmed from 18C to 32C. The specific heat for gold is 0.129 J/gC. The correct set-up for this problems is

A. (100-g) (18C-32C) (0.129 J/gC)
B. (100-g) (4.19 J/gC) (32C-18C)
C. (0.129 J/gC) (100-g) (32C-18C) — it has the mass (100g), C_p (0.129 J/g°C), and change in temp. (32C - 18C)
D. 0.129 J/gC = (100-g) (32C-18C)

6. Drying of clothes in a clothes dryer is
A. cost effective
B. exothermic
C. endothermic — heats up the clothes, increasing their heat content
D. none of the above

8. For a person of average weight, jogging requires an energy consumption of about 100 kJ per mile. If hamburger has an energy value of 15 kJ/g, how much hamburger would provide enough energy to jog 3 miles?
. 1500 g
B. 100 g
C. 20 g — see calculation below
D. 0.15 g
$3mi \times \frac{100kJ}{mi} = 300kJ \times \frac{g}{15kJ} = 20g$

9. Boiling of water is
A. endothermic — adds energy to the water
B. exothermic
C. isothermic
D. paleothermic

11. In an air-conditioned room you touch the metal of your chair with one hand and the wood of your desk with your other hand. Which is colder?
A. metal chair
B. wood of desk
C. same temperature — may feel different temperatures because of different specific heat — lower specific heat conducts heat quicker from your hand, feeling colder (metal), and vice versa (wood)
D. none of the above

13. A high school chemistry student shows her younger brother how the dissolving of ammonia chloride in water makes the beaker feel cool. When asked to describe what is happening, he says "It is giving off cold." Which of the following is the scientific explanation for what is occurring?
a. The reaction is releasing energy.
b. The reaction is absorbing energy. — if it were releasing energy, the reaction would be cold. Instead, it is absorbing energy from its surroundings
c. The reaction is exothermic.
d. There is no explanation better than what her brother said.

14. To calculate the amount of heat energy to change 5.0-g of ice from -10C to a liquid at room temperature 27C, involves how many calculations would you expect it to involve?
b. 1
c. 2
d. 3 — heat of ice, heat of fusion, heat of water

e. 4
f. 5

16. The ability to do work is defined as
b. Energy. — definition of energy
c. Kinetic energy.
d. Potential energy.
e. The joule

17. When 85.0 g of liquid water freezes to ice at 0C, the enthalpy is
b. positive
c. negative — it is cooled, losing energy, so there is a negative change in enthalpy (change in heat content)
d. undefined
e. doesn't exist

18. What quantity of ice, at 0C, will be melted b y 6.8 x 10^4 J?
a. 200-g — see calculation below (but this should have 2 sigfigs)
b. 2.3 x 107-g
c. 2 000-g
d. none, ice doesn't melt at 0C but rather 335C.
$q = m\Delta H_{sol};\ m = \frac{q}{\Delta H_{sol}} = \frac{6.8\times10^4 J}{334\frac{J}{g}} = 200g$

19. When calculating the quantity of heat, in joules, that is required to change 25.0-g of ice, at
-5.0C, to ice at 0.0C, how many phase changes occur?
b. 1
c. 2
d. 3
e. none — it is still "ice at 0.0C," as it has not changed phase yet

20. A catalyst increases the rate of a reaction by
b. lowering the activation energy — definition of a catalyst
c. raising the activation energy
d. decreasing the potential energy of
the reactants
e. all of the above

22. For an exothermic reaction the H is
b. positive
c. negative — in an exothermic reaction, there is negative change in enthalpy (heat content) because the solution loses heat (definition of an exothermic reaction)
d. zero
e. none of the above

24. For an endothermic reaction the potential energy of the reactants compared to the potential
energy of the products is
b. always higher
c. always lower — in an endothermic reaction, there is always a *gain* in heat, so the *products* will have a higher heat content
d. the same as

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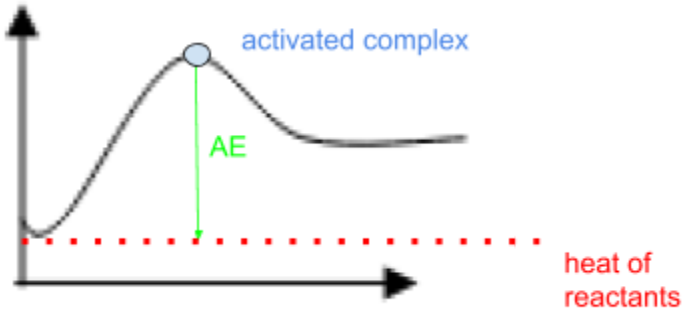
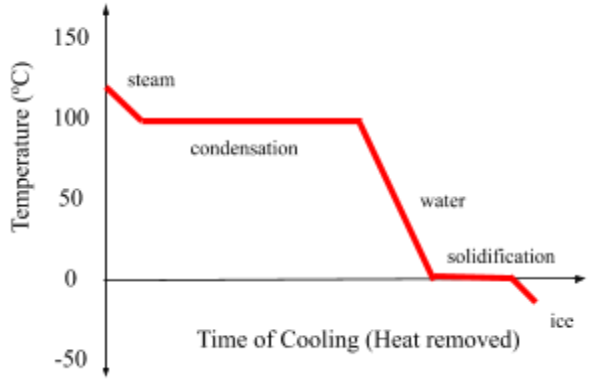
e. doesn't exist

25. On the diagram below draw where the H for the reaction is. Is this endothermic or exothermic? Label the activation energy and the activated complex.

- **endothermic** — absorbs energy (products have higher heat content than reactants)



26. Draw and label a cooling curve for steam @ 115C to ice at -5C. Calculate the amount of energy needed to change 49.3 g of water from 95C to 37C. Is this an endothermic or exothermic process? Explain from your calculation your reasoning.



$q = mC_p\Delta T = (49.3g)(\frac{4.184J}{g^oC})(37^oC - 95^oC) = -12000J = -12kJ$

This process is exothermic — the ice loses heat, and q is negative.