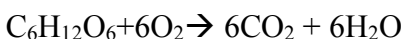


Thermodynamics Review Questions

1. (true or false) When the potential energy of a system increases, the kinetic energy must also increase.
2. Define potential energy and give an example of potential energy, that does not involve a roller coaster.
3. What is kinetic energy and how does it relate to the temperature of a system?
4. When a reaction takes place the total enthalpy of the products is usually different than the total enthalpy of the reactants. This difference in total enthalpy between the products and the reactants is called ΔH . If the total enthalpy of the products is greater than the enthalpy of the reactants, is the reaction exothermic or endothermic?
5. When a $\text{Br}_{2(l)}$ is transformed to $\text{Br}_{2(g)}$, is this reaction entropically favored or entropically disfavored? (Does entropy increase, and is a reaction favored when entropy increases or when it decreases?)
6. When $\text{Br}_{2(l)}$ changes to $\text{Br}_{2(g)}$, energy, in the form of heat, must be added to the system. Does this mean that $\Delta H > 0$ or $\Delta H < 0$?
7. If heat needs to be added when $\text{Br}_{2(l)} \rightarrow \text{Br}_{2(g)}$ does it mean that the reaction is not spontaneous?
8. When water that is 32F is cooled to ice at 32F, 1.44 kcal is released for every mole of water that is converted to ice.
 - a) What is ΔH for this process?
 - b) How many kcal are released when 9.9 moles of water are frozen.
 - c) How many kcal are absorbed when melting 1 mole of 32 F frozen water?
9. The sugar glucose has the formula $\text{C}_6\text{H}_{12}\text{O}_6$. In plants glucose is created from CO_2 and water. When glucose is burned it forms these two chemicals according to the following chemical equation.



This reaction generates 685 kcal of heat for each mole of glucose that is burnt.

- a) How much heat, in kcal, would be generated if 0.7 moles of glucose were burned?
 - b) How much heat, in kcal, would be needed to make 0.7 moles of glucose from CO_2 and water?
 - c) How does the amount of heat needed to generate this much glucose relate to the amount of energy needed to make this much glucose from CO_2 and water.
10. Which processes results in an increase in entropy?
 - a) water evaporating
 - b) water in a river slowly eroding a rock
 - c) water freezing
 - d) sodium chloride dissolving in water

- e) acetic acid reacting with sodium bicarbonate (vinegar and baking soda)
 - f) building the pyramids
 - g) cleaning up after a party
 - h) $I_2(g) + 3F_2(g) \rightarrow 2IF_3(g)$
11. (true or false) When a reaction is observed to occur it is spontaneous.
 12. (true or false) Whether or not a reaction is spontaneous, depends on the enthalpy of a reaction and on the entropy change that occurs during a reaction.
 13. (true or false) Calories are units that tell you how much fat is in food.
 14. What is the difference between an exothermic reaction and a spontaneous reaction?
 15. Does disorder increase in all spontaneous reactions?
 16. When a reaction is spontaneous and exothermic, ΔS is _____.
 - a) greater than 0
 - b) less than 0
 - c) equal to 0
 - d) greater than 0, equal to 0, or less than 0
 17. When a reaction is spontaneous and endothermic, ΔS is _____.
 - a) greater than 0
 - b) less than 0
 - c) equal to 0
 - d) greater than 0, equal to 0, or less than 0
 18. When clean sodium is put into water a reaction is seen immediately. What does this tell you about E_a ?
 19. (true or false) When a reaction happens slowly you do not know anything about the difference between the free energy of the products and the free energy of the reactants.
 20. (true or false) Many chemical reactions go partially to completion. When this happens you know that $\Delta G > 0$. (For example when ammonia reacts with water only part of the ammonia is converted to the ammonium ion. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$)
 21. Adding heat to a nonspontaneous reaction will always turn it into a spontaneous reaction, as long as enough heat is added. (Think about the equation $\Delta G = \Delta H - T\Delta S$, are there values that will cause this reaction to be less spontaneous as the temperature of the system is increased.?)
 22. Why does the rate of a reaction increase when the temperature of the reactants is increased? (You should be able to give 2 reasons.)
 23. E_a relates only to the enthalpy of a reaction.
 24. (true or false) Natural gas and oxygen can exist in the same room for a long time with nothing happening. Then if there is a spark in the room, the natural gas reacts quickly with the oxygen and the room can explode. This occurs because the heat from the spark turns a non spontaneous reaction into a spontaneous one. Once this happens in 1 little part of the room, the reaction become spontaneous everywhere because of the heat.

25. (true or false) It is possible to change the activation barrier of a reaction. It The amount of energy needed to make the reaction intermediates can be changed by changing how the reaction happens.
26. (true or false) The free energy of the products can be decreased, and this will speed the rate of a reaction.
27. Why does increasing the concentration of the reactants increase the rate of a reaction?
28. Does increasing the concentration of the reactants change the free energy of either the reactants or the products.