Chapter 5/19
Quiz

1) The internal energy of a system _____.
A) is the sum of the kinetic energy of all of its components
B) is the sum of the rotational, vibrational, and translational energies of all of its components
C) refers only to the energies of the nuclei of the atoms of the component molecules
D) is the sum of the potential and kinetic energies of the components
E) none of the above

2) Which one of the following is an endothermic process?
A) ice melting
B) water freezing
C) boiling soup
D) Hydrochloric acid and barium hydroxide are mixed at 25 °C: the temperature increases.
E) Both A and C

3) Which one of the following is an exothermic process?
A) ice melting
B) water evaporating
C) boiling soup
D) condensation of water vapor
E) Ammonium thiocyanate and barium hydroxide are mixed at 25 °C: the temperature drops.

4) Of the following, which one is a state function?
A) H
B) q
C) w
D) heat
E) none of the above

5) ΔH for an endothermic process is _____while ΔH for an exothermic process is _____.
A) zero, positive
B) zero, negative
C) positive, zero
D) negative, positive
E) positive, negative

6) A chemical reaction that absorbs heat from the surroundings is said to be _____and has a _____ΔH at constant pressure.
A) endothermic, positive
B) endothermic, negative

C) exothermic, negative
D) exothermic, positive
E) exothermic, neutral

7) When _____is constant, the enthalpy change of a process equal to the amount of heat transferred into or out of the system?
A) temperature
B) volume
C) pressure and volume
D) temperature and volume
E) pressure

8) For which one of the following reactions is $\Delta H°_{rxn}$ equal to the heat of formation of the product?
A) N_2 (g) + $3H_2$ (g) → $2NH_3$ (g)
B) $(1/2)N_2$ (g) + O_2 (g) → NO_2(g)
C) 6C (s) + 6H (g) → C_6H_6 (l)
D) P (g) + 4H (g) + Br (g) → PH_4Br (l)
E) 12C (g) + $11H_2$ (g) + 11O (g) → $C_6H_{22}O_{11}$ (g)

9) Of the following, $\Delta H°_f$ is <u>not</u> zero for _____.
A) O_2 (g)
B) C (graphite)
C) N_2 (g)
D) F_2 (s)
E) Cl_2 (g)

10) The energy released by combustion of _____of a substance is called the fuel value of the substance.
A) 1 kJ
B) 1 kg
C) 1 lb
D) 1 J
E) 1 g

11) The change in the internal energy of a system that absorbs 2,500 J of heat and that does 7,655 J of work on the surroundings is _____J.
A) 10,155
B) 5,155
C) -5,155
D) -10,155
E) 1.91×10^7

12) Hydrogen gas and bromine gas react to form hydrogen bromide gas. How much heat (kJ) is released when 155 grams of HBr is formed in this reaction? $\Delta H° = -72$ kJ.
A) 137
B) 69
C) -69
D) -137
E) 1.12×10^5

13) The value of $\Delta H°$ for the reaction below is -790 kJ. The enthalpy change accompanying the reaction of 0.95 g of S is _____kJ.

$$2S\ (s) + 3O_2\ (g) \rightarrow 2SO_3\ (g)$$

A) 23
B) -23
C) -12
D) 12
E) -790

14) The enthalpy change for the following reaction is -483.6 kJ:

$$2H_2\ (g) + O_2\ (g) \rightarrow 2H_2O\ (g)$$

Therefore, the enthalpy change for the following reaction is _____kJ.

$$4H_2\ (g) + 2O_2\ (g) \rightarrow 4H_2O\ (g)$$

A) -483.6
B) -967.2
C) 2.34×10^5
D) 483.6
E) 967.2

15) The specific heat capacity of lead is 0.13 J/g-K. How much heat (in J) is required to raise the temperature of 15g of lead from 22 °C to 37 °C?
A) 2.0 J
B) -0.13 J
C) 5.8×10^{-4} J
D) 29 J
E) 0.13 J

16) What is the molar heat capacity (in J/mol-K) of liquid bromine? The specific heat of liquid bromine is 0.226 J/g-K.
A) 36.1 J/mol-K
B) 707 J/mol-K
C) 18.1 J/mol-K

D) 9.05 J/mol-K
E) 0.226 J/mol-K

17) Given the following reactions

Fe_2O_3 (s) + 3CO (s) → 2Fe (s) + $3CO_2$ (g) $\Delta H = -28.0$ kJ

3Fe (s) + $4CO_2$(s) → 4CO (g) + Fe_3O_4(s) $\Delta H = +12.5$ kJ

the enthalpy of the reaction of Fe_2O_3 with CO

$3Fe_2O_3$ (s) + CO (g) → CO_2 (g) + $2Fe_3O_4$ (s)

is _____kJ.
A) -59.0
B) 40.5
C) -15.5
D) -109
E) +109

18) Given the following reactions

2S (s) + $3O_2$ (g) → $2SO_3$ (g) $\Delta H = -790$ kJ

S (s) + O_2 (g) → SO_2(g) $\Delta H = -297$ kJ

the enthalpy of the reaction in which sulfur dioxide is oxidized to sulfur trioxide

$2SO_2$ (g) + O_2 (g) → $2SO_3$ (g)

is _____kJ.
A) 196
B) -196
C) 1087
D) -1384
E) 19

19) Given the data in the table below, $\Delta H°_{rxn}$ for the reaction

$4NH_3$ (g) + $5O_2$ (g) → 4NO (g) + $6H_2O$ (l)

is _____kJ.

Substance	$\Delta H°_f$ (kJ/mol)
H_2O (l)	-286
NO (g)	90
NO_2 (g)	34
HNO_3 (aq)	-207
NH_3 (g)	-46

A) -1172
B) -150
C) -1540
D) -1892
E) The $\Delta H°_f$ of O_2 (g) is needed for the calculation.

20) A 3.00 L pitcher of sweetened ice tea contains 600. g of sugar. Assuming that the sugar is the only fuel source, what is the fuel value (in kJ) of a 250. mL serving? The respective fuel values for protein, fat, and carbohydrate are 17, 38, and 17 kJ/g, respectively.
A) 8.50×10^2 kJ
B) 10.2×10^4 kJ
C) 2.55×10^3 kJ
D) 38 kJ
E) 17 kJ

21) A reaction that is spontaneous as written _____.
A) is very rapid
B) will proceed without outside intervention
C) is also spontaneous in the reverse direction
D) has an equilibrium position that lies far to the left
E) is very slow

22) Of the following, only _____is <u>not</u> a state function.
A) S
B) H
C) q
D) E
E) T

23) Which of the following statements is true?
A) Processes that are spontaneous in one direction are spontaneous in the opposite direction.
B) Processes are spontaneous because they occur at an observable rate.
C) Spontaneity can depend on the temperature.
D) All of the statements are true.

24) The thermodynamic quantity that expresses the extent of randomness in a system is _____.
A) enthalpy
B) internal energy
C) bond energy
D) entropy
E) heat flow

25) The entropy of the universe is _____.
A) constant
B) continually decreasing
C) continually increasing
D) zero
E) the same as the energy, E

26) Which one of the following processes produces a decrease of the entropy of the system?
A) dissolving sodium chloride in water
B) sublimation of naphthalene
C) dissolving oxygen in water
D) boiling of alcohol
E) explosion of nitroglycerine

27) ΔS is positive for the reaction _____.
A) $2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(g)$
B) $2NO_2\,(g) \rightarrow N_2O_4\,(g)$
C) $CO_2\,(g) \rightarrow CO_2\,(s)$
D) $BaF_2\,(s) \rightarrow Ba^{2+}\,(aq) + 2F^-\,(aq)$
E) $2Hg\,(l) + O_2\,(g) \rightarrow 2HgO\,(s)$

28) Which reaction produces a decrease in the entropy of the system?
A) $CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$
B) $2C\,(s) + O_2\,(g) \rightarrow 2CO\,(g)$
C) $CO_2\,(s) \rightarrow CO_2\,(g)$
D) $2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(l)$
E) $H_2O\,(l) \rightarrow H_2O\,(g)$

29) A reaction that is not spontaneous at low temperature can become spontaneous at high temperature if ΔH is _____and ΔS is _____.
A) +, +
B) -, -
C) +, -
D) -, +

E) +, 0

30) Given the following table of thermodynamic data,

Substance	$\Delta H_f°$ (kJ/mol)	S° (J/mol • K)
$TiCl_4$ (g)	-763.2	354.9
$TiCl_4$ (l)	-804.2	221.9

complete the following sentence. The vaporization of $TiCl_4$ is _____.
A) spontaneous at all temperatures
B) spontaneous at low temperature and nonspontaneous at high temperature
C) nonspontaneous at low temperature and spontaneous at high temperature
D) nonspontaneous at all temperatures
E) not enough information given to draw a conclusion

31) At what temperature in Kelvin will a reaction have $\Delta G = 0$? ΔH = -24.2 kJ/mol and ΔS = -55.5 J/K-mol and assume both do not vary with temperature.
A) 2.29
B) 2293
C) 298
D) 436
E) 0.436

32) When a system is at equilibrium, _____.
A) the reverse process is spontaneous but the forward process is not
B) the forward and the reverse processes are both spontaneous
C) the forward process is spontaneous but the reverse process is not
D) the process is not spontaneous in either direction
E) both forward and reverse processes have stopped