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Chem 3/ Exam 1
FS/95
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To facilitate grading, please transfer all final answers to the answer sheet.

A system absorbs 49.0 J of heat while expanding its volume by 0.500 L against a constant external pressure of 1.00 atm. (1 L atm=101.3 J) Calculate the following(in Joules):
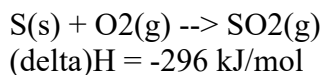
1. q =

2. w =

3. (delta)E =

4. In a potato gun, a gaseous fuel/air mixture with an initial volume of 450. cm3 releases
9550 J of energy on combustion. If the external resisting pressure is 1231 torr,
to what volume would the gases expand if all of the available energy could be used for expanding the gas? (760. torr = 1.00 atm)

5. For the combustion reaction of sulfur:

$S(s) + O_2(g) \rightarrow SO_2(g)$
(delta)H = -296 kJ/mol

How much heat is evolved when 275 gm of sulfur is burned in excess O2?
(MWt. of S = 32.06 g/mole)

6. What would be the expected sign of (delta)S for the combustion of sulfur reaction?

Positive, negative, zero,
not enough information given

7. A bomb calorimeter is used to measure the caloric content of food.
The state function directly obtained from this device is:

(delta)E, (delta)H, q, w, (delta)S, (delta)G, P(delta)V

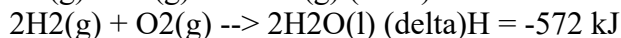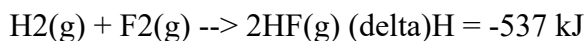8. In a bomb calorimeter, phase changes and reactions occur under conditions of:

(delta)T=0, (delta)S=0, (delta)P=0, (delta)V=0,
two of the above,
none of the above

9. If it takes 2250.0 J of energy to raise the temperature of a 100.0 gram alloy bearing by 50.0 oC, what is the specific heat capacity of the alloy?
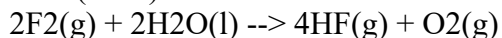
10. A 55.5 gm aluminum casting is heated to 99.8 oC in a boiling water bath,
and placed in a coffee cup calorimeter containing 150.0 gm of water initially at 23.5 oC.
The final temperature of metal and water is 29.1 oC.
Assuming no heat loss to the cup or surroundings, find the specific heat capacity of the aluminum.
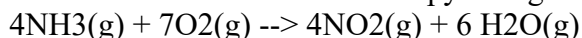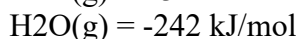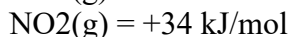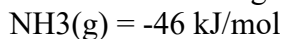(Cs for water = 4.18 J/gm C)

11. Given:
H2(g) + F2(g) --> 2HF(g) (delta)H = -537 kJ
2H2(g) + O2(g) --> 2H2O(l) (delta)H = -572 kJ

Find (delta)H for:
2F2(g) + 2H2O(l) --> 4HF(g) + O2(g)

12. Calculate the standard enthalpy change for the reaction:
4NH3(g) + 7O2(g) --> 4NO2(g) + 6 H2O(g)

Given the following Hfo (standard free energy of formation) values:
NH3(g) = -46 kJ/mol
NO2(g) = +34 kJ/mol
H2O(g) = -242 kJ/mol

13. The (delta)S change for the process in #12 would be predicted to be

(delta)S < 0, (delta)S > 0, (delta)S= 0
can't tell from given information

14. Which fuel would contribute the least to global warming on combustion?

Coal, Methane, Methanol, Hydrogen

15. The impurity(ies) in coal responsibile for acid rain is(are):

C, N, O, S, Na, Ca, Mg, Al

16. Which of the following physical processes would be expected to have a positive (delta)S change?
(may be more than one)

Melting / Freezing / Evaporation / Condensation / Expansion / Compression

17. The enthalpy of fusion of tungsten, used for light bulb filaments, is 35.2 kJ/mol, and the entropy of fusion is

9.57 J/K mol. What is the melting point of tungsten?

18. One mole of gas undergoes a reversible isothermal expansion at 25.0 C, until its volume has doubled.
Calculate q & w.
(R=8.31 J/ K mole)

19. For a reaction with a positive (delta)H and negative (delta)S, it will be:

Spontaneous at high temperatures
Spontaneous at low temperatures
Always spontaneous
Never spontaneous
Can't tell from given information

20. AgCl is sparingly soluble in water. The solubility product constant, Ksp for

$AgCl(s) \longrightarrow Ag^+(aq) + Cl^-(aq)$
is 1.6 x 10-10 at 25.0 oC .

What is (delta)G for this process?
(R=8.31 J/K mol)

(Problems 21-23 refer to the following reaction used in the refining of nickel:)

$Ni(s) + 4CO(g) \longrightarrow Ni(CO)_4(g)$

H= +607 kJ/mol S = -417 J/K mol

21. What would be the expected effect of increasing overall pressure at constant T
on the equilibrium yield of $Ni(CO)_4(g)$?

increase, decrease, no change,
can't tell from given information

22. What is the effect of increasing temperature on the yield of $Ni(CO)_4(g)$?

increase, decrease, no change,
can't tell from given information

23. Which parameter will change the equilibrium concentration of $Ni(CO)_4(g)$
via a change in the value of Keq?

Total system pressure
Pressure of CO(g)
Pressure of $Ni(CO)_4(g)$

Temperature change
All of the above
None of the above

For the equilibrium reaction:

$2NO_2(g) \longrightarrow N_2O_4(g)$
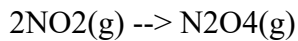
H = -58 kJ S = -176 J/K

24. Calculate the temperature at which the reaction first becomes spontaneous.
(Assume pNO2 = pN2O4 = 1.00 atm, so no correction for Q is needed)

25. For the reaction in #24, calculate the reaction quotient, Q when
pNO2 = 2.00 atm, pN2O4 = 2.00 atm

26. For the reaction in #24, calculate (delta)G at
T = 200 K, pNO2 = 2.00 atm, pN2O4 = 2.00 atm