For questions 1-4, use the following reaction to predict which direction the equilibrium will shift when certain stressors are applied.

N_2 (g) + $3H_2$ (g) ⇌ $2NH_3$ (g) + 100 kJ

1. Concentration of nitrogen gas is increased.
    a. no change
    b. left
    c. right

2. Concentration of hydrogen gas is increased.
    a. no change
    b. left
    c. right

3. Concentration of ammonia is increased.
    a. no change
    b. left
    c. right

4. Temperature is increased.
    a. no change
    b. left
    c. right

For questions 5-8, use the following reaction to predict which direction the equilibrium will shift when certain stressors are applied.

$CaCO_3$ (s) + 200 kJ ⇌ CaO (s) + CO_2 (g)

5. Calcium carbonate is added.
    a. no change
    b. left
    c. right

6. Calcium oxide is added.
    a. no change
    b. left
    c. right

7. Concentration of carbon dioxide gas is increased.
    a. no change
    b. left
    c. right

8. Temperature is increased.
    a. no change
    b. left
    c. right

Which direction will the following equilibrium reactions shift to accommodate the changes detailed to the right of the reactions?

9. $2SO_2\ (g) + O_2\ (g) \rightleftharpoons 2SO_3\ (g) + heat$ decrease temperature
    a. no change
    b. left
    c. right

10. $C\ (s) + CO_2\ (g) + energy \rightleftharpoons 2CO\ (g)$ increase temperature
    a. no change
    b. left
    c. right

11. $3Fe\ (s) + 4H_2O\ (g) \rightleftharpoons Fe_3O_4\ (s) + 4H_2\ (g)$ add elemental iron
    a. no change
    b. left
    c. right

12. $N_2\ (g) + 3H_2\ (g) \rightleftharpoons 2NH_3\ (g)$ volume of vessel increased
    a. no change
    b. left
    c. right

13. Given the following reaction:

    $2H^+\ (aq) + 2CrO_4^{2-}\ (aq) + energy \rightleftharpoons Cr_2O_7^{2-}\ (aq) + H_2O\ (l)$

    Which stress change would result in a color change from original state if chromate ions in solution are yellow and dichromate ions are orange in solution?
    a. increase in hydrogen ion concentration
    b. increase in dichromate ion concentration
    c. decrease in temperature
    d. decrease in chromate ion concentration

14. Given the following reaction:

    $N_2O_4\ (g) + heat \rightleftharpoons 2NO_2\ (g)$

    Which would result increase product yield?
    a. decreasing the temperature
    b. decreasing the concentration of NO_2 (g)
    c. increasing pressure
    d. decreasing the concentration of N_2O_4 (g)

15. At equilibrium, the concentration of sulfite ions is 0.700M, water vapor 0.900M, and pure sulfuric acid 0.500M according to the following reaction:

$SO_3\ (g) + H_2O\ (g) \rightleftharpoons H_2SO_4\ (l)$

Calculate the equilibrium constant.

a. 1.59
b. 0.794
c. 0.630
d. 1.26

16. Consider the following equilibrium reaction:

$2SO_2\ (g) + O_2\ (g) \rightleftharpoons 2SO_3\ (g)$

If 0.900 mol of SO_2 and 0.900 mol of O_2 are together in a 5.00 L flask at equilibrium and the K_{eq} = 460, calculate the number of moles of SO_3 assuming that x is negligible.

a. 2.73
b. 5.46
c. 27.3
d. 13.7

17. A 4.20 mol sample of phosphorus pentachloride, PCl_5, dissociates according to the following equation to give 0.339 mol of chlorine, Cl_2, at equilibrium. What is the concentration of the PCl_5 at equilibrium?

$PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$

a. 0.339 M
b. 4.20 M
c. 3.86 M
d. 4.54 M

18. For the following reaction equilibrium concentrations are found to be
$[H_2]$ = 0.212 M $[I_2]$ = 0.098 M [HI] = 1.08 M
What is the equilibrium constant of this reaction?

$H_2\ (g) + I_2\ (g) \rightleftharpoons 2\ HI\ (g)$

a. 11.0
b. 2.34
c. 52.0
d. 56.1

19. Find the concentration of I when 5 mol of I_2 is placed in a 5 L flask at 100 K according to the following reaction assuming that the change in concentration is negligible. The equilibrium constant is 3.2×10^{-4}.

I_2 (g) ⇌ 2I (aq)

a. 0.018
b. 0.009
c. 0.00032
d. 4.1×10^{-7}

20. Which represents the equilibrium constant for the reaction

$2O_3$ (g) ⇌ $3O_2$ (g)

a. $[O_3]^2 / [O_2]^3$
b. $[O_2] / [O_3]$
c. $[O_3] / [O_2]$
d. $[O_2]^3 / [O_3]^2$

Complete the following matching section by placing the letter of the matching description on the line next to each question.

__L___	21. Transition Metals	A. This group of elements includes solids, liquid, and gases. They have 7 valence electrons.
___K__	22. Representative Elements	B. The two rows that are traditional cut from the periodic table and pasted to the bottom for the purpose of conserving paper. They represent the "f-block".
__N___	23. Period	C. Series of elements that produce a spark when struck.
___J__	24. Nonmetals	D. Series of elements that are all radioactive.
__F___	25. Noble Gases	E. Particle with either a positive or negative charge.
__M___	26. Metals	F. Group of elements that have the highest ionization energies.
__I___	27. metalloids	G. Elements that react with the air and water, but have 2 valence electrons.
__C___	28. Lanthanides	H. Elements that react violently with water and air. They have one valence electron and very low electronegativities and ionization energies.
__Q___	29. Ionization Energy	I. Elements that are lustrous and somewhat malleable, but are poor conductors of electricity.
__E___	30. Ion	J. Elements that are dull, brittle, and do not conduct electricity.
__B___	31. Innertransition Metals	K. Elements in the tall columns of the periodic table. These columns are usually depicted with the letter "A". They are the elements that follow the general patterns with very few exceptions.
_A____	32. Halogens	L. Elements in the shorter columns of the periodic table. These columns are usually depicted with the letter "B".
__O___	33. Group	M. Elements that are lustrous, malleable, ductile, and conduct electricity and heat well.
__P___	34. Electronegativity	N. Another name for a "row" within the periodic table.
__G___	35. Alkaline Earth Metals	O. Another name for a "column" within the periodic table.
__H___	36. Alkali Metals	P. An atom's affinity for electrons.
__D___	37. Actinides	Q. Amount of energy needed to remove an electron from an atom.

38. As the atomic number of elements increases down a column:
    a. atomic radius decreases
    b. atomic mass decreases
    c. ionization energy decreases
    d. the number of electrons in outermost energy level increases

39. Arrange the following elements in order of increasing atomic radius.
    Carbon, Fluorine, Hydrogen, Nitrogen, Aluminum
    a. H, Al, F, N, C
    b. H, F, N, C, Al
    c. H, C, F, Al, N
    d. Al, C, N, F, H
40. The most electronegative element is:
    a. fluorine
    b. hydrogen
    c. lithium
    d. nickel