

# CH 121

## General Chemistry Final Examination June 25, 2002

### KEY

Name: \_\_\_\_\_  
(please print)

SSN:  \* \* \* - \* \* -   
(last 4 digits)

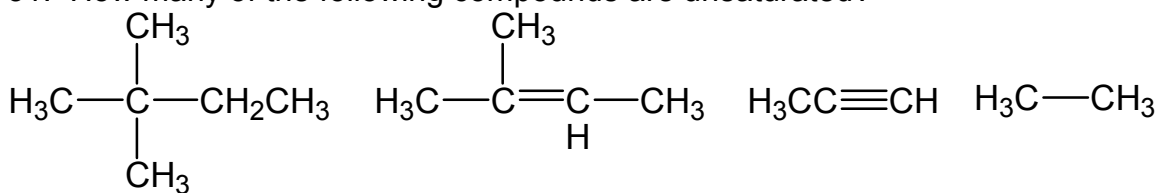
There are 40 Questions. Each question is worth 1 point.  
Circle your answer **clearly**; otherwise no credit will be given.  
Circle only **one** answer. If you circle two or more, you will receive no credit.

$R = 0.082057 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol}$

1. A good example of an ionic compound is
  - d. sodium chloride
2. When a pure solid substance was heated, a student obtained another solid and a gas, each of which was a pure substance. From this information which of the following statements is ALWAYS a correct conclusion?
  - a. The original solid is not an element.
3. You have  $1.36 \times 10^{-4}$  g of the radioactive element americium, Am. How many moles of americium do you have?
  - b.  $5.60 \times 10^{-7}$  mol
4. An average sample of coal contains 3.0% sulfur by mass. How many moles of sulfur are there in 1.00 metric ton of coal? (1 metric ton = 1000. kg)
  - a. 940 mol
5. How many moles of fluorine **molecules** are in 5.00 grams of elemental fluorine?
  - a. 0.132 mol
6. Give the ions present and their relative numbers in barium nitrate.
  - c. 1  $\text{Ba}^{2+}$  and 2  $\text{NO}_3^-$
7. What is the name of  $\text{FeSO}_4$ ?
  - c. iron(II) sulfate
8. Ammonia will react with fluorine at a high temperature in the presence of copper to produce some dinitrogen tetrafluoride and hydrogen fluoride.
 
$$\underline{\hspace{1cm}} \text{NH}_3(\text{g}) + \underline{\hspace{1cm}} \text{F}_2(\text{g}) \rightarrow \underline{\hspace{1cm}} \text{N}_2\text{F}_4(\text{g}) + \underline{\hspace{1cm}} \text{HF}(\text{g})$$
 When the equation above is properly balanced with the smallest whole numbers, the respective coefficients are:
  - c. 2, 5, 1, 6
9. Hydrazine,  $\text{N}_2\text{H}_4$ , is an important industrial reagent. It is synthesized by the Raschig process.
 
$$2\text{NaOH}(\text{aq}) + \text{Cl}_2(\text{g}) + 2\text{NH}_3(\text{aq}) \rightarrow \text{N}_2\text{H}_4(\text{l}) + 2\text{NaCl}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$$
 If you combine 100. g each of NaOH,  $\text{Cl}_2$ , and  $\text{NH}_3$  and the reaction is complete, which reactant(s) will be left over?
  1. NaOH
  2.  $\text{Cl}_2$
  3.  $\text{NH}_3$
  - e. 2 and 3 only

10. Phosphoric acid is made from phosphate rock, one form of which is apatite,  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  (molar mass = 504.3 g/mol).  
$$\text{Ca}_5(\text{PO}_4)_3\text{F}(\text{s}) + 5\text{H}_2\text{SO}_4(\text{aq}) \rightarrow 5\text{CaSO}_4(\text{s}) + 3\text{H}_3\text{PO}_4(\text{aq}) + \text{HF}(\text{aq})$$
  
If you use 100. g of apatite and 500. g of sulfuric acid (molar mass = 98.07 g/mol), what is the maximum possible yield of phosphoric acid (97.99 g/mol)?
- c. 58.3 g
11. A precipitate will form when an aqueous solution of lead(II) nitrate is added to an aqueous solution of
- e. NaCl
12. The oxidation number of chromium in  $\text{Na}_2\text{CrO}_4$  is
- c. +6.
13. The oxidation number of chlorine in  $\text{KClO}_3$  is
- b. +5.
14. Equal masses of two substances, A and B, each absorb 25 joules of energy. If the temperature of A increases by 4 degrees and the temperature of B increases by 8 degrees, one can say that
- a. the specific heat of A is double that of B.
15. Which response lists the processes that are endothermic and none that are exothermic?
1. Evaporation of water
  2. Sublimation of ice
  3. Condensation of steam
  4. Freezing of water
- a. 1 and 2 only
16. Which process involves the largest energy change for one mole of 1,4 dichlorobenzene, moth balls?
- b.  $\Delta H_{\text{sublimation}}$
17. Which of the following has the longest wavelength?
- b. red light
18. When  $l = 4$ , what set of orbitals is designated?
- e. g
19. How many electrons can be described by the set of quantum numbers  $n = 3$ ,  $l = 3$ ,  $m_l = -1$ ,  $m_s = -1/2$ ?
- e. 0
20. Which of the following elements is paramagnetic?
- a. P

21. Which of the following has the lowest 1st ionization energy?  
c. Na
22. Which of the following particles would be predicted to be paramagnetic?  
a. Na
23. Which of the following best describes the variation of ionization energy of the elements with respect to their position on the periodic table?  
c. Increases across a period, decreases down a group.
24. Which of the following element combinations is likely to produce covalent bonds in a compound?  
c. nitrogen and oxygen
25. Which statement is true regarding bond order, bond length, and bond energy?  
b. As the bond order increases, the bond length decreases.
26. Which compound contains a carbon-oxygen bond with a bond order of 2?  
a. CO<sub>2</sub>
27. Which of the following elements is most likely to display sp<sup>3</sup>d hybridization?  
c. phosphorus
28. The number of π-bonds in hydrazine, H<sub>2</sub>NNH<sub>2</sub> is  
a. 0
29. All of the following species contain two π-bonds **EXCEPT**  
e. NO<sup>-</sup>
30. Consider the diatomic molecules of the second period Li<sub>2</sub>, Be<sub>2</sub>, and C<sub>2</sub>. Which is (are) unlikely to exist?  
a. Li<sub>2</sub>  
b. Li<sub>2</sub> and Be<sub>2</sub>  
c. Be<sub>2</sub>  
d. C<sub>2</sub>  
e. Be<sub>2</sub> and C<sub>2</sub>
31. How many of the following compounds are unsaturated?

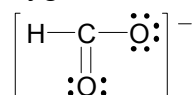


c. 2

32. The condensation reaction of ethanol and formic acid will yield as products water and an  
 a. ester.
33. If the volume of a confined gas is doubled while the temperature remains constant, what change (if any) would be observed in the pressure?  
 a. It would be half as large.
34. What is the molar mass of a gas which has a density of 1.30 g/L measured at 27 °C and 0.400 atm?  
 d. 80.0 g/mol
35. What is the molar mass of a gas which has a density of 1.83 g/L measured at 27 °C and 0.538 atm?  
 e. 83.7 g/mol
36. Of the gases, Ne, N<sub>2</sub>, O<sub>2</sub>, CH<sub>4</sub>, and SiH<sub>4</sub>, which one would you expect to be easiest to liquefy?  
 e. SiH<sub>4</sub>

The following questions pertain to lead (atomic mass of 207.2 g/mol) which crystallizes in a face-centered cubic arrangements. Lead has an atomic radius of  $1.75 \times 10^{-8}$  cm.

37. How many lead atoms are there per unit cell?  
 c. 4
38. What is the mass of the unit cell in grams?  
 d.  $1.38 \times 10^{-21}$  g/cell
39. What is the average carbon-oxygen bond order in the formate ion?



- c. 1.5
40. The functional group C-O-H is characteristic of  
 c. alcohols