| Na | me:   |  | Score:/1                                     | 100            |
|----|---|--|--|----------------|
| Pa | rt I. Multiple choice. Write the let  | tter of the correct answer for each p  | problem. 3 points ea                         | ach            |
| 1. | Which of the following pairs of sub<br>A) A polar compound in a polar s   | ostances is <u>least likely</u> to form a solution   | lution?                                      |                |
|    | <ul><li>B) A nonpolar compound in a polar (C)</li><li>B) A nonpolar compound in a nonpolar C)</li><li>C) An ionic compound in a nonpolar D) An ionic compound in a nonpolar</li></ul> | npolar solvent<br>solvent<br>olar solvent  | Answer                                       |                |
| 2. | That energy goes spontaneously fro<br>the:  | om more useful forms to less usefu   | l forms is a statemen                        | nt o           |
|    | <ul><li>A) first law of thermodynamics</li><li>B) second law of thermodynamic</li><li>C) third law of thermodynamics</li><li>D) standard law of energy convert</li></ul>              | rsion  | Answer                                       |                |
| 3. | According to the kinetic-molecular total energy   | theory of gases, in collisions betw  | een gas particles, the                       | e              |
|    | <ul><li>A) decreases slightly.</li><li>B) decreases considerably.</li></ul>   | <ul><li>C) increases slightly.</li><li>D) remains the same.</li></ul>  | Answer                                       |                |
| 4. | One 1.00L flask (flask A) contains gas. If both flasks are at the same t  | CO gas and another 1.00 L flask (<br>temperature and pressure, flask A c                                     | flask B) contains CC<br>contains             | $\mathbf{D}_2$ |
|    | <ul><li>A) more mass but the same numb</li><li>B) more mass and more molecules</li><li>C) less mass and fewer molecules</li><li>D) less mass but the same number</li></ul>            | ber of molecules than flask B.<br>es than flask B.<br>s than flask B.<br>r of molecules than flask B.        | Answer                                       |                |
| 5. | Which of the following contains th  | e greatest number of moles of O?   |  |                |
|    | <ul><li>A) 2.3 mol H<sub>2</sub>O</li><li>B) 0.9 mol NaNO<sub>3</sub></li></ul>   | <ul> <li>C) 1.2 mol H<sub>2</sub>O<sub>2</sub></li> <li>D) 0.5 mol Ca(NO<sub>3</sub>)<sub>2</sub></li> </ul> | Answer                                       |                |
| 6. | Argon gas is enclosed in a 10.2 L to value for the pressure when the arg  | ank at 12.01 atm. Which of the folgon is transferred to a 30.0 L tank a                                      | lowing is a reasonab<br>t constant temperatu | ble<br>1re?    |
|    | <ul><li>A) 3.0 atm</li><li>B) 4.0 atm</li></ul>   | <ul><li>C) 36.0 atm</li><li>D) 120.0 atm</li></ul>   | Answer                                       |                |
| 7. | Which intermolecular force is most water relative to other substances of  | t significant in accounting for the h<br>of similar molar mass?  | igh boiling point of                         |                |
|    | <ul><li>A) ion-dipole interactions</li><li>B) hydrogen bonding interactions</li><li>C) dipole-induced dipole interact</li><li>D) dispersion forces</li></ul>                          | s<br>ions  | Answer                                       |                |
| 8. | The fundamental law that energy c   | annot be created or destroyed is:  |  |                |
|    | <ul><li>A) The first law of thermodynam</li><li>B) The second law of thermodyna</li><li>C) The third law of thermodynam</li><li>D) The law of the jungle</li></ul>                    | ics<br>amics<br>nics   | Answer                                       |                |

| 9. Molecules are farthest apart i   | D. Molecules are farthest apart in a(n)  |        |  |  |  |  |
|---|--|--------|--|--|--|--|
| A) ionic solid  | C) covalent solid  |        |  |  |  |  |
| B) liquid   | D) gas   | Answer |  |  |  |  |
| 10. Consider the reaction below. How many moles of $CO_2$ are produced if 50 moles of $O_2$ react?<br>2 $C_8H_{18} + 25 O_2 \rightarrow 16 CO_2 + 18 H_2O$  |  |        |  |  |  |  |
| A) 50   | C) 48  |        |  |  |  |  |
| B) 100  | D) 32  | Answer |  |  |  |  |
| 11. Which of the following is lik having the highest melting pe   | 11. Which of the following is likely to require the greatest input of energy to melt, therefore having the highest melting point?  |        |  |  |  |  |
| A) $C_6H_{12}O_6$   | C) NaCl  |        |  |  |  |  |
| B) N <sub>2</sub> O   | D) Ar  | Answer |  |  |  |  |
| 12. Reactions tend to proceed fas   | ster at higher temperatures because  |        |  |  |  |  |
| <ul><li>A) the energy of the product</li><li>B) the pressure in the react</li><li>C) there are more molecule</li><li>D) reactant molecules collidered</li></ul>   | <ul> <li>A) the energy of the products has increased.</li> <li>B) the pressure in the reaction vessel has decreased.</li> <li>C) there are more molecules available to react.</li> <li>D) reactant molecules collide more frequently.</li> </ul> |        |  |  |  |  |
| 13. How many grams of sulfur a  | re in 0.20 mol of $Cr(SO_4)_3$ ?   |        |  |  |  |  |
| A) 3.20 g   | C) 12.8 g  |        |  |  |  |  |
| B) 6.40 g   | D) 19.2 g  | Answer |  |  |  |  |
| 14. In the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ , with all the substances at the same temperature and pressure, what volume of ammonia is produced when 2.25 L of nitrogen reacts with excess hydrogen? |  |        |  |  |  |  |
| A) 2.25 L   | C) 9.00 L  |        |  |  |  |  |
| B) 4.50 L   | D) 13.5 L  | Answer |  |  |  |  |
| 15. Of CH <sub>3</sub> OH, H <sub>2</sub> , HF, and H <sub>2</sub> O, which molecule(s) can participate in hydrogen bonding?  |  |        |  |  |  |  |
| A) $H_2$ only   | C) CH <sub>3</sub> OH, HF, and H <sub>2</sub> O  |        |  |  |  |  |
| B) $H_2O$ only  | D) $CH_3OH$ , $H_2$ , $HF$ , and $H_2O$  | Answer |  |  |  |  |
| Part II. Complete each of the following. Point values are noted by each question.   |  |        |  |  |  |  |

16. Complete the following table. (6 points)

|--|

17. Match the term with its definition. (8 points)

| thermodynamics    | A. | the tendency for an atom in a bond to attract electrons to              |
|-------------------|----|---|
| 1 4               | Б  | itself.   |
| molarity          | В. | a process that releases heat energy                                     |
| a a luita         | C. | a process that absorbs heat energy                                      |
| solute            | D. | a thermodynamic concept that does not depend on pathway (or mechanism). |
| electronegativity | E. | the substance that is dissolved in another substance to form a solution |
| joule             | F. | the substance that dissolves another substance to form a solution       |
|                   | G. | energy transferred as heat  |
| enthalpy          | H. | concentration in terms of moles per liter                               |
|                   | I. | a quantity of energy  |
| state function    | J. | the study of energy and its changes                                     |

18. How would you prepare 350 g of an aqueous solution that is 3.50% glucose ( $C_6H_{12}O_6$ ) by mass, starting with pure, solid glucose? (6 points)

19. How does the statement "you can't break even" relate to the second law of thermodynamics? (6 points)

20. In a laboratory experiment, you use 25 mL of 2.0 M sodium hydroxide solution to begin the alloy formation. How many grams of NaOH are present in 25 mL of 2.0 M NaOH? (6 points)

**Part III.** <u>Complete 3 of the following 4 problems.</u> Clearly mark the problem you do not want graded. Each problem is worth eight (8) points. You must show you work on calculations to receive partial credit. Report numerical results to the correct number of significant figures and with the appropriate units.

- 21. Nitroglycerin,  $C_3H_5(ONO_2)_3$ , is a contact explosive that undergoes a rapid decomposition to form carbon dioxide, water vapor, nitrogen gas and oxygen gas.
  - a. Balance the reaction for the decomposition of nitroglycerin. I've given you a coefficient of 4 for nitroglycerin as a starting point.

$$4 \operatorname{C_{3}H_{5}(ONO_{2})_{3}}(s) \rightarrow \underline{CO_{2}}(g) + \underline{H_{2}O}(g) + \underline{N_{2}}(g) + \underline{O_{2}}(g)$$

- b. What is the molar mass of nitroglycerin?
- c. If 20.0 grams of nitroglycerin decomposes, how many total moles of gas are produced?
- d. Assuming the 20.0 grams of nitroglycerin from <u>part c</u> decomposes in a closed metal pipe with a volume of 0.200 L at a temperature of 5000°C (typical for nitroglycerin), what will the pressure be inside the pipe?

22. At a temperature of  $-100^{\circ}$ C, tetrafluoromethane (CF<sub>4</sub>) is a gas, while water is a solid. Use your understanding of the structure of these two compounds to explain this difference in their physical properties.

23. Calculate the amount of energy that is involved when 1 mol of nitrogen gas reacts with 3 mol hydrogen gas to produce 2 mol ammonia gas, given the information below. (*Hint: start with a Lewis structure for each compound.*)

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

| Bond | Bond Energy |  |
|------|-------------|--|
|      | (kJ/mol)    |  |
| N-N  | 163         |  |
| N=N  | 418         |  |
| N≡N  | 964         |  |
| N-H  | 391         |  |
| H-H  | 432         |  |

24. Oxygen gas  $(O_2)$  and nitrogen gas  $(N_2)$  can react to form nitrogen dioxide. What mass of oxygen is needed to react with 1.50 grams nitrogen in this process?

Form B

| % by mass =   | g component<br>100 g mixture | R = 0.0821 (I  | L atm)/(mol K)   | $\frac{P_1}{T_1} = \frac{P_2}{T_2}$   | $\frac{\mathbf{P}_1\mathbf{V}_1}{\mathbf{T}_1} = \frac{\mathbf{P}_2\mathbf{V}_2}{\mathbf{T}_2}$   |
|---|------------------------------|--|--|---|---|
| At STP, $P = 1$ atm, $T = 25^{\circ}C$                              |                              | $K = {}^{o}C + 273.15$   |  | $\frac{\mathbf{V}_1}{\mathbf{T}_1} = \frac{\mathbf{V}_2}{\mathbf{T}_2}$   | PV=nRT  |
| Avogadro's number:<br>$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ |                              | d =  | m/v  | $\mathbf{P}_1\mathbf{V}_1 = \mathbf{P}_2\mathbf{V}_2$   |   |
|   | L Helium<br>Ba               | 4.003<br>10<br>Neon<br>20.180<br>20.180<br>20.180<br>39.948  | 36 Kr<br>Krypton<br>8.7980<br>54 Xe<br>Xenon<br>131.294  | Radon<br>222.018<br>Oganesson<br>Coanesson<br>Coanesson   | 60<br>Lium<br>sciencenetine<br>sciencenetine  |
|   | LIA<br>VIIA                  | 7A<br>9<br>11<br>180908<br>11<br>18398<br>11<br>18398<br>135453<br>35453   | 5<br>Bromine<br>79.904<br>126.904  | At A  | 55 7439<br>Um Lawrend<br>103 103<br>1103<br>1262<br>1262  |
| mic   | 16<br>VIA                    | 64<br>69<br>60<br>0xygen<br>155999<br>155999<br>155999<br>0xygen<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>155999<br>15   | Partial Andread Andrea   |   | <b>d</b><br>102<br>102<br>102<br>102<br>102<br>29311  |
| ato   | 15<br>VA                     | 54<br>Nitrogen<br>14.007<br>8<br>9.974<br>8<br>3.0974  | <sup>3</sup> As<br>Arsenic<br>74.922<br>Antimony<br>1121.760   | Moscovium<br>Moscovium<br>Moscovium<br>Moscovium<br>Bismuch<br>Moscovium<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Mosco<br>Bismuch<br>Bismuch<br>Mosco<br>Bismuch<br>Moscovium<br>Moscovium<br>Bismuch<br>Bismuch<br>Moscovium<br>Moscovium<br>Bismuch<br>Bismuch<br>Moscovium<br>Bismuch<br>Bismuch<br>Moscovium<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Collana<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Collana<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bismuch<br>Bism | 101<br>Mendelet   |
| ound.   | 14<br>IVA                    | 44 4<br>Carbon<br>12.011<br>12.011<br>1<br>28.086  | <sup>2</sup> <sup>2</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup> <sup>5</sup> <sup>5</sup> <sup>5</sup> <sup>5</sup> <sup>5</sup> <sup>118,711</sup>  | Etrovium<br>Bend<br>Bend<br>Bend<br>Bend<br>Bend<br>Bend<br>Bend<br>Bend  | 167.232<br>160<br>100<br>257.09   |
| ay rc<br>oints  | 13<br>IIA                    | 3A<br>Boron<br>10.811<br>10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.811<br>1.10.8111<br>1.10.8111<br>1.10.8111<br>1.10.8111<br>1.10.8111<br>1. 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| al po   | nts                          | 28 B 2   | Sinc zinc zinc zinc zinc zinc zinc zinc z  | Mercury<br>Mercury<br>Permicium<br>2851<br>2851<br>2851<br>2851<br>2851<br>2851<br>2851<br>2851   | <b>38</b><br><b>61</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>16</b><br><b>17</b><br><b>16</b><br><b>17</b><br><b>16</b><br><b>17</b><br><b>16</b><br><b>17</b><br><b>16</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b><br><b>17</b> |
| you<br>cim  | ileme                        | <b>2 8 8</b>   | Copper<br>Gopper<br>Silver<br>Silver<br>107.868  | AU<br>AO<br>AO<br>AO<br>AO<br>AO<br>AO<br>AO<br>AO<br>AO<br>AO  | 97<br>97<br>Berkeliuru<br>247.070   |
| ime<br>() de  | the I                        | م 2  | Nickel<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S8.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9.693<br>S9 | et allations and  | 96<br>547.070<br>247.070  |
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| ulati<br>o tw   | lic Tal                      |  | Frence Parallel Paral   |   | 15036<br>94<br>Plutonium<br>244.064   |
| calc<br>ses t   | Perioc                       | 7<br>VIIB<br>78  | 26 Againese  | 61<br>61<br>61<br>61<br>61<br>61<br>61<br>61<br>61<br>61  | 93<br>93<br>Neptumur<br>237,048   |
| me (<br>mas   | <b>–</b>                     | 6<br>6B  | Comium Comium Comium Comium Comium Comium Comium Comium Market Comium Comi<br>Comium Comium Comiu Comiu Comium  |   | 92<br>144,243<br>238,029  |
| e so  |                              | 5 8 S  | 0.942 Characteristic  | De lo constante de la constant  | P140,000<br>P1<br>Protactinium<br>231,036   |
| sav   |                              | 4 8<br>4 8   | Zr 23<br>23<br>7.867<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24   |   | 90<br>90<br>Thorium<br>232.038  |
| To  |                              | ۳ B ۳  | 22<br>mdium<br>1356<br>1,1356<br>40<br>40<br>21<br>22<br>22<br>22<br>23<br>20<br>6<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   | 101 101 101 101 101 101 101 101 101 101   | 138.905<br>89<br>Actinum<br>227.028   |
|   | ۵ م                          | 2A<br>Villum<br>012<br>assum<br>305<br>IIII  | 21<br>1078<br>1078<br>23<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24   | Sa 37-7<br>inium<br>7328<br>89-1<br>6005<br>6025<br>5025<br>5eries  | Actinide<br>Series  |
|   |                              | 008<br>941 m H<br>941 m Ber<br>12<br>990 Mag<br>24<br>12<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24<br>24   | 20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20   |   |   |
|   |                              | <sup>22</sup> <sup>28</sup> <sup>2</sup> <sup>3</sup> <sup>3</sup> <sup>3</sup>  | <b>19</b><br>37<br>85<br>85<br>85  | <b>8</b><br><sup>13</sup><br><sup>22</sup><br><sup>22</sup>   |   |