



DO NOT OPEN

UNTIL INSTRUCTED TO DO SO

*CHEM 110 – Dr. McCorkle – Exam #1 **KEY***

While you wait, please complete the following information:

Name: _____

Student ID: _____

Turn off cellphones and stow them away. No headphones, mp3 players, hats, sunglasses, food, drinks, restroom breaks, graphing calculators, programmable calculators, or sharing calculators. Grade corrections for incorrectly marked or incompletely erased answers will not be made.

Periodic Table of the Elements

GROUP	PERIOD										18							
1	IIA										VIIIA							
2	IIIA										VIIIA							
3	IIIB										VIIIA							
4	IIIB										VIIIA							
5	IIIB										VIIIA							
6	IIIB										VIIIA							
7	IIIB										VIIIA							
1	H 1.01											He 4.00						
2	Li 6.94	Be 9.01											B 10.81					
3	Na 22.99	Mg 24.31											Al 26.98					
4	K 39.10	Ca 40.08	Sc 44.96	Ti 47.88	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.69	Cu 63.55	Zn 65.39	Ga 69.72	Ge 72.61	As 74.92	Se 78.97	Br 79.90	Kr 83.80
5	Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.95	Tc (98)	Ru 101.07	Rh 102.91	Pd 106.42	Ag 107.87	Cd 112.41	In 114.82	Sn 118.71	Sb 121.75	Te 127.60	I 126.90	Xe 131.29
6	Cs 132.91	Ba 137.33	La* 138.91	Hf 178.49	Ta 180.95	W 183.85	Re 186.21	Os 190.23	Ir 192.22	Pt 195.08	Au 196.97	Hg 200.59	Tl 204.38	Pb 207.2	Bi 208.98	Po (209)	At (210)	Rn (222)
7	Fr (223)	Ra (226)	Ac** (227)	Rf (267)	Db (268)	Sg (271)	Bh (270)	Hs (277)	Mt (276)	Ds (281)	Rg (280)	Cn (285)	Uut (284)	Fl (289)	Uup (288)	Lv (293)	Uus (294)	Uuo (294)

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1	IIA										VIIIA				
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6	IIIB										VIIIA				
7	IIIB										VIIIA				
58	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	171
140.12	140.91	144.24	(145)	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.05	174.97		
90	91	92	93	94	95	96	97	98	99	100	101	102	103		
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		
232.04	231.04	238.03	(237)	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(262)		

Lanthanide Series *

Actinide Series **

Multiple Choice – Choose the answer that best completes the question. Use an 815-E Scantron to record your response. [2 points each]

1. How would you correctly express the measurement 0.0000043 m using scientific notation?

- A) 4.3×10^{-7} m **B) 4.3×10^{-6} m** C) 4.3×10^6 m
D) 0.43×10^{-5} m E) 4.3 m

2. How many significant digits are in 0.00300210 mL?

- A) 5 **B) 6** C) 7 D) 8 E) 9

3. Perform the following calculation and give the answer with the correct significant digits:

$$42.0 \times 0.070 \div 2.010 =$$

- A) 2 B) 1.4 **C) 1.5** D) 1.46 E) 1.463

4. Perform the following calculation and give the answer with the correct significant digits:

$$8700 \text{ in.} + 3849 \text{ in.} - 473.2 \text{ in.} =$$

- A) 121 in. B) 12000 in. **C) 12100 in.** D) 12180 in. E) 12176 in.

5. Perform the following calculation and give the answer with the correct significant digits

$$\frac{3.14 \times 10^{-5} \times 0.080}{7.20 \times 10^3} =$$

- A) 3×10^{-10} **B) 3.5×10^{-10}** C) 3.49×10^{-10}
D) 3.5×10^{-4} E) 3.49×10^{-4}

6. Which of the following equalities is correct?

- A) $10^{-6} \mu\text{g} = 1 \text{ g}$ B) $10^3 \text{ kg} = 1 \text{ g}$ C) $10^{-2} \text{ g} = 1 \text{ dg}$
D) $10^{12} \text{ g} = 1 \text{ Tg}$ E) $10^9 \text{ g} = 1 \text{ Mg}$

7. The mass of an electron is only 9.1×10^{-31} kg. What is this mass in fg?

- A) 9.1×10^{-13} fg** B) 9.1×10^{-49} fg C) 9.1×10^{-16} fg
D) 9.1×10^{-43} fg E) 9.1×10^{-19} fg

8. Which physical state assumes the volume and shape of its container?

- A) solid B) liquid **C) gas**

9. Which of the following is a physical change?

- A) salt dissolves in water** B) silver tarnishes & turns green C) a log burns
D) Alka-Seltzer fizzes in water E) dynamite explodes

10. Which term best describes a bowl of granola?

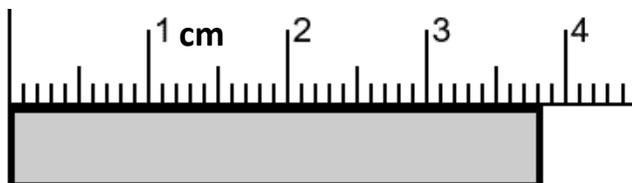
- A) element
D) heterogenous mixture
B) compound
E) homogeneous mixture
C) pure substance

11. Which of the following is a chemical property?

- A) magnetic
D) fizzes in water
B) conducts electricity
E) dissolves in water
C) tastes sweet

12. What measurement is indicated on the metric ruler at right?

- A) 3.8 cm
C) 3.08 cm
E) 4.20 cm
B) 3.80 cm
D) 3.800 cm



13. Indicate which isotope has 26 p⁺, 32 n⁰, and 26 e⁻.

- A) ${}_{26}^{32}\text{Fe}$
B) ${}_{26}^{58}\text{Fe}$
C) ${}_{26}^{32}\text{Ge}$
D) ${}_{32}^{58}\text{Ge}$
E) ${}_{26}^{58}\text{S}$

14. How many neutrons are in the nucleus of ${}^{198}\text{Pt}$?

- A) 78
B) 117
C) 120
D) 195
E) 198

15. What is the symbol for the ion with 19 protons and 18 electrons?

- A) F⁺
B) F⁻
C) Ar⁺
D) K⁻
E) K⁺

Calculations – Write your initials in the upper-right corner of every page that contains work. For full credit show all work and write neatly; give answers with correct significant figures and units. Place a box around your final answer.

16. The average temperature on the planet Venus is 462°C.

a. Convert this temperature to Fahrenheit. [2 points]

$$T_{\circ\text{F}} = 1.8 \times T_{\circ\text{C}} + 32$$

$$T_{\circ\text{F}} = 1.8 \times 462 + 32$$

$$T_{\circ\text{F}} = 864 \text{ }^{\circ}\text{F}$$

b. Convert this temperature to Kelvin. [2 points]

$$T_{\text{K}} = T_{\circ\text{C}} + 273.15$$

$$T_{\text{K}} = 462 + 273.15 = 735 \text{ K}$$

17. Large Peruvian sea scallops are on sale at Sprouts for \$9.99 per pound. What is the cost of 2.50 kg of scallops in dollars? [3 points]

$$2.50 \text{ kg} \times \frac{2.205 \text{ lb}}{1 \text{ kg}} \times \frac{\$9.99}{1 \text{ lb}} = \$55.1$$

18. The standard acceleration due to gravity is 98.07 dm/s². Convert this to fm/ms². [4 points]

$$\frac{98.07 \text{ dm}}{\text{s}^2} \times \frac{10^{-1} \text{ m}}{1 \text{ dm}} \times \frac{1 \text{ fm}}{10^{-15} \text{ m}} \times \left(\frac{10^{-3} \text{ s}}{1 \text{ ms}} \right)^2 = 9.807 \times 10^9 \frac{\text{fm}}{\text{ms}^2}$$

19. Dentists often administer “laughing gas” or nitrous oxide to patients. A dentist has 5.0×10^3 gal of nitrous oxide on hand. If the flow rate of the gas is 45 L/min and the average procedure takes 25 minutes, how many procedures can the dentist complete before he runs out of laughing gas? [4 points]

$$5.0 \times 10^3 \text{ gal} \times \frac{3.785 \text{ L}}{1 \text{ gal}} \times \frac{1 \text{ min}}{45 \text{ L}} \times \frac{1 \text{ procedure}}{25 \text{ min}} = \underline{16.8 \text{ procedures}}$$

With significant digits we'd normally round to 17 but the dentist will run out on the 17th so he can really only complete 16 procedures.

20. Silicon has three naturally occurring isotopes (Si-28, Si-29, and Si-30). The atomic mass and natural abundance of Si-28 are 27.9769 amu and 92.2 %, respectively. The atomic mass and natural abundance of Si-29 are 28.9765 amu and 4.67 %, respectively. What is the atomic mass of Si-30 to two decimal places? [4 points]

$$100\% = {}^{28}\text{Si} + {}^{29}\text{Si} + {}^{30}\text{Si}$$

$$100\% = 92.2\% + 4.67\% + {}^{30}\text{Si}$$

$${}^{30}\text{Si} = 3.13\%$$

$$\text{avg mass} = \% {}^{28}\text{Si} \times \text{mass } {}^{28}\text{Si} + \% {}^{29}\text{Si} \times \text{mass } {}^{29}\text{Si} + \% {}^{30}\text{Si} \times \text{mass } {}^{30}\text{Si}$$

$$28.09 \text{ amu} = (0.922 \times 27.9769) + (0.0467 \times 28.9765) + (0.0313 \times X)$$

$$28.09 \text{ amu} = 25.79 \text{ amu} + 1.353 \text{ amu} + 0.0313X$$

$$0.947 \text{ amu} = 0.0313X$$

$$X = 30.26 \text{ amu}$$

21. What is the mass of 1.55×10^{24} atoms of cadmium in ng? [4 points]

$$1.55 \times 10^{24} \text{ atoms} \times \frac{1 \text{ mol Cd}}{6.022 \times 10^{23} \text{ atoms}} \times \frac{112.41 \text{ g}}{1 \text{ mol Cd}} \times \frac{1 \text{ ng}}{10^{-9} \text{ g}} = 2.89 \times 10^{11} \text{ ng}$$

22. A sphere of pure osmium has a volume of $8.2 \times 10^{12} \mu\text{m}^3$. If the density of osmium is 22.59 g/cm^3 , how many atoms of osmium (symbol Os) are in the sphere? [5 points]

$$8.2 \times 10^{12} \mu\text{m}^3 \times \left(\frac{10^{-6} \text{ m}}{1 \mu\text{m}} \right)^3 \times \left(\frac{1 \text{ cm}}{10^{-2} \text{ m}} \right)^3 \times \frac{22.59 \text{ g}}{1 \text{ cm}^3} \times \frac{1 \text{ mol Os}}{190.23 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol Os}} \\ = 5.9 \times 10^{23} \text{ atoms}$$

23. In lecture we discussed several important experiments that have helped us understand the structure of the atom.

- J.J. Thomson's experiment that proved the existence of electrons and determined their charge-to-mass ratio.
- Ernest Rutherford's experiment that discovered the existence of a small, positively charged nucleus.

Briefly explain ONE of these experiments, including what they did and how they used their results to reach the underlined conclusion. [4 points]

J.J. Thomson performed the cathode ray experiment. He passed a beam of cathode rays (electrons) between magnetic and electric fields. By noting the rays bent away from the negatively charged plate and towards the positively charged plate, he determined the rays themselves must be negatively charged. By varying the magnitude of the two fields he was able to determine the charge-to-mass ratio of the electrons.

OR

Ernest Rutherford fired positively charged alpha particles at a thin piece of gold foil. Most of the alpha particles passed straight through indicating that atoms are mostly empty space. But a very small percentage of alpha particles were deflected quite strongly indicating they must have struck something both very small/dense and positively charged.

Extra Credit: What is the name of the physics laboratory at Cambridge University that is home to 29 Nobel laureates? [2 points]

Cavendish Laboratory

**Formulas & Constants
(you may or may not need)**

$$1 \text{ inch} = 2.54 \text{ cm (exact)}$$

$$1 \text{ lb} = 453.6 \text{ g}; 1 \text{ lb} = 16 \text{ oz}$$

$$T_K = T_{\text{C}} + 273.15$$

$$1 \text{ cal} = 4.184 \text{ J}$$

$$\text{Avogadro's \#} = 6.022 \times 10^{23}$$

$$1 \text{ mile} = 5280 \text{ ft} \approx 1.609 \text{ km}$$

$$1 \text{ gal} = 4 \text{ qt} = 8 \text{ pt} \approx 3.785 \text{ L}$$

$$T_{\text{F}} = 1.8 \times T_{\text{C}} + 32$$

$$1 \text{ Cal} = 1000 \text{ cal}$$

$$1 \text{ kg} \approx 2.205 \text{ lb}$$

$$1 \text{ L} = 1000 \text{ cm}^3$$

$$T_{\text{C}} = (T_{\text{F}} - 32)/1.8$$

$$q = m \times C \times \Delta T$$

Scratch Page
(to be handed in)