

# KEY

## TEST 1, VERSION A

CHEM 1110.24492

Spring 2016, Dr. Potts

Put your NAME, TEST VERSION, and ALL YOUR ANSWERS on the SCANTRON and submit the scantron for grading.

	IA											VIII A										
1	1											2										
	<b>H</b>																					
	1.008																					
2	3	4											5	6	7	8	9	10				
	<b>Li</b>	<b>Be</b>											<b>B</b>	<b>C</b>	<b>N</b>	<b>O</b>	<b>F</b>	<b>Ne</b>				
	6.94	9.01											10.81	12.01	14.01	16.00	19.00	20.18				
3	11	12											13	14	15	16	17	18				
	<b>Na</b>	<b>Mg</b>											<b>Al</b>	<b>Si</b>	<b>P</b>	<b>S</b>	<b>Cl</b>	<b>Ar</b>				
	22.99	24.31											26.98	28.09	30.97	32.06	35.45	39.95				
			IIIB	IVB	VB	VIB	VII B	VIII B				IB	IIB									
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36				
	<b>K</b>	<b>Ca</b>	<b>Sc</b>	<b>Ti</b>	<b>V</b>	<b>Cr</b>	<b>Mn</b>	<b>Fe</b>	<b>Co</b>	<b>Ni</b>	<b>Cu</b>	<b>Zn</b>	<b>Ga</b>	<b>Ge</b>	<b>As</b>	<b>Se</b>	<b>Br</b>	<b>Kr</b>				
	39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.37	69.72	72.59	74.92	78.96	79.90	83.80				
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54				
	<b>Rb</b>	<b>Sr</b>	<b>Y</b>	<b>Zr</b>	<b>Nb</b>	<b>Mo</b>	<b>Tc</b>	<b>Ru</b>	<b>Rh</b>	<b>Pd</b>	<b>Ag</b>	<b>Cd</b>	<b>In</b>	<b>Sn</b>	<b>Sb</b>	<b>Te</b>	<b>I</b>	<b>Xe</b>				
	85.47	87.62	88.91	91.22	92.91	95.94	[98]	101.1	102.9	106.4	107.9	112.40	114.8	118.7	121.8	127.60	126.90	131.30				
6	55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86				
	<b>Cs</b>	<b>Ba</b>	<b>Lu</b>	<b>Hf</b>	<b>Ta</b>	<b>W</b>	<b>Re</b>	<b>Os</b>	<b>Ir</b>	<b>Pt</b>	<b>Au</b>	<b>Hg</b>	<b>Tl</b>	<b>Pb</b>	<b>Bi</b>	<b>Po</b>	<b>At</b>	<b>Rn</b>				
	132.9	137.3	175	178.5	181	183.9	186.2	190.2	192.2	195.1	197	200.59	204.4	207.2	209	[209]	[210]	[222]				
7	87	88	103	104	105	106	107	108	109	110	111	112	113	114	115	116		118				
	<b>Fr</b>	<b>Ra</b>	<b>Lr</b>	<b>Rf</b>	<b>Db</b>	<b>Sg</b>	<b>Bh</b>	<b>Hs</b>	<b>Mt</b>	<b>Ds</b>	<b>Rg</b>	<b>Uub</b>	<b>Uut</b>	<b>Uuq</b>	<b>Uup</b>	<b>Uuh</b>		<b>Uuo</b>				
	[223]	[226]	[262]	[267]	[268]	[271]	[272]	[270]	[276]	[281]	[280]	[285]	[284]	[289]	[288]	[293]		[294]				
	57	58	59	60	61	62	63	64	65	66	67	68	69	70								
	<b>La</b>	<b>Ce</b>	<b>Pr</b>	<b>Nd</b>	<b>Pm</b>	<b>Sm</b>	<b>Eu</b>	<b>Gd</b>	<b>Tb</b>	<b>Dy</b>	<b>Ho</b>	<b>Er</b>	<b>Tm</b>	<b>Yb</b>								
	138.9	140.1	140.9	144.2	[145]	150.4	152	157.3	158.9	162.5	164.93	167.3	168.9	173								
	89	90	91	92	93	94	95	96	97	98	99	100	101	102								
	<b>Ac</b>	<b>Th</b>	<b>Pa</b>	<b>U</b>	<b>Np</b>	<b>Pu</b>	<b>Am</b>	<b>Cm</b>	<b>Bk</b>	<b>Cf</b>	<b>Es</b>	<b>Fm</b>	<b>Md</b>	<b>No</b>								
	[227]	232	[231]	238	[237]	[244]	[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]								

**Part I (64pts).** 16 multiple-choice questions worth 4 points each. Choose the best answer from the options given, and record your final answer on your scantron.

- How many significant figures are in 0.006570?
  - A. 7
  - B. 3
  - C. 4
  - D. 5
  - E. 6
- Liquid nitrogen boils at  $-195.8^{\circ}\text{C}$ . Express the boiling point of liquid nitrogen in kelvin.
  - A.  $-469.0\text{ K}$
  - B.  $-77.4\text{ K}$
  - C.  $469.0\text{ K}$
  - D.  $77.4\text{ K}$
  - E. all temperatures are 0 K on the Kelvin scale

$-195.8$   
 $+ 273.15$   

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 $77.4\text{ K}$
- An automobile engine has a piston displacement of  $1,600\text{ cm}^3$ . Express this volume in cubic inches. (1 in = 2.54 cm)
  - A.  $2.6 \times 10^6\text{ in}^3$
  - B.  $4100\text{ in}^3$
  - C.  $98\text{ in}^3$
  - D.  $630\text{ in}^3$
  - E. None of these

$1600\text{ cm}^3 \times \left(\frac{1\text{ in}}{2.54}\right)^3 = 98\text{ in}^3$
- Who is credited with discovering the atomic nucleus?
  - A. Millikan
  - B. Dalton
  - C. Gay-Lussac
  - D. Thomson
  - E. Rutherford
- Which of these elements is chemically similar to oxygen?
  - A. sulfur, S same group
  - B. nickel, Ni
  - C. potassium, K
  - D. calcium, Ca
  - E. iron, Fe
- The elements in Group 2A are known by what name?
  - A. halogens
  - B. alkaline earth metals
  - C. noble gases
  - D. alkali metals
  - E. transition metals
- Which of these elements is most likely to be a good conductor of electricity?
  - A. N
  - B. Fe metal
  - C. He
  - D. Cl
  - E. S
- Which isotope is *not* possible?
  - A.  ${}^1_1\text{H}$
  - B.  ${}^2_1\text{H}$
  - C.  ${}^{52}_{24}\text{Cr}$
  - D.  ${}^{25}_{54}\text{Mn}$
  - E. All of these isotopes are possible.
- How many micrograms are in 65.3 kg?
  - A.  $0.653\text{ }\mu\text{g}$
  - B.  $6.53 \times 10^{10}\text{ }\mu\text{g}$
  - C.  $6.53 \times 10^4\text{ }\mu\text{g}$
  - D.  $6.53 \times 10^7\text{ }\mu\text{g}$
  - E.  $6.53 \times 10^{-8}\text{ }\mu\text{g}$

$65.3\text{ kg} \times \frac{1000\text{ g}}{1\text{ kg}} \times \frac{10^6\text{ }\mu\text{g}}{1\text{ g}} = 6.53 \times 10^{10}\text{ }\mu\text{g}$

10. Complete the following chart, in order from left to right

Isotope	Mass Number	Protons	Neutrons
	4	2	

- A.  ${}^4\text{He}$ , 4  
 B.  ${}^2\text{H}$ , 2  
 C.  ${}^4\text{He}$ , 2  
 D.  ${}^4\text{Be}$ , 4  
 E.  ${}^4\text{Be}$ , 2

11. Bromine is a red liquid at  $25^\circ\text{C}$ . Its density is  $3.12\text{ g/cm}^3$ . What is the volume of 28.1 g of liquid bromine?

- A.  $87.7\text{ cm}^3$   
 B.  $0.111\text{ cm}^3$   
 C.  $9.01\text{ cm}^3$   
 D.  $28.1\text{ cm}^3$   
 E. None of these
- $28.1\text{ g} \times \frac{1\text{ cm}^3}{3.12\text{ g}} = 9.01\text{ cm}^3$

12. Which of the following does *not* represent a *chemical* change?

- A. a freshly cut apple turns brown  
 B. fermentation of sugar to alcohol  
 C. milk turns sour on standing at room temperature  
 D. when cooled to  $0^\circ\text{C}$ , liquid water becomes ice  
 E. frying an egg

13. What is defined as a tentative explanation for observations that are made that result in the formulation of this concept?

- A. Theory  
 B. Law  
 C. Hypothesis  
 D. Prediction  
 E. Phenomena

14. Five vials each contain 12 grams of a solid metal sample. The samples include calcium, platinum, barium, gold, and silver. Which vial has the fewest moles of metal atoms?

- A. barium, Ba 137.3  
 B. calcium, Ca 40.08  
 C. platinum, Pt 195.1  
 D. silver, Ag 107.9  
 E. gold, Au 197

15. The shape of an atomic orbital is associated with

- A. the magnetic and spin quantum numbers, together.  
 B. the angular momentum quantum number ( $l$ ).  
 C. the principal quantum number ( $n$ ).  
 D. the magnetic quantum number ( $m_l$ ).  
 E. the spin quantum number ( $m_s$ ).

16. Atoms X, Y, Z, and R have the following nuclear compositions:



Which two are isotopes?

- A. Z & R  
 B. X & Y  
 C. Y & R  
 D. X & Z  
 E. X & R

**Part 2 (40 pts).** Calculations: Clearly show all work on the blank space on the scantron answer sheet for full credit.

1. (10 pts) Determine the mass of magnesium (in grams) that contains  $5.08 \times 10^{15}$  magnesium atoms.

$$5.08 \times 10^{15} \text{ atoms Mg} \times \frac{1 \text{ mol Mg}}{6.022 \times 10^{23} \text{ atoms Mg}} \times \frac{24.31 \text{ g Mg}}{1 \text{ mol Mg}} = 2.05 \times 10^{-7} \text{ g Mg}$$

2. (10 pts) A radio wave has a frequency of  $8.6 \times 10^8 \text{ s}^{-1}$ . What is the energy of **one photon** of this radiation in J ( $h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$ )?

$$E = h\nu = (6.63 \times 10^{-34} \text{ J} \cdot \text{s})(8.6 \times 10^8 \text{ s}^{-1}) = 5.7 \times 10^{-25} \text{ J}$$

3. (10 pts) Diamond is composed of carbon atoms. Jewelers commonly use the carat as to weigh diamonds. One carat is exactly 200.0 mg, 1.00 carat diamond = 200.0 mg C. How many carbon atoms are present in a 2.5 carat diamond? (Molar mass of carbon = 12.011 g/mol)

$$2.5 \text{ carat} \times \frac{200.0 \text{ mg C}}{1.00 \text{ carat}} \times \frac{1 \text{ g C}}{10^3 \text{ mg C}} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} \times \frac{6.022 \times 10^{23} \text{ atoms C}}{1 \text{ mol C}} = 2.5 \times 10^{22} \text{ atoms C}$$

4. (10 pts) We know that atoms are composed of protons, neutrons or electrons. Select **one** of these types of subatomic particles and in **4 – 6 grammatically correct sentences**, explain how the subatomic particle that you selected was discovered. (pick-one and discuss; don't discuss all three).

**PUT ALL ANSWERS AND SHOW ALL WORK FOR PART 2 ON THE BLANK SPACE ON THE SCANTRON.**

## **Test 1 Essay Spring 2016**

### **Discovery of Electrons**

J.J. Thomson developed a cathode ray tube. This consists of two metal plates and the cathode emits radiation. He applied electric fields to the rays and the rays bent towards positively charged plates and away from negatively charged plates. Thomson suggested these were negatively charged particles, and these deflected particles are called electrons. He won the Nobel Prize for this. Millikan actually determined the charge on an electron by using the oil drop experiment. He suspended charged oil drops in a magnetic field and was able to calculate the charge of an electron.

### **Discovery of Protons**

Ernest Rutherford directed positive alpha particles on a thin gold foil. The positive particles mostly passed directly through the gold foil. A few changed their trajectory and even a smaller few bounced directly back. Rutherford proposed that atoms were composed of mostly of empty space but had a very positive center, the nucleus. The dense nucleus was composed of protons, which are positively charged particles.

### **Discovery of Neutrons**

Protons and electrons alone could not account for all the mass of an atom. Though Rutherford proposed the presence of neutrons, James Chadwick is credited with the discovery of neutrons. He used a beryllium target and directed positive alpha particles at the target. New radiation was emitted from the atoms. This new radiation beam did not bend when a field was applied and therefore was not charged. The particles were electrically neutral and were named neutrons. This also accounts for the extra mass in the nucleus of atoms.