General Chemistry 1 *(CHEM 1141)*

Shawnee State University – Autumn 2023

September 21, 2023

Exam # 1 A

Name KEY _____

Please print your full name, and the exam version (1 A) that you have on the scantron sheet!
(Bubble in the best answer choice for each question on the scantron sheet in pencil!)

Please ☑ check the box next to your correct section number.

Section #:

- ❒ 1. (Mon Lab, 11:10 AM – 1:55 PM)
- ❒ 2. (Wed Lab, 11:10 AM – 1:55 PM) — **Fleeman**
- ❒ 3. (Tue Lab, 11:00 AM – 1:50 PM)
- ❒ 4. (Thu Lab, 11:00 AM – 1:50 PM) — **Napper**

Multiple Choice:	_____	**/ 50**
Q21:	_____	**/ 10**
Q22:	_____	**/ 10**
Q23:	_____	**/ 10**
Q24:	_____	**/ 10**
Q25:	_____	**/ 10**
BONUS:	_____	**/ 3**
TOTAL:	_____	**/ 100**

Each problem in this section (multiple choice) is worth 2.5 points!

Q1. The SI prefixes meaning $\times 10^{-3}$, $\times 10^{9}$, and $\times 10^{-9}$ respectively are:

A) milli, mega, and pico

B) micro, mega, and pico

C) milli, giga, and nano

D) micro, tera, and nano

Q2. Tungsten has a density of 19.0 g/cm^3. A sample of tungsten with a mass of 48.5 g would have a volume of:

A) 2.55 cm^3

B) 0.392 cm^3

C) 922 cm^3

D) 29.5 cm^3

$d = m/V \rightarrow V = m/d$

$= \frac{48.5\,g}{19.0\,g/cm^3}$

$= 2.55\,cm^3$

Q3. The quantity 1.100 (4 s.f.) $\times 10^5$ m contains how many significant figures?

A) 2 B) 3 C) 4 D) 5

Q4. An example of a compound, a homogeneous mixture, and an element (respectively) would be:

A) water, air, & mercury

B) saline, salt, & water

C) salt, water, & silver

D) baking soda, air, & chalk

water = H_2O (2+ elements)

air = $N_2, O_2, Ar, \ldots$ (homogeneous mix)

mercury = Hg

Q5. Which scientist is credited with the "modern" invention of atomic theory in 1808?

A) Dmitri Mendeleyev

B) Michael Faraday

C) Amadeo Avogadro

D) John Dalton

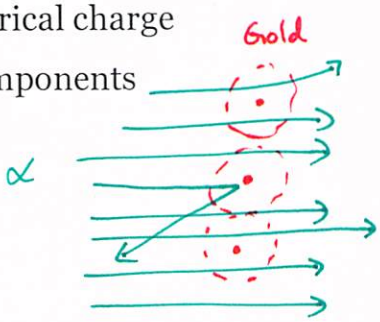
Q6. The gold foil experiment showed that:

A) neutrons are constituent particles of nuclei and have no electrical charge

B) elements cannot be broken down chemically into simpler components

C) atoms are mostly empty space, with a solid nuclear core

D) electrons behave like both waves and particles



Q7. A single atom of neon-16 would contain:

A) 16 p, 10 n, 10 e

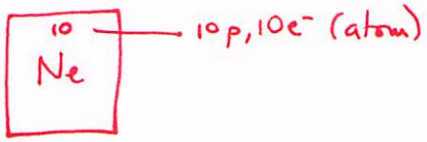
B) 10 p, 10 e, 16 n

C) 16 p, 8 e, 8 n

D) 10 p, 6 n, 10 e

A (mass #)

#p + #n°



→ 10 p⁺ , ⇒ 6 n°

Q8. Based upon its location on the periodic table, which element would be most chemically similar to potassium?

A) Na

B) As

C) O

D) C

↑ group 1 / 1A (alkali metals)

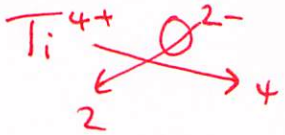
Q9. Which of the following compounds would have the IUPAC name of titanium(IV) oxide?

A) TiO_2

B) TiO_4

C) Ti_4O

D) Ti_2O



2 : 4 = 1 : 2 → TiO_2

Q10. How many atoms are there in a 8.9 g sample of chlorine?

A) 6.0×10^{23}

B) 3.0×10^{23}

C) 1.5×10^{23}

D) 0.75×10^{23}

$$8.9\text{ g Cl} \times \frac{1\text{ mol Cl}}{35.45\text{ g Cl}} \times \frac{6.022 \times 10^{23}}{1\text{ mol}} = 1.5 \times 10^{23}$$

Q11. How many moles of K_2SO_4 are in 35.0 g of K_2SO_4?

A) 2.11 moles

B) 0.259 moles

C) 610 moles

D) 0.201 moles

K_2SO_4

$2 \times K = 2 \times 39.10$

$1 \times S = 32.07$

$4 \times O = 4 \times 16.00$

$174.27\ g/mol$

$35.0\ g \times \frac{1\ mol}{174.27\ g} = 0.201\ mol$

Q12. What is the mass percentage of phosphorus in cupric phosphate, $Cu_3(PO_4)_2$?

A) 8.14%

B) 65.1 %

C) 16.3 %

D) 13.3%

$Cu_3(PO_4)_2$

$3 \times Cu = 3 \times 63.55$

$2 \times P = 2 \times 30.97 = 61.94$

$8 \times O = 8 \times 16.00$

380.59

$\%P = \frac{61.94}{380.59} \times 100 = 16.27\%$

Q13. A common ingredient in slime is borax with the following chemical formula, $Na_2B_4O_7 \cdot 10H_2O$. Calculate the molar mass of borax.

A) 219.2 g/mol

B) 381.4 g/mol

C) 201.2 g/mol

D) 221.4 g/mol

$2 \times Na = 2 \times 22.99$

$4 \times B = 4 \times 10.81$

$17 \times O = 17 \times 16.00$

$20 \times H = 20 \times 1.008$

$381.38\ g/mol$

Q14. What is the mass number of an ion with 106 electrons, 157 neutrons, and a 1+ charge?

A) 106

B) 107

C) 263

D) 264

1+ charge : → lost $1e^-$

→ $106e^- + 1e = 107e^-$ (atom)

$= 107p^+$ (atom)

Q15. Which of the following is not a physical process?

A) distillation

B) chromatography

C) evaporation

D) rusting changes chemical ID

Q16. Which of the following is a diatomic element?

A) carbon
B) iodine
C) sulfur
D) helium

N_2, O_2, F_2, Cl_2, Br_2, I_2, H_2

Q17. Convert 3600 mL to nL.

A) 3.6×10^{-6} nL
B) 3.6×10^{-9} nL
C) 3.6×10^{9} nL
D) 3.6×10^{6} nL

$$3600\,mL \left| \frac{10^{-3}\,L}{mL} \right| \left| \frac{nL}{10^{-9}\,L} \right| = 3600 \times 10^{6}\,nL = 3.6 \times 10^{9}\,nL$$

Q18. An element has two isotopes with the following abundances and isotopic masses: 59.69% abundance with 79.9813 amu and 40.31% with 80.9163 amu. Calculate the average atomic mass of this element.

A) 80.44 amu
B) 80.36 amu
C) 80.20 amu
D) 80.07 amu

$$\text{avg. at. mass} = \frac{59.69}{100} \times 79.9813u + \frac{40.31}{100} \times 80.9163u$$
$$= 80.36u$$

Q19. Luke is practicing for a golf tournament. His normal driver distance is 250 yards. He drives three balls, traveling at distances of 190 yards, 195 yards, and 193 yards. Which of the following is true about his driver distances?

A) accurate but not precise
B) precise but not accurate
C) both accurate and precise
D) neither accurate nor precise

not accurate as avg ≠ 250 yd
precise as all 3 values are close

Q20. Which of the following substances can be classified as an acid?

A) HNO_3 nitric acid, when dissolved in water!
B) KOH
C) $Mg(OH)_2$
D) Li_3PO_4

Each problem in this section (short answer) is worth 10 points!

All work must be shown to receive credit!

You must use the factor–label (conversion–factor) method for all conversions!

Be sure to include units where applicable!

All numeric answers must be rounded to the correct number of significant figures!

Q21. (a) Provide IUPAC names for the following substances:

$MgSO_4$ magnesium sulfate

N_2F_6 dinitrogen hexafluoride

$CuCl$ copper (I) chloride $Cu^+ Cl^-$

$K_2SO_4 \cdot 3H_2O$ potassium sulfate trihydrate

Cl_4F_{10} tetrachlorine decafluoride

Br_7F_8 heptabromine octafluoride

$NaHCO_3$ sodium bicarbonate

(b) Write molecular formulas that correspond to the following names:

aluminum hydroxide $Al(OH)_3$ Al^{3+} OH^-

pentachlorine nonafluoride Cl_5F_9

sulfuric acid $H_2SO_4(aq)$

Q22. (a) What is the empirical formula of a compound containing 17.41 % carbon (by mass), and 82.59 % fluorine (by mass)? Show all work.

Assume 100 g

$17.41\,g\ C \times \frac{1\ mol\ C}{12.01\,g\ C} = 1.450\ mol\ C$

$82.59\,g\ F \times \frac{1\ mol\ F}{19.00\,g\ F} = 4.347\ mol\ F$

$\div 1.450$ mol

1.000 C

2.998 F

$\approx$ 1 : 3

so CF_3

(b) If the molar mass of the compound above is 272.0 g/mol, what must its molecular formula be?

CF_3

$1 \times C = 12.01$

$3 \times F = 3 \times 19.00$

$69.01\ g/mol$

$\frac{272.0\ g/mol}{69.01\ g/mol} = 3.941 \approx 4$, so molecular formula = 4 x empirical formula

$\rightarrow (CF_3)_4$ or C_4F_{12}

Q23. (a) While preparing for his chemistry exam, a student drank 1.75 L of coffee. If 12 fluid ounces of coffee contains 85 mg of caffeine, how many pounds of caffeine did he consume? (1 fl oz = 29.57 mL) (1 lb= 453.6 g)

Use the conversion-factor method when solving this problem!

$$1.75\,L \times \frac{1000\,mL}{1\,L} \times \frac{1\,fl.oz.}{29.57\,mL} \times \frac{85\,mg\ caffeine}{12\,fl.oz} \times \frac{1\,g}{1000\,mg} \times \frac{1\,lb}{453.6\,g} = \boxed{9.2 \times 10^{-4}\,lb}$$

$(0.42\,g)$

(b) Calculate the number of molecules of caffeine, ($C_8H_{10}N_4O_2$), he consumed.

$C_8H_{10}N_4O_2$

$8 \times C = 8 \times 12.01$

$10 \times H = 10 \times 1.008$

$4 \times N = 4 \times 14.01$

$2 \times O = 2 \times 16.00$

$194.209\,g/mol$

$$0.42\,g \times \frac{1\,mol}{194.20\,g} \times \frac{6.022 \times 10^{23}}{1\,mol} = \boxed{1.3 \times 10^{21}\ molecules}$$

Q24. Place the correct number of the element or ion next to the letter that best matches.

(use each number only once)

5	A.	Lithium ion	1.	Ne
8	B.	Cupric ion	2.	Sm
9	C.	Polyatomic ion	3.	Se
4	D.	Alkaline-earth metal	4.	Mg
3	E.	Element with 34 protons	5.	Li^+
6	F.	Element in Group 1A	6.	Cs
1	G.	Noble gas	7.	Sr
7	H.	Period 5 element	8.	Cu^{2+}
2	I.	Inner-transition metal	9.	CN^-
10	J.	A metalloid	10.	Si

Q25. Complete the following calculations and record your answers with the correct number of significant figures and units if applicable:

A) $227.47 - 27.00 =$ (2dp, 2dp) → 200.00 (2d.p.)

B) $\dfrac{47.25 - 33.2}{2.720 \times 4.624} =$ (2dp, 1dp; 4sf, 4sf) → $\dfrac{14.05}{12.577}$ (1dp; 4sf) → 1.12 (3s.f.)

division (sf.): $\frac{3sf}{4sf} = 3sf$

C) $0.000432 \times 0.0733 =$ (3sf, 3sf) → 3.17×10^{-5} (3s.f.)

D) $\dfrac{0.0238\ m \times 5.00\ m}{3.712\ m + 4.6\ m} =$ (3sf, 3sf; 3dp, 1dp) → $\dfrac{0.119\ m^2}{8.3\ m}$ (1dp)

(3sf) div sf $\frac{3sf}{2sf} = 2sf$

$= 0.014\ m$ (2sf.)

E) $2700.0 + 47 - 9.02 =$ (1dp, 0dp, 2dp) → 2,738 (0d.p.)

3 Point Bonus Question

What mass does a silver nugget with a volume of 1.5 in^3 have? The density of silver is 10.5 g/cm^3. Hint: 1 in = 2.54 cm (exactly).

$d = m/V \rightarrow m = d \times V$

$= \frac{10.5\,g}{cm^3} \times \left(\frac{2.54\,cm}{1\,in}\right)^3 \times 1.5\,in^3$

(3sf · exact · 2sf)

$= 260\,g$ (2sf.)

Exam checklist:

(Check the boxes to certify the following:)

- ☐ My full name is written legibly on the front page
- ☐ My correct lab section has been indicated on the front page
- ☐ My full name is written legibly on the scantron sheet
- ☐ My exam version (A, B, C, or D) is written on the scantron sheet
- ☐ I have shown work for all problems (where appropriate), paying attention to
  - Significant figures / decimal places
  - Units
- ☐ I have used the conversion-factor method for all conversions
- ☐ If I have torn off the back page (periodic table), I will not turn it in with my exam!

Thank you from the Chemistry Professors and Good Luck!

Useful information:

$N_A = 6.022 \times 10^{23}\ mol^{-1}$

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1																	2
H																	He
1.008																	4.003
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
6.941	9.012											10.81	12.01	14.01	16.00	19.00	20.18
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
22.99	24.31											26.98	28.09	30.97	32.07	35.45	39.95
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39.10	40.08	44.96	47.87	50.94	52.00	54.94	55.85	58.93	58.69	63.55	65.39	69.72	72.61	74.92160	78.96	79.90	83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
85.47	87.62	88.91	91.22	92.91	95.94	[98]	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.60	126.9	131.3
55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba*	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
132.9	137.3	175.0	178.5	180.9	183.8	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	[210]	[210]	[222]
87	88	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
Fr	Ra**	Lr	Rf	Db	Sg	Bh	Hs	Mt									
[223]	[226]	[262]	[261]	[262]	[266]	[264]	[265]	[268]	[269]	[272]	[277]		[285]		[289]		[293]

*	57	58	59	60	61	62	63	64	65	66	67	68	69	70
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
	138.9	140.1	140.9	144.2	[145]	150.4	152.0	157.3	158.9	162.50	164.9	167.3	168.9	173.0
**	89	90	91	92	93	94	95	96	97	98	99	100	101	102
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
	[227]	232.0	231.0	238.0	[237]	[244]	[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]