

# General Chemistry 1 (CHEM 1141)

Shawnee State University – Autumn 2024

November 14, 2024

## Exam # 2 A

Name \_\_\_\_\_

*Please print your full name, and the exam version (2 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) } **Fleeman**
  - 2. (Wed Lab, 11:10 AM – 1:55 PM) }
  - 3. (Tue Lab, 11:00 AM – 1:50 PM) } **Napper**
  - 4. (Thu Lab, 11:00 AM – 1:50 PM) }

**Multiple Choice:** \_\_\_\_\_ / **50**

**Q21:** \_\_\_\_\_ / **10**

**Q22:** \_\_\_\_\_ / **10**

**Q23:** \_\_\_\_\_ / **10**

**Q24:** \_\_\_\_\_ / **10**

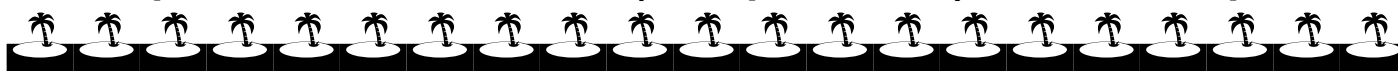
**Q25:** \_\_\_\_\_ / **10**

**BONUS:** \_\_\_\_\_ / **3**

**TOTAL:** \_\_\_\_\_ / **100**



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



- Q1. What is the molarity of a  $\text{NaNO}_3$  solution made by diluting 250.0 mL of a 1.60 M solution to a final volume of 400.0 mL?
- A) 0.160M
  - B) 0.200M
  - C) 1.00 M
  - D) 1.20 M
- Q2. What is the molarity of a solution that contains 1.50 mol HCl in 2.50 L of solution?
- A) 0.600 M
  - B) 1.20 M
  - C) 1.40 M
  - D) 1.67 M
- Q3. What does NOT change when a solution is diluted by the addition of solvent?
- A) volume of solvent
  - B) mass of solvent
  - C) number of moles of solute
  - D) molarity of the solution
- Q4. Which of the following compounds is insoluble in water?
- A) KI
  - B)  $\text{PbI}_2$
  - C)  $\text{Na}_2\text{CO}_3$
  - D)  $\text{NH}_4\text{OH}$

- Q5. The volume of a gas is doubled while the temperature is held constant. The pressure of the gas
- A) remains unchanged
  - B) is reduced by one-half
  - C) is doubled
  - D) depends on the type of gas in the container
- Q6. A mixture of gases contains 1.5 moles of oxygen, 3.0 moles of nitrogen, and 0.5 mole of argon. If the total pressure is 700 mmHg, what is the partial pressure of the nitrogen gas?
- A) 70 mmHg
  - B) 210 mmHg
  - C) 350 mmHg
  - D) 420 mmHg
- Q7. Give the equation for the standard enthalpy of formation ( $\Delta H_f^\circ$ ) for  $\text{CaCO}_3$ .
- A)  $\text{Ca(s)} + \text{C(s, graphite)} + \frac{3}{2} \text{O}_2(\text{g}) \rightarrow \text{CaCO}_3(\text{s})$
  - B)  $2 \text{Ca(s)} + 2 \text{C(s, graphite)} + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{CaCO}_3(\text{s})$
  - C)  $\text{Ca(s)} + \text{C(s, graphite)} + 3 \text{O}(\text{g}) \rightarrow \text{CaCO}_3(\text{s})$
  - D)  $\text{CaCO}_3(\text{s}) \rightarrow \text{Ca(s)} + \text{C(s, graphite)} + 3 \text{O}(\text{g})$
- Q8. Determine the oxidation number of **sulfur** in  $\text{S}_2\text{O}_3^{2-}$ .
- A) +2
  - B) -2
  - C) +3
  - D) +4

- Q9. A student observed that when ammonium nitrate is dissolved in water, the temperature of the water decreases. Which statement describes this process?
- A) The process is exothermic and heat is absorbed.
  - B) The process is exothermic and heat is released.
  - C) The process is endothermic and heat is absorbed.
  - D) The process is endothermic and heat is released.
- Q10. What is the chemical formula of the salt produced in the neutralization reaction of potassium hydroxide (KOH) with sulfuric acid (H<sub>2</sub>SO<sub>4</sub>)?
- A) H<sub>2</sub>O
  - B) K SO<sub>4</sub>
  - C) K<sub>2</sub>SO<sub>4</sub>
  - D) KCl
- Q11. When going from a molecular to a full-ionic equation, “MgCl<sub>2</sub>(aq)” would be written as:
- A) Mg(s) + Cl<sub>2</sub>(g)
  - B) Mg<sup>2+</sup>(aq) + Cl<sub>2</sub>(g)
  - C) Mg(s) + Cl<sub>2</sub><sup>-</sup>(aq)
  - D) Mg<sup>2+</sup>(aq) + 2 Cl<sup>-</sup>(aq)
- Q12. Which combination of reactants will form a gas?
- A) NaOH(aq) + H<sub>2</sub>SO<sub>4</sub>(aq)
  - B) HNO<sub>3</sub>(aq) + Na<sub>2</sub>CO<sub>3</sub>(aq)
  - C) Mg(OH)<sub>2</sub>(aq) + LiHCO<sub>3</sub>(aq)
  - D) HCl(aq) + Ca(NO<sub>3</sub>)<sub>2</sub>(aq)
- Q13. In a chemical reaction, the **oxidizing agent** is the species that:
- A) increases in oxidation number
  - B) is reduced by another reactant
  - C) causes another species to decrease in oxidation number
  - D) loses electrons to another substance

- Q14. In a titration, the device used to deliver a variable volume of reactant is called a(n):
- A) volumetric pipet
  - B) indicator
  - C) buret
  - D) volumetric flask
- Q15. Which of the following elements is not a gas at room temperature and pressure?
- A) bromine
  - B) hydrogen
  - C) krypton
  - D) fluorine
- Q16. Which gas law states that volume is proportion to number of moles?
- A) Avogadro's
  - B) Boyle's
  - C) Charles's
  - D) Gay Lussac's
- Q17. The temperature of 2.00 mol of an ideal gas which has a pressure of 1.50 atm and a volume of 18.4 L is:
- A) 2.01 K
  - B) 168 K
  - C) 192 K
  - D) 1.13 K
- Q18. A 15.0 g sample of an unknown metal with a temperature of 34.9 °C loses 129 J of heat and ends up at 21.1 °C. What is the specific heat capacity of the metal?
- A) 3200 J/g·°C
  - B) 0.124 J/g·°C
  - C) 119 J/g·°C
  - D) 0.623 J/g·°C

- Q19. Given  $\text{C}_2\text{H}_6(\text{g}) + 7/2 \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{g})$ ;  $\Delta H = -1560 \text{ kJ/mol}$   
how many moles of  $\text{H}_2\text{O}(\text{g})$  will be produced when 1200 kJ of heat is given off?
- A) 2.3
  - B) 1.6
  - C) 0.77
  - D) 0.43

Q20. Which has a  $\Delta H_f^\circ$  value of 0?

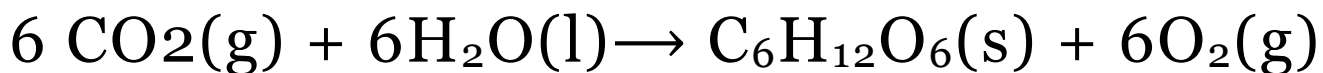
- A) Ar(s)
- B) Na(l)
- C) C(s,diamond)
- D) He(g)



**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 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. During photosynthesis, plants use light energy to convert carbon dioxide and water to sugar and oxygen gas as shown in the equation below:



A. Determine the enthalpy of reaction ( $\Delta H_{\text{rxn}}^\circ$ ) for the photosynthesis reaction given the following:

$$\Delta H_f^\circ \text{CO}_2(\text{g}) = -393.5 \text{ kJ/mol}$$

$$\Delta H_f^\circ \text{H}_2\text{O}(\text{l}) = -285.8 \text{ kJ/mol}$$

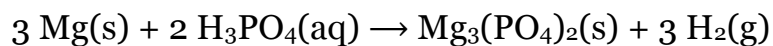
$$\Delta H_f^\circ \text{C}_6\text{H}_{12}\text{O}_6(\text{s}) = -1273.3 \text{ kJ/mol}$$

B. How much heat in kJ is (released or absorbed, **circle one**) if 2.004 g of  $\text{CO}_2$  is reacted?

Q22. If 16.3 mL of a 0.185 M  $\text{Mg}(\text{OH})_2$  solution is used to titrate 0.0250 L of gastric juice (HCl), what is the molarity of the HCl solution? Be sure to write a balanced chemical equation.



Q23. Given the balanced chemical equation:



(i) Calculate the oxidation numbers for the atoms Mg and H on each side of the equation.

(ii) If 150.0 mL of 3.000 M  $\text{H}_3\text{PO}_4$  reacts with an excess of Mg, how many moles of hydrogen gas is formed?

(iii) If 10.0 g of Mg and 250.0 mL of 3.000 M  $\text{H}_3\text{PO}_4$  react, what volume of gas is formed at a pressure of 1.10 atm and a temperature of 35 °C? Be sure to clearly identify the limiting reactant as part of your answer!

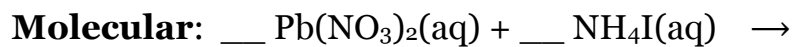
Q24. *Clearly show all work for this problem, being sure to explain which equation(s) is(are) being used!*

(i) A 150 mL sample of gas is compressed from an initial pressure of 250 Pa to a final pressure of 1200 Pa. What will its new volume be?

(ii) What volume would 54.0 g of  $\text{CH}_4(\text{g})$  occupy at a temperature of  $-58\text{ }^\circ\text{C}$  and a pressure of 455 mmHg?

(iii) A gas bubble has a pressure of 125 mmHg at a temperature of 245 K and a volume of 35.0 mL. If the bubble is cooled down to 212 K while simultaneously compressed to 25.0 mL, what will its final pressure be?

Q25. Write out the **balanced** molecular, full-ionic, and net-ionic equation for the reaction below:



**Full-ionic:**

**Net-ionic:**



**3 Point Bonus Question**



Write the chemical formula for three strong inorganic acids.

# 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 or B) 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:

### Partial List of Solubility Rules

**TABLE 4.2** Solubility Rules for Common Ionic Compounds in Water at 25°C

Soluble Compounds	Exceptions
Halides ( $\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ )	Halides of $\text{Ag}^+$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
Sulfates ( $\text{SO}_4^{2-}$ )	Sulfates of $\text{Ag}^+$ , $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Hg}_2^{2+}$ , and $\text{Pb}^{2+}$
Insoluble Compounds	Exceptions
Carbonates ( $\text{CO}_3^{2-}$ ), phosphates ( $\text{PO}_4^{3-}$ ), chromates ( $\text{CrO}_4^{2-}$ ), and sulfides ( $\text{S}^{2-}$ )	Compounds containing alkali metal ions and the ammonium ion
Hydroxides ( $\text{OH}^-$ )	Compounds containing alkali metal ions and the $\text{Ba}^{2+}$ ion

$$M_1V_1 = M_2V_2 \quad N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$1 \text{ atm} = 101,325 \text{ Pa} = 760 \text{ mmHg} = 760 \text{ torr}$$

$$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$$

$$p_1V_1 = p_2V_2 \quad \frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2} \quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$pV = nRT \quad p\mathcal{M} = dRT$$

$$q = m \cdot c \cdot DT$$

IUPAC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Old	IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 <b>H</b> 1.008	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.87	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.61	33 <b>As</b> 74.92160	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80
2	3 <b>Li</b> 6.941	4 <b>Be</b> 9.012	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> [98]	44 <b>Ru</b> 101.1	45 <b>Rh</b> 102.9	46 <b>Pd</b> 106.4	47 <b>Ag</b> 107.9	48 <b>Cd</b> 112.4	49 <b>In</b> 114.8	50 <b>Sn</b> 118.7	51 <b>Sb</b> 121.8	52 <b>Te</b> 127.60	53 <b>I</b> 126.9	54 <b>Xe</b> 131.3
3	11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31	51-71	72 <b>Hf</b> 178.5	73 <b>Ta</b> 180.9	74 <b>W</b> 183.8	75 <b>Re</b> 186.2	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.2	78 <b>Pt</b> 195.1	79 <b>Au</b> 197.0	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207.2	83 <b>Bi</b> 209.0	84 <b>Po</b> [210]	85 <b>At</b> [210]	86 <b>Rn</b> [222]
4	19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	88-103	91.22 <b>Zr</b>	92.91 <b>Nb</b>	95.94 <b>Mo</b>	98 <b>Tc</b>	101.1 <b>Ru</b>	102.9 <b>Rh</b>	106.4 <b>Pd</b>	107.9 <b>Ag</b>	112.4 <b>Cd</b>	114.8 <b>In</b>	118.7 <b>Sn</b>	121.8 <b>Sb</b>	127.60 <b>Te</b>	126.9 <b>I</b>	131.3 <b>Xe</b>
5	37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	51-71	104 <b>Rf</b> [267]	105 <b>Db</b> [268]	106 <b>Sg</b> [269]	107 <b>Bh</b> [270]	108 <b>Hs</b> [277]	109 <b>Mt</b> [278]	110 <b>Ds</b> [281]	111 <b>Rg</b> [282]	112 <b>Cn</b> [285]	113 <b>Nh</b> [285]	114 <b>Fl</b> [289]	115 <b>Mc</b> [290]	116 <b>Lv</b> [293]	117 <b>Ts</b> [294]	118 <b>Og</b> [294]
6	55 <b>Cs</b> 132.9	56 <b>Ba*</b> 137.3	51-71	178.5 <b>Hf</b>	180.9 <b>Ta</b>	183.8 <b>W</b>	186.2 <b>Re</b>	190.2 <b>Os</b>	192.2 <b>Ir</b>	195.1 <b>Pt</b>	197.0 <b>Au</b>	200.6 <b>Hg</b>	204.4 <b>Tl</b>	207.2 <b>Pb</b>	209.0 <b>Bi</b>	210 <b>Po</b>	210 <b>At</b>	222 <b>Rn</b>
7	87 <b>Fr</b> [223]	88 <b>Ra**</b> [226]	89-103	267 <b>Rf</b>	268 <b>Db</b>	269 <b>Sg</b>	270 <b>Bh</b>	277 <b>Hs</b>	278 <b>Mt</b>	281 <b>Ds</b>	282 <b>Rg</b>	285 <b>Cn</b>	285 <b>Nh</b>	289 <b>Fl</b>	290 <b>Mc</b>	293 <b>Lv</b>	294 <b>Ts</b>	294 <b>Og</b>
			6	57 <b>La</b> 138.9	58 <b>Ce</b> 140.1	59 <b>Pr</b> 140.9	60 <b>Nd</b> 144.2	61 <b>Pm</b> [145]	62 <b>Sm</b> 150.4	63 <b>Eu</b> 152.0	64 <b>Gd</b> 157.3	65 <b>Tb</b> 158.9	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.9	68 <b>Er</b> 167.3	69 <b>Tm</b> 168.9	70 <b>Yb</b> 173.0	71 <b>Lu</b> 175.0
			7	89 <b>Ac</b> [227]	90 <b>Th</b> 232.0	91 <b>Pa</b> 231.0	92 <b>U</b> 238.0	93 <b>Np</b> [237]	94 <b>Pu</b> [244]	95 <b>Am</b> [243]	96 <b>Cm</b> [247]	97 <b>Bk</b> [247]	98 <b>Cf</b> [251]	99 <b>Es</b> [252]	100 <b>Fm</b> [257]	101 <b>Md</b> [258]	102 <b>No</b> [259]	103 <b>Lr</b> [266]