Midterm Exam 1 **Name**_____

Minneapolis Community and Technical College
CHEM 1151 Fall 2023 ...Boraas

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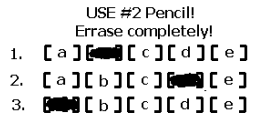
Scantron: _____ + SW _____ = _____

Directions:

1. Write your name at the top of this exam (No chemical symbols).
2. Record your name and the exam version (A or B) on the scantron answer sheet.
3. Record your answer to each question on the Scantron answer sheet IN PENCIL.
4. Return this exam and all other materials (Scantron, periodic table, scratch paper) when finished. Failure to do so at the time of the exam will result in a zero for the exam.
5. Scantron answer sheets will be graded as received and not reviewed for erasures, smudges or anything else that may result in a mis-graded form. Make no stray marks or smudges on the scantron answer sheet. If you must erase, do so completely.
6. On your scantron answer sheet, next to your written name, write the chemical symbol for calcium.
7. If you believe your scantron answer sheet will not grade properly, ask for a new, clean scantron answer sheet.
8. Always choose the closest answer. **"f" is NEVER the correct answer.**



1. Carefully examine the nuclide symbol at right and determine which of the following is correct.

$^{34}_{18}X^{+2}$

a. Protons = 16	Neutrons = 18	Electrons = 14
b. Protons = 18	Neutrons = 34	Electrons = 16
c. Protons = 34	Neutrons = 18	Electrons = 20
d. Protons = 18	Neutrons = 16	Electrons = 16
e. Protons = 20	Neutrons = 18	Electrons = 16
f. Protons = 18	Neutrons = 16	Electrons = 20

2. How many **individual** potassium ions would be found in 5.33 grams of K_3PO_4? (Closest Answer)

a. 1.51×10^{22} potassium ions
b. 4.54×10^{22} potassium ions
c. 5.04×10^{21} potassium ions
d. 3.79×10^{22} potassium ions
e. 1.12×10^{23} potassium ions
f. 1.24×10^{22} potassium ions

3. Two atoms are isotopes when …

a. Both atoms have the same number of protons and neutrons
b. Both atoms have the same number of protons and electrons
c. Both atoms have different numbers of protons and neutrons
d. Both atoms have the same number of neutrons but different numbers of protons
e. Both atoms have the same number of protons but different numbers of neutrons

4. How many moles of $Ca(NO_3)_2$ there in a 12.88 gram sample? (Closest answer)

a. 0.07850 moles
b. 0.1261 moles
c. 0.08582 moles
d. 0.1838 moles
e. 0.2011 moles

5. What is the result of the calculation at right with the correct number of significant digits?

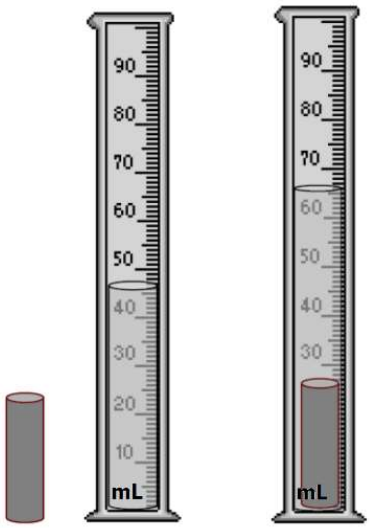
$$\frac{(0.88 + 0.21)}{(150.50 - 145.88)} =$$

a. 0.23593 b. 0.2359 c. 0.236 d. 0.24 e. 0.20 f. 0.10

6. Which of the following is the correct formula for **Z**orba (I) sulfate?

a. **Z** $(SO_4)_2$ **b.** $\mathbf{Z}_2SO_4$ **c.** **Z** SO_4 **d.** $\mathbf{Z}_2(SO_4)_2$ **e.** **Z** S

7. A metal rod is weighed and found to have a mass of 112.5 grams.
Next the metal rod is placed in a partially filled graduated cylinder (See figure at right).



What is the density of the metal rod? (Closest answer please)

a. 15.61 g/mL b. 7.86 g/mL c. 11.98 g/mL

d. 13.89 g/mL e. 5.84 g/mL f. 0.180 g/mL

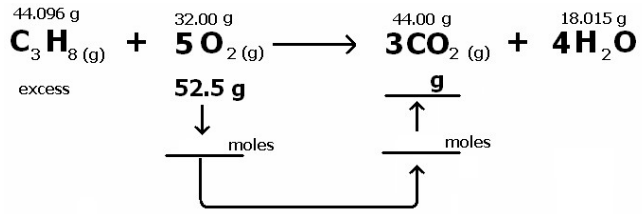
8. What is the correct chemical formula for **calcium nitrate**?

a. $CaNO_3$ b. KNO_3 c. $Ca(NO_3)_2$

d. CaN e. CaN_2 f. Ca_2NO_3

9. Given the problem outlined at right =>

Which of the following dimensional analysis solutions is correct? (Molar masses are given on top)



a. $\frac{52.5\text{ g}}{1} \times \frac{1\text{ mole}}{32.00\text{ g}} \times \frac{1\text{ mole}}{1\text{ mole}} \times \frac{18.015\text{ g}}{1\text{ mole}} =$

b. $\frac{52.5\text{ g}}{1} \times \frac{1\text{ mole}}{32.00\text{ g}} \times \frac{5\text{ mole}}{3\text{ mole}} \times \frac{44.00\text{ g}}{1\text{ mole}} =$

c. $\frac{52.5\text{ g}}{1} \times \frac{1\text{ mole}}{32.00\text{ g}} \times \frac{3\text{ mole}}{5\text{ mole}} \times \frac{44.00\text{ g}}{1\text{ mole}} =$

d. $\frac{52.5\text{ g}}{1} \times \frac{1\text{ mole}}{44.00\text{ g}} \times \frac{4\text{ mole}}{5\text{ mole}} \times \frac{44.00\text{ g}}{1\text{ mole}} =$

10. Which of the following volume measurements is correct for the graduated cylinder at right?

a. 36 mL b. 4.4 mL c. 3.610 mL

d. 3.59 mL e. 3.5 mL f. 3.6 mL

11. Which of the following is a molecular compound?

a. CH_3Cl b. KCl c. $NaNO_3$ d. $CuCl_2$ e. RbBr

12. What is the correct name for PF_5?

a. Phosphorus fluoride

b. Monophosphorus tetrafluoride

c. Phosphorus pentafluoride

d. Platinum fluoride

e. Paladium fluoride

f. unobtainium phosphide

13. Calculate the mass percent composition of lithium in Li_3PO_4.

a. 26.75 % b. 17.98 % c. 30.72 % d. 55.27 % e. 20.82 %

14. Which of the following is a possible *molecular formula* for C_4H_4O?

a. $C_8H_8O_2$ b. $C_{12}H_{12}O_2$ c. C_2H_2O d. C_8H_8O d. $C_{12}H_8O$

15. Completely balance the following chemical reaction and determine the H_2O coefficient:

$$C_8H_{18\,(l)} + O_{2\,(g)} \rightarrow CO_{2\,(g)} + H_2O_{(g)}$$

a. 25 b. 22 c. 18 d. 14 e. 10 f. 9

16. How many moles of K_2SO_4 can be produced by 14.8 moles of H_2SO_3 and excess $KMnO_4$?

$$2\ KMnO_4 + 5\ H_2SO_3 \rightarrow 2\ MnSO_4 + K_2SO_4 + 2\ H_2SO_4$$

a. 74.0 moles K_2SO_4 b. 25.9 moles K_2SO_4 c. 12.0 moles K_2SO_4
d. 2.96 moles K_2SO_4 e. 1.15 moles K_2SO_4 f. 0.150 moles K_2SO_4

17. Which of the following is the **balanced** equation for the reaction of gaseous ethane with gaseous oxygen **to form** carbon monoxide gas and water vapor.

a. $2\ C_2H_{6\,(g)} + 7\ O_{2\,(g)} \rightarrow 4\ CO_{2\,(g)} + 6\ H_2O_{\,(g)}$

b. $C_2H_{6\,(g)} + 5\ O_{\,(g)} \rightarrow 2\ CO_{\,(g)} + 3\ H_2O_{\,(g)}$

c. $2\ C_2H_{6\,(g)} + 5\ O_{2\,(g)} \rightarrow 4\ CO_{\,(g)} + 6\ H_2O_{\,(g)}$

d. $C_2H_{6\,(g)} + 7\ O_{\,(g)} \rightarrow 2\ CO_{2\,(g)} + 3\ H_2O_{\,(g)}$

e. $2\ C_2H_{6\,(g)} + 6\ O_{2\,(g)} \rightarrow 2\ CO_{\,(g)} + 3\ H_2O_{\,(g)}$

18. Given the molecular equation:

$$NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$$

What is the correct *net ionic equation*?

a. $Na^+_{(aq)} + Cl^-_{(aq)} + Ag^+_{(aq)} + NO_3^-{}_{(aq)} \rightarrow AgCl_{(s)} + Na^+_{(aq)} + NO_3^-{}_{(aq)}$
b. $Na^+_{(aq)} + Cl^-_{(aq)} + Ag^+_{(aq)} + NO_3^-{}_{(aq)} \rightarrow Ag^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + NO_3^-{}_{(aq)}$
c. $NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + Na^+_{(aq)} + NO_3^-{}_{(aq)}$
d. $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$
e. *no correct answer given*

19. What is the mass (in kg) of 5.84 moles of titanium (Ti)?
a. 0.352 kg b. 0.122 kg c. 0.820 kg d. 0.280 kg e. 0.632 kg

20. Calculate the atomic mass of element "X", if it has 2 naturally occurring isotopes with the following masses and natural abundances:

X-45	44.8776 amu	32.88%
X-47	46.9443 amu	67.12%

a. 46.26 amu b. 45.91 amu c. 46.34 amu d. 46.84 amu e. 44.99 amu

21. Which species is reduced in the redox reaction at right: $Mn^{2+}_{(aq)} + Fe_{(s)} \rightarrow Mn_{(s)} + Fe^{2+}_{(aq)}$

a. Mn^{2+} b. Mn c. Fe d. Fe^{2+}

22. The following reaction occurs with 75% yield in the laboratory.
How many moles of $SrF_{2(g)}$ will actually be produced by 4.0 moles of HF and excess $Sr(OH)_2$?

$$\mathbf{Sr(OH)_{2(s)} + 2\ HF_{(g)} \rightarrow SrF_{2(g)} + 2H_2O_{(l)}}$$

a. 0.50 mole SrF_2 **b. 1.0 mol SrF_2** **c. 1.5 moles SrF_2**

d. 2.0 moles SrF_2 **e. 2.5 moles SrF_2** **f. 3.0 moles SrF_2**

23. Examine the following chemical equation and mole values:

$$Cr_2O_{3(s)} + 3\ H_2S_{(g)} \rightarrow Cr_2S_{3(s)} + 3\ H_2O_{(l)}$$
2 moles ***5 moles***

What is the limiting reactant? a. $Cr_2O_{3(s)}$ b. $H_2S_{(g)}$ c. $Cr_2S_{3(s)}$ d. $H_2O_{(l)}$

24. The volume of a sample of oxygen gas is 4500. mL at 26.0 °C and 765 torr.
How many grams of oxygen, O_2 are present in the sample? (closest answer please)

a. 1.25 g_{O2} b. 4.88 g_{O2} c. 10.9 g_{O2} d. 5.90 g_{O2} e. 2.95 g_{O2} f. 5.10 g_{O2}

25. Which of the following gas samples would behave most ideally under the stated conditions?

a. CO_2 at 200 atm and 25°C b. O_2 at 0.5 atm and 30°C c. CCl_4 at 15 atm and 0 K d. C_2H_6O at STP

26. What effect does doubling the volume of an ideal gas have on the pressure of a gas if there are no leaks in the container and the temperature is held constant.

a. Doubling the volume will have no effect on the pressure under these conditions.
b. Doubling the volume will double the pressure.
c. Doubling the volume will half the pressure.
d. No correct answer. More information required.

27. Calculate the change in internal energy (ΔE) for a system that is **absorbing** 35.8 kJ of heat and is **expanding** from 8.00 to 24.0 L in volume at 1.00 atm. *(Useful Information: 101.3 J = 1 L·atm)*

a. +51.8 kJ b. –15.8 kJ c. –16.6 kJ d. –29.3 kJ e. +34.2 kJ

28. Calculate the amount of heat (**in kJ**) required to raise the temperature of a 79.0 g sample of ethanol from 298.0 K to 385.0 K. The specific heat capacity of ethanol is 2.42 J/g°C.

a. 57.0 kJ b. 16.6 kJ c. 73.6 kJ d. 28.4 kJ e. 12.9 kJ

29. Which of the following processes is endothermic?
a. The freezing of water.
b. The combustion of propane.
c. A hot cup of coffee (system) cools on a countertop
d. The chemical reaction in a "hot pack" often used to treat sore muscles and athletic injuries.
e. The vaporization of rubbing alcohol.

30. Exothermic reactions ALWAYS release heat energy. a. True b. False

31. A 21.8 g sample of ethanol (C_2H_5OH: 46.069 g/mol)) is burned in a bomb calorimeter. (Combustion reaction below)

$$C_2H_5OH_{(l)} + 3\ O_{2(g)} \rightarrow 2\ CO_{2(g)} + 3\ H_2O_{(g)} \qquad \Delta H°_{rxn} = \_\_\_\_\_$$

858 kJ of heat are released by the reaction. What is the value for $\Delta H°_{rxn}$? *(Closest answer please)*

a. 39.4 kJ/mol b. 858 kJ/mol c. 1044 kJ/mol d. 1813 kJ/mol e. 2145 kJ/mol

32. Examine the following reaction and identify the **spectator ions:**

$$H_2SO_{4(aq)} + Ba(OH)_{2(aq)} \rightarrow BaSO_{4(s)} + 2\ H_2O_{(l)}$$

a. Ba^{2+} & SO_4^{-2} b. H^+ & OH^- c. Ba^{2+} & OH^- d. H^+ & SO_4^{-2}

e. There are no spectator ions in this reaction.

33. Hot water is mixed with cold water in a calorimeter cup.
The hot water gives up 3,500 joules of heat energy and the calorimeter cup absorbs 325 joules of heat energy.
Which of the following is TRUE?

a. The cold water absorbs 3825 Joules of heat energy
b. The cold water absorbs 3500 Joules of heat energy
c. The cold water absorbs 3175 Joules of heat energy

d. The cold water releases 3825 Joules of heat energy
e. The cold water releases 3500 Joules of heat energy
f. The cold water releases 3175 Joules of heat energy

34. What is the chemical symbol for tungsten?

a. W b. T c. K d. Tn e. Ts f. Ag

35. What mass of $CaCl_2$ must be dissolved in enough water to produce 2000. mL of 1.25 M $CaCl_2$?

a. 174 g $CaCl_2$ b. 277 g $CaCl_2$ c. 90.7 g $CaCl_2$
d. 81.1 g $CaCl_2$ e. 310 g g $CaCl_2$

36. (5 pts) ***Show all work neatly for full credit.***
Answers must be circled, adjusted for significant figures and appear with correct units.

Zinc metal reacts with phosphoric acid to produce hydrogen gas according to the following reaction:

$$2H_3PO_{4(aq)} + 3Zn_{(s)} \rightarrow Zn_3(PO_4)_{2(aq)} + 3\,H_{2(g)}$$

How many grams of zinc metal were consumed if 875.0 mL of H_2 gas is collected over water?

Experimental conditions: P_{atm} = 568.5 torr and T_{lab} = 18.8 °C

Water Vapor Pressure (torr)
At Various Temperatures (°C)

T, °C	P, torr	T, °C	P, torr
0	4.5851	25	23.7695
5	6.5450	30	31.8439
10	9.2115	35	42.2037
15	12.7931	40	55.3651
20	17.5424	45	71.9294

37. (5 pts) ***Show all work neatly for full credit.***
Answers must be circled, adjusted for significant figures and appear with correct units.

n-Butyl phthalate is used as an insect repellant and is composed of carbon, hydrogen, and oxygen.

When a 0.3413 g sample was analyzed via combustion analysis, 0.2430 g of water and 0.8633 g of carbon dioxide were produced.

In another analysis, a mass spectrometer is used to determine the molecular weight to be 278.38 g/mol.

Determine the empirical formula and the molecular formula for n-Butyl phthalate.

38. (5 pts) ***Show all work neatly for full credit.***
Answers must be circled, adjusted for significant figures and appear with correct units.

120.0 mL of an unknown sulfuric acid solution is neutralized with 1.50 M potassium hydroxide (See figure at right).

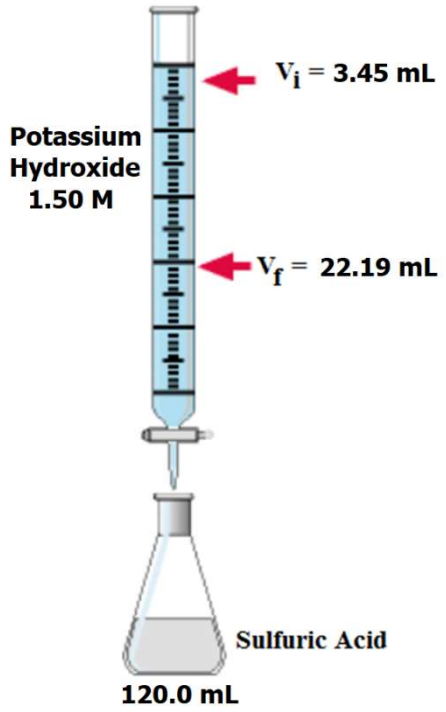
The endpoint of the titration is reached at 15.56 mL

a. What is the balanced chemical reaction for this experiment?

b. How many moles of sodium hydroxide are used in the titration?

c. How many moles of sulfuric acid are consumed?

d. What is the concentration of the original sulfuric acid?



Bonus Problems…. Show all work….Circle answer … SIG FIGS … All or nothing

(+1 pt). **39**. Why is the calorimeter constant important?

(+1 pt) **40.** Concentrated hydrochloric acid has a concentration of 12.0 M.
How much distilled water must be carefully combined with 125.0 mL concentrated hydrochloric acid for the final solution's concentration to be 2.25 M?

(+1 pt) **41.** Determine the percent yield of a reaction that produces 28.65 g of Fe when **50.00 g of Fe_2O_3** react with **excess Al** according to the following reaction.

$$Fe_2O_{3(s)} + 2\ Al_{(s)} \rightarrow Al_2O_{3(s)} + 2\ Fe_{(s)}$$

(+1 pt) **42.** **55.0 grams of hot water at 65.0 ºC** is added to a coffee cup calorimeter containing **75.0 grams of cold water at 24.5ºC**.

After stirring, the water mixture reaches a final temperature of **39.0 ºC.**

Determine the heat gained by the calorimeter in Joules.