Question #: 1
Which of the following statements is(are) true for ionic bonds?
Select all that apply.
A. These bonds typically form between a metal and a nonmetal.
B. The formation of these bonds involves the transfer of electron(s) between atoms.
C. The formation of these bonds involves the sharing of electron(s) between atoms.
D. These bonds typically form between nonmetals.

Question #: 2
What is the empirical formula for C₆H₁₂O₂?
A. CHO
B. C₃H₆O
C. C₂H₄O
D. C₁₂H₂₄O₄

Question #: 3
Select all of the ionic compound(s).
A. N₂O₄
B. BaCl₂
C. NH₄Br
D. FeSO₄
E. SF₄

Question #: 4
Which of the following is the formula for calcium perchlorate?
A. CaClO
B. CaClO₃
C. CaClO₄
D. Ca(ClO₄)₂

Question #: 5
What is the name of N₂O₅?
A. dinitrogen pentoxide
B. nitrogen oxide
C. nitrogen(IV) oxide
D. nitrogen(II) oxide

Question #: 6
A 0.138 kg crystal of calcium chloride contains ___ 1 ___ formula units of CaCl₂.
Report your answer with three significant figures using the form 2.20E2 for exponential notation.
1. _________
Question #: 7
What is the percent composition by mass of Al in Al₂O₃?

1%  
Report your answer with three significant figures and do not include units.

1. __________

Question #: 8
How many moles of oxygen are present in 11.5 moles of Al₂(SO₄)₃?

1 mol  
Report your answer to the correct number of significant figures and do not include units.

1. __________

Question #: 9
Determine the empirical formula for a compound that is 29.44% calcium, 23.55% sulfur and 47.01% oxygen by mass.

A. Ca₂SO₂  
B. CaSO₂  
C. Ca₂SO₃  
D. CaSO₄

Question #: 10
What is the molecular formula for a compound with a molar mass of 504.4 g/mol and composition 42.9% carbon, 6.39% hydrogen and 50.7% oxygen?

A. C₂₀H₃₀O₁₈  
B. C₉H₆O₈  
C. C₁₆H₃₂O₁₆  
D. CH₂O

Question #: 11
Balance this chemical equation showing the reaction of ethane with oxygen with the smallest possible whole numbers.
Fill in the blanks with the proper coefficients. If the coefficient is 1, fill in 1.

1 C₂H₆(g) + 2 O₂(g) → 3 CO₂(g) + 4 H₂O(l)

1. __________  
2. __________  
3. __________  
4. __________

Question #: 12
1 g of oxygen gas are required to completely react with 0.420 mol of C₄H₁₀ according to the reaction below.

2 C₄H₁₀(g) + 13 O₂(g) → 8 CO₂(g) + 10 H₂O(l)

Report your answer with three significant figures and do not include units.

1. __________
**Question #13**
Ammonia and oxygen gases react according to the balanced chemical equation below.

\[ 4 \text{NH}_3(g) + 5 \text{O}_2(g) \rightarrow 4 \text{NO}(g) + 6 \text{H}_2\text{O}(g) \]

If 2.50 grams of \(\text{NH}_3(g)\) react with 2.85 grams of \(\text{O}_2(g)\), how many grams of \(\text{NO}(g)\) are produced? Assume 100% yield.

1. \underline{_______} grams
Report your answer with **three significant figures** and **do not include units**.

**Question #14**
The percent yield of a reaction is 89.9%. What is the actual yield for this reaction, if the theoretical yield is 55.0 grams?

Actual yield = \underline{_______} g
Report your answer with **three significant figures** and **do not include units**.

**Question #15**
What is the molarity of a solution formed by dissolving 468 mg of \(\text{MgI}_2\) (molar mass 278.1 g/mol) in enough water to yield 50.0 mL of solution?

A. 0.0297 M  
B. 0.0337 M  
C. 0.0936 M  
D. 0.0107 M

**Question #16**
Which statement(s) is/are **true** about solutions A, B, and C?
Red dots represent solute and light blue represents solvent. Select **all that apply**.

A. Solution A has a higher concentration than solution B.  
B. Solution C is more dilute than solution B.  
C. Solutions B and C have the same concentration.  
D. Solution A is the most dilute.
**Question #**: 17
Which of the following statements is/are **true** about Na₂SO₄ added to water?
Select **all that apply**.
A. Na₂SO₄ is soluble.
B. Na₂SO₄ is a nonelectrolyte.
C. Na₂SO₄ is a strong electrolyte.
D. Na₂SO₄ is a weak electrolyte
E. Na₂SO₄ is insoluble.

**Question #**: 18
Which of the following reactions produces a precipitate?
A. CoCl₂ (aq) + Na₂SO₄(aq) → CoSO₄(aq) + 2 NaCl(aq)
B. 2 LiBr(aq) + Hg₂(NO₃)₂(aq) → Hg₂Br₂(s) + 2 LiNO₃(aq)
C. KCl(aq) + NaBr(aq) → KBr(aq) + NaCl(aq)
D. HBr(aq) + KOH(aq) → KBr(aq) + H₂O(l)

**Question #**: 19
What is the **net ionic** equation for the reaction that occurs when aqueous solutions of H₂SO₄ and KOH are mixed?
A. H⁺(aq) + OH⁻(aq) → H₂O(l)
B. 2 K⁺(aq) + SO₄²⁻(aq) → K₂SO₄(s)
C. H⁺(aq) + OH⁻(aq) + 2 K⁺(aq) + SO₄²⁻(aq) → H₂O(l) + K₂SO₄(s)
D. 2 H⁺(aq) + SO₄²⁻(aq) + 2 K⁺(aq) + 2 OH⁻(aq) → 2 H₂O(l) + 2 K⁺(aq) + SO₄²⁻(aq)

**Question #**: 20
A 25.2 mL sample of an aqueous nitric acid (HNO₃) solution requires 16.3 mL of 0.105 M Ba(OH)₂ to reach the equivalence point.
The concentration of the HNO₃ solution is ___ M.
Report your answer with **three significant figures** and **do not include units**.
1. __________

**Question #**: 21
Which one of the following pairs of reactants undergoes a gas-evolution reaction?
A. HCl(aq) + NaHCO₃(aq) →
B. HCl(aq) + NaOH(aq) →
C. 2 Na(s) + Cl₂(g) →
D. 4 Fe(s) + O₂(g) →
**Question #**: 22
Determine the oxidation number for each element in \( \text{H}_3\text{PO}_4 \).

H \( \boxed{1} \)

P \( \boxed{2} \)

O \( \boxed{3} \)

1. __________
2. __________
3. __________

**Question #**: 23
Which one of the following is a redox reaction?

A. \( \text{Ca}(s) + 2 \text{HF}(aq) \rightarrow \text{CaF}_2(aq) + \text{H}_2(g) \)

B. \( \text{KCl}(aq) + \text{AgNO}_3(aq) \rightarrow \text{AgCl}(s) + \text{KNO}_3(aq) \)

C. \( \text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2(aq) + 2 \text{LiBr}(aq) \rightarrow \text{PbBr}_2(s) + 2 \text{LiC}_2\text{H}_3\text{O}_2(aq) \)

D. \( \text{HCl}(aq) + \text{NaOH}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l) \)

**Question #**: 24
The atmospheric pressure supports a column of mercury 695 mm tall in a barometer.

What is this pressure in torr and in atmospheres?

The pressure is \( \boxed{1} \) torr and \( \boxed{2} \) atm.

Report your answers with **three significant figures** and do not include units.

1. __________
2. __________

**Question #**: 25
A sample of \( \text{N}_2(g) \) occupies 25.0 mL at 25.0 \( ^\circ \text{C} \). At what temperature \( \text{in} ^\circ \text{C} \) does the volume of the gas sample double if the pressure is held constant?

\( \boxed{1} \) \( ^\circ \text{C} \)

Report your answer with **three significant figures** and do not include units.

1. __________

**Question #**: 26
To what temperature must an ideal gas inside a rigid container be cooled in order to have a pressure of 2.00 atm, when the initial temperature and pressure are 288 K and 4.00 atm, respectively?

A. 72.0 K
B. 144 K
C. 36.0 K
D. 576 K
Question #: 27
Which of the following statements is not consistent with the ideal gas law?
A. The volume of the gas is inversely proportional to pressure of the gas.
B. The number of moles of gas is proportional to the volume of the gas.
C. The ideal gas constant is independent of the identity of the gas.
D. The volume of the gas is inversely proportional to the temperature of the gas.

Question #: 28
What volume does 2.34 mol of an ideal gas occupy at a temperature of 25.0 °C and a pressure of 785 torr?

1. L
Report your answer with three significant figures and do not include units.
1. __________

Question #: 29
A 2.524 g sample of gas in a 0.435 L vessel exerts a pressure of 2.00 atm at 388 K. What is the molar mass of the gas?
A. 92.4 g/mol
B. 13.1 g/mol
C. 44.3 g/mol
D. 73.1 g/mol

Question #: 30
What mass of solid product will be produced when 25.0 mL of 0.300 M CaCl$_2$ are mixed with 35.0 mL of 0.250 M AgNO$_3$? Assume 100% yield.
A. 2.15 g
B. 1.25 g
C. 1.44 g
D. 2.46 g
Course Name: -
Exam Psychometrics:

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Question #: 1

Which of the following statements is(are) **true** for ionic bonds?

**Select all that apply.**

- ✓ A. These bonds typically form between a metal and a nonmetal.
- ✓ B. The formation of these bonds involves the transfer of electron(s) between atoms.
- C. The formation of these bonds involves the sharing of electron(s) between atoms.
- D. These bonds typically form between nonmetals.

**Rationale:** CHE 105 Ex 2 #1

Question #: 2

What is the empirical formula for $\text{C}_6\text{H}_{12}\text{O}_2$?

- A. CHO
- ✓ B. $\text{C}_3\text{H}_6\text{O}$
- C. $\text{C}_2\text{H}_4\text{O}$
- D. $\text{C}_{12}\text{H}_{24}\text{O}_4$

Question #: 3

Select **all** of the **ionic** compound(s).

- A. $\text{N}_2\text{O}_4$
- ✓ B. $\text{BaCl}_2$
Question #: 4

Which of the following is the formula for calcium perchlorate?

A. CaClO
B. CaClO₃
C. CaClO₄
✓D. Ca(ClO₄)₂

Question #: 5

What is the name of N₂O₅?

✓A. dinitrogen pentoxide
B. nitrogen oxide
C. nitrogen(IV) oxide
D. nitrogen(II) oxide

Question #: 6

A 0.138 kg crystal of calcium chloride contains 1 formula units of CaCl₂. Report your answer with three significant figures using the form 2.20E2 for exponential notation.

1. 7.49E23 | 7.49E+23 | 7.49 E23 | 7.49 E+23 |

Rationale: Answers from 7.34E23 to 7.63E23 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

Question #: 7

What is the percent composition by mass of Al in Al₂O₃?
Report your answer with **three significant figures** and **do not include units**.

1. 52.9
**Rationale:** Answers from 51.8 to 54.0 (± 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

**Question #:** 8

How many moles of oxygen are present in 11.5 moles of Al₂(SO₄)₃?

1 moles

Report your answer to the **correct number of significant figures** and **do not include units**.

1. 138
**Rationale:** Answers from 135 to 141 (± 2%) with 2, 3 or 4 significant figures were accepted.

**Question #:** 9

Determine the empirical formula for a compound that is 29.44% calcium, 23.55% sulfur and 47.01% oxygen by mass.

A. Ca₂SO₂
B. CaSO₂
C. Ca₂SO₃
✓D. CaSO₄

**Question #:** 10

What is the molecular formula for a compound with a molar mass of 504.4 g/mol and composition 42.9% carbon, 6.39% hydrogen and 50.7% oxygen?

A. C₂₀H₃₀O₁₈
B. C₉H₁₆O₈
✓C. C₁₈H₃₂O₁₆
D. CH₂O
Question #: 11

Balance this chemical equation showing the reaction of ethane with oxygen with the smallest possible whole numbers.
Fill in the blanks with the proper coefficients. If the coefficient is 1, fill in 1.

\[ \text{1 } \text{C}_2\text{H}_6(\text{g}) + \text{2 } \text{O}_2(\text{g}) \rightarrow \text{3 } \text{CO}_2(\text{g}) + \text{4 } \text{H}_2\text{O}(\text{l}) \]

1. 2
2. 7
3. 4
4. 6

Question #: 12

1 g of oxygen gas are required to completely react with 0.420 mol of \( \text{C}_4\text{H}_{10} \) according to the reaction below.

\[ 2 \text{C}_4\text{H}_{10}(\text{g}) + 13 \text{O}_2(\text{g}) \rightarrow 8 \text{CO}_2(\text{g}) + 10 \text{H}_2\text{O}(\text{l}) \]

Report your answer with three significant figures and do not include units.

1. 87.4

Rationale: Answers from 85.689.2 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

Question #: 13

Ammonia and oxygen gases react according to the balanced chemical equation below.

\[ 4 \text{NH}_3(\text{g}) + 5 \text{O}_2(\text{g}) \rightarrow 4 \text{NO}(\text{g}) + 6 \text{H}_2\text{O}(\text{g}) \]

If 2.50 grams of \( \text{NH}_3(\text{g}) \) react with 2.85 grams of \( \text{O}_2(\text{g}) \), how many grams of \( \text{NO}(\text{g}) \) are produced? Assume 100% yield.

\[ \text{1 } \text{grams} \]

Report your answer with three significant figures and do not include units.

1. 2.14

Rationale: Answers from 2.10 to 2.18 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.
Question #: 14

The percent yield of a reaction is 89.9%. What is the actual yield for this reaction, if the theoretical yield is 55.0 grams?
Actual yield = \( \boxed{1} \) g
Report your answer with three significant figures and do not include units.

1. 49.4
Rationale: Answers from 48.4 to 50.4 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

Question #: 15

What is the molarity of a solution formed by dissolving 468 mg of MgI\(_2\) (molar mass 278.1 g/mol) in enough water to yield 50.0 mL of solution?

A. 0.0297 M
✓B. 0.0337 M
C. 0.0936 M
D. 0.0107 M

Question #: 16

Which statement(s) is/are true about solutions A, B, and C?
Red dots represent solute and light blue represents solvent.
Select all that apply.

![Diagram of solutions A, B, and C]
✓A. Solution A has a higher concentration than solution B.
✓B. Solution C is more dilute than solution B.
    C. Solutions B and C have the same concentration.
    D. Solution A is the most dilute.

**Question #: 17**

Which of the following statements is/are **true** about Na$_2$SO$_4$ added to water? Select **all that apply**.

✓A. Na$_2$SO$_4$ is soluble.
    B. Na$_2$SO$_4$ is a nonelectrolyte.
✓C. Na$_2$SO$_4$ is a strong electrolyte.
    D. Na$_2$SO$_4$ is a weak electrolyte
    E. Na$_2$SO$_4$ is insoluble.

**Question #: 18**

Which of the following reactions produces a precipitate?

A. CoCl$_2$ ($aq$) + Na$_2$SO$_4$ ($aq$) → CoSO$_4$ ($aq$) + 2 NaCl($aq$)
✓B. 2 LiBr($aq$) + Hg$_2$(NO$_3$)$_2$ ($aq$) → Hg$_2$Br$_2$ ($s$) + 2 LiNO$_3$ ($aq$)
    C. KCl($aq$) + NaBr($aq$) → KBr($aq$) + NaCl($aq$)
    D. HBr($aq$) + KOH($aq$) → KBr($aq$) + H$_2$O($l$)

**Question #: 19**

What is the **net ionic** equation for the reaction that occurs when aqueous solutions of H$_2$SO$_4$ and KOH are mixed?

✓A. H$^+$($aq$) + OH$^-$($aq$) → H$_2$O($l$)
    B. 2 K$^+$($aq$) + SO$_4^{2-}$($aq$) → K$_2$SO$_4$ ($s$)
    C. H$^+$($aq$) + OH$^-$($aq$) + 2 K$^+$($aq$) + SO$_4^{2-}$($aq$) → H$_2$O($l$) + K$_2$SO$_4$ ($s$)
    D. 2 H$^+$($aq$) + SO$_4^{2-}$($aq$) + 2 K$^+$($aq$) + 2 OH$^-$($aq$) → 2 H$_2$O($l$) + 2 K$^+$($aq$) + SO$_4^{2-}$($aq$)
Question #: 20

A 25.2 mL sample of an aqueous nitric acid (HNO₃) solution requires 16.3 mL of 0.105 M Ba(OH)₂ to reach the equivalence point. The concentration of the HNO₃ solution is 1 M. Report your answer with three significant figures and do not include units.

1. 0.136
Rationale: Answers from 0.133 to 0.139 (+/- 2%) with 2, 3 or 4 significant figures were accepted.

Question #: 21

Which one of the following pairs of reactants undergoes a gas-evolution reaction?

✓ A. HCl(aq) + NaHCO₃(aq) →
B. HCl(aq) + NaOH(aq) →
C. 2 Na(s) + Cl₂(g) →
D. 4 Fe(s) + O₂(g) →
Rationale: CHE 105 Ex 2 F15 #21

Question #: 22

Determine the oxidation number for each element in H₃PO₄.

H 1
P 2
O 3

1. +1\|1\|+\|one\|
2. five\|+5\|5\|5+\|
3. -2\|2\|-

Question #: 23

Which one of the following is a redox reaction?

✓ A. Ca(s) + 2 HF(aq) →CaF₂(aq) + H₂(g)
B. KCl(aq) + AgNO₃(aq) → AgCl(s) + KNO₃(aq)

C. Pb(C₂H₃O₂)₂(aq) + 2 LiBr(aq) → PbBr₂(s) + 2 LiC₂H₃O₂(aq)

D. HCl(aq) + NaOH(aq) → NaCl(aq) + H₂O(l)

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**Question #**: 24

The atmospheric pressure supports a column of mercury 695 mm tall in a barometer. What is this pressure in torr and in atmospheres?
The pressure is _1_ torr and _2_ atm.
Report your answers with **three significant figures** and **do not include units**.

1. 695
2. 0.914

**Rationale**: Answers from 681 to 709 and 0.896 to 0.932 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

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**Question #**: 25

A sample of N₂(g) occupies 25.0 mL at 25.0 °C. At what temperature _1 °C_ does the volume of the gas sample double if the pressure is held constant?
Report your answer with **three significant figures** and **do not include units**.

1. 323

**Rationale**: Answers from 316 to 330. (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

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**Question #**: 26

To what temperature must an ideal gas inside a rigid container be cooled in order to have a pressure of 2.00 atm, when the initial temperature and pressure are 288 K and 4.00 atm, respectively?

A. 72.0 K
B. 144 K
✓ C. 36.0 K
Question #: 27

Which of the following statements is not consistent with the ideal gas law?

A. The volume of the gas is inversely proportional to pressure of the gas.
B. The number of moles of gas is proportional to the volume of the gas.
C. The ideal gas constant is independent of the identity of the gas.
D. The volume of the gas is inversely proportional to the temperature of the gas.

Question #: 28

What volume does 2.34 mol of an ideal gas occupy at a temperature of 25.0 °C and a pressure of 785 torr?

1 L

Report your answer with three significant figures and do not include units.

1. 55.4

Rationale: Answers from 54.3 to 56.5 (+/- 2%) with 2, 3 or 4 significant figures (in a few cases, 3 decimal places) were accepted.

Question #: 29

A 2.524 g sample of gas in a 0.435 L vessel exerts a pressure of 2.00 atm at 388 K. What is the molar mass of the gas?

✓ A. 92.4 g/mol
   B. 13.1 g/mol
   C. 44.3 g/mol
   D. 73.1 g/mol

Question #: 30

What mass of solid product will be produced when 25.0 mL of 0.300 M CaCl\text{₂} are mixed with 35.0 mL of 0.250 M AgNO\text{₃}? Assume 100% yield.
A. 2.15 g
✓B. 1.25 g
C. 1.44 g
D. 2.46 g