This print-out should have 40 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

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001 10.0 points

Calculate the number of H_2O molecules in 1.00 cm^3 of water at 0°C (density = 0.99987 g/cm^3).

1. 8.36×10^{24} molec

2. 1.55×10^{23} molec

3. 6.69×10^{22} molec

4. 3.35×10^{22} molec **correct**

Explanation:

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002 10.0 points

How many moles of hydrogen are contained in 3.00 moles of ethanol (CH_3CH_2OH)?

1. $3.00 \times 6.02 \times 10^{23}$ mol

2. $3.00 \times 3.61 \times 10^{24}$ mol

3. 3.61×10^{24} mol

4. 6.02×10^{23} mol

5. 18.00 mol **correct**

6. 3.00×10^{23} mol

7. 3.00 mol

8. 1.00×10^{23} mol

9. 1.00 mol

10. 6.00 mol

Explanation:
$n = 3$ mol

From the molecular formula of ethanol (CH_3CH_2OH) we can see that for every molecule of ethanol there are 6 atoms of hydrogen. Therefore, in one mole of ethanol there would be 6 moles of hydrogen atoms. If this isn't immediately clear, it can be seen in the conversion below using Avogadro's number to convert from atoms and molecules to moles. Starting with our 6 atoms H per 1 molecule ethanol (etOH) ratio:

$$? \frac{\text{mol H}}{\text{mol EtOH}} = \frac{6 \text{ atoms H}}{1 \text{ molec } CH_3CH_2OH} \times \frac{1 \text{ mol H}}{6.022 \times 10^{23} \text{ atoms H}} \times \frac{6.022 \times 10^{23} \text{ molec etOH}}{1 \text{ molec etOH}} = \frac{6 \text{ mol H}}{1 \text{ mol } CH_3CH_2OH}$$

Note, the 6.022×10^{23} factors cancel, leaving us with 6 mol H/1 mol CH_3CH_2OH. Thus in 3.00 moles of ethanol, there would be 3.00 times as many H atoms, or 18.00 mol H.

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003 10.0 points

Find the molar mass for $(NH_4)_2CrO_4$.

1. 168.10 g/mol

2. 110.13 g/mol

3. 136.10 g/mol

4. 142.20 g/mol

5. 152.10 g/mol **correct**

Explanation:
molar mass of $(NH_4)_2CrO_4$ = ?

$$2 \text{ mol N} \times \frac{14.01 \text{ g N}}{\text{mol N}} = 28.02 \text{ g}$$
$$8 \text{ mol H} \times \frac{1.01 \text{ g H}}{\text{mol H}} = 8.08 \text{ g}$$
$$1 \text{ mol Cr} \times \frac{52.00 \text{ g Cr}}{\text{mol Cr}} = 52.00 \text{ g}$$
$$4 \text{ mol O} \times \frac{16.00 \text{ g O}}{\text{mol O}} = 64.00 \text{ g}$$

Molar mass = 152.10 g /mol

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004 10.0 points

What is the weight of a single molecule of CO_2?

1. 6.0×10^{-23} g

2. 44 g

3. 7.31×10^{-23} g **correct**

4. 6.0×10^{23} g

5. 7.31×10^{23} g

Explanation:

We don't have a direct method of looking up the mass in grams of a single molecule, but we can determine the mass in grams of a mole of molecules. This is the formula weight of the compound and is based on the atomic weights of the elements in the compound.

Each mole of CO_2 contains 1 mol of C and 2 mol of O. We know the atomic masses of each of these elements from the periodic table. Using these atomic masses we calculate the formula weight of CO_2:

$$\mathrm{FW}_{CO_2} = 1 \text{ mol C} \cdot \frac{12.0107 \text{ g C}}{1 \text{ mol C}} + 2 \text{ mol O} \cdot \frac{15.9994 \text{ g O}}{1 \text{ mol O}} = \frac{44.0095 \text{ g } CO_2}{\text{mol } CO_2}$$

Now we know the grams per mole of CO_2. We also know there are Avogadro's number of molecules per mole. We can use Avogadro's number to convert from moles to grams:

$$\frac{? \text{ g } CO_2}{\text{molec } CO_2} = \frac{44.0095 \text{ g } CO_2}{\text{mol } CO_2} \times \frac{1 \text{ mol } CO_2}{6.022 \times 10^{23} \text{ molec } CO_2} = 7.30812 \times 10^{-23} \text{ g/molec}$$

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005 10.0 points

What is the percent carbon by weight in a pure sample of $C_2H_4O_2$?

1. 40% **correct**

2. 30%

3. 25%

4. 10%

5. 20%

Explanation:

Assume a 1 mole sample of $C_2H_4O_2$. The percent carbon is

$$\frac{\text{mass of carbon}}{\text{total mass of compound}} \times 100\% = \frac{1 \text{ mol } C_2H_4O_2}{60 \text{ g } C_2H_4O_2} \times \frac{2 \text{ mol C}}{1 \text{ mol } C_2H_4O_2} \times \frac{14 \text{ g C}}{1 \text{ mol C}} \times 100\% = 40\%$$

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006 10.0 points

A compound consists of 65.45% C, 5.492% H, and 29.06% O on a mass basis and has a molar mass of 110 g/mol. Determine the molecular formula of the compound.

1. CHO

2. $C_5H_5O_2$

3. C_3H_3O

4. $C_6H_6O_2$ **correct**

Explanation:

% C = 65.45% % H = 5.492%
% O = 29.06% formula mass = 42.08 amu

We start by finding the empirical formula of the compound. The empirical formula is the simplest whole number ratio of atoms present in the molecule. The ratio of atoms in a compound is the same as the ratio of moles of atoms in a molecule of the compound. The compound is 29.06% O, 5.492% H, and 65.45% H by mass. These percentages are true no matter how large or small our sample of the compound. Assuming we have a 100 g sample of the compound, our sample would contain 29.06 g O, 5.492 g H, and 65.45 g C. Using the atomic weight of each element, we find the moles of each element present in the 100 g of sample:

$$? \text{ mol O} = 29.06 \text{ g O} \times \frac{1 \text{ mol O}}{15.999 \text{ O}} = 1.816 \text{ mol O}$$

$$? \text{ mol H} = 5.492 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ H}} = 5.448 \text{ mol H}$$

$$? \text{ mol C} = 65.45 \text{ g C} \times \frac{1 \text{ mol C}}{12.011 \text{ C}} = 5.449 \text{ mol C}$$

We now have a mole ratio, but we want the smallest whole-number ratio. Dividing each of the above moles by the smallest number guarantees us at least one whole number:

$$\frac{1.816 \text{ mol O}}{1.816} = 1 \text{ mol O}$$
$$\frac{5.448 \text{ mol H}}{1.816} = 3 \text{ mol H}$$
$$\frac{5.449 \text{ mol C}}{1.816} = 3 \text{ mol C}$$

In this case, all of these numbers are whole numbers or are close enough for rounding to a whole number. The empirical formula is C_3H_3O.

Next we find the molecular formula. The molecular formula gives the actual number of atoms of each element present in a molecule of the compound. We were given the formula weight of the compound, 110. We calculate the formula weight of our empirical formula, C_3H_3O. This formula weight is 55.06. Since the emiprical formula gives the ratio of each element, the molecular formula must always be a multiple of the empirical formula. We can find this multiple by dividing the formula weight of the compound by the molecular weight of the empirical formula:

$$? \text{ multiple} = \frac{110}{55.06} = 2$$

The molecular formula is found by multiplying all subscripts in the empirical formula by 2, so the molecular formula is $C_6H_6O_2$.

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007 10.0 points

A compound is found to contain 53.70% iron and 46.30% sulfur. Find its empirical formula.

1. Fe_2S

2. FeS

3. Fe_2S_3 **correct**

4. Fe_2S_5

Explanation:
% Fe = 53.70 % % S = 46.30%
Mass composition of 100 g sample: 53.70 g Fe, 46.30 g S composition in moles:

$$53.70 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} = 0.9615 \text{ mol Fe}$$

$$46.30 \text{ g S} \times \frac{1 \text{ mol S}}{32.07 \text{ g S}} = 1.444 \text{ mol S}$$

Smallest whole-number ratio of atoms:

$$\frac{0.9615 \text{ mol Fe}}{0.9615} : \frac{1.444 \text{ mol S}}{0.9615}$$

1.000 mol Fe : 1.502 mol S
2.000 mol Fe : 3.004 mol S
2 mol Fe : 3 mol S

The empirical formula is therefore Fe_2S_3.

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008 10.0 points

Given the balanced formula

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

for the combustion of hydrogen molecules with oxygen molecules, which ratio of hydrogen to oxygen would you expect to produce the loudest bang?

1. 1 mol H_2 : 1 mol O_2

2. 1 mol H_2 : 2 mol O_2

3. 2 mol H_2 : 2 mol O_2

4. 3 mol H_2 : 1 mol O_2

5. 0 mol H_2 : 3 mol O_2

6. 2 mol H_2 : 1 mol O_2 **correct**

Explanation:

To produce the biggest bang, you would want the amount of hydrogen to be twice that of the oxygen. Any extra would just be wasted.

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009 10.0 points

Balance the equation

$$? \, CS_2 + ? \, O_2 \rightarrow ? \, CO_2 + ? \, SO_2 \, ,$$

using the smallest possible integers. The coefficient of O_2 is

1. 1.

2. 5.

3. 2.

4. 4.

5. 3. **correct**

Explanation:

A balanced equation has the same number of each kind of atom on both sides of the equation. We find the number of each kind of atom using equation coefficients and composition stoichiometry. For example, we find there are 2 S atoms on the product side:

$$? \text{ S atoms} = 2 \, SO_2 \times \frac{1 \, S}{1 \, SO_2} = 2 \, S$$

The balanced equation is

$$CS_2 + 3 \, O_2 \rightarrow CO_2 + 2 \, SO_2,$$

and the coefficient of O_2 is 3.

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010 10.0 points

Ethylene (C_2H_4) burns in oxygen to produce carbon dioxide and water. The correct form of the chemical equation that describes this reaction is

1. $C_2H_4 + 2O_2 \rightarrow 2 \, CO + 2 \, H_2O$.

2. $C_2H_4 + O_2 \rightarrow CO_2 + H_2O$.

3. $2 \, C_2H_4 + O_2 \rightarrow 2 \, CO_2 + H_2O$.

4. $C_2H_4 + 3 \, O_2 \rightarrow 2 \, CO_2 + 2 \, H_2O$. **correct**

Explanation:

The key to writing a correct balanced equation is to first determine the correct formula for each of the molecules in the reaction.

Oxygen is O_2. (Remember, oxygen is diatomic). Carbon dioxide is CO_2. Water is H_2O.

$$? \, C_2H_4 + ? \, O_2 \rightarrow ? \, CO_2 + ? \, H_2O$$

A balanced equation must have the same number of each kind of atom on both sides of the equation. The balanced equation is

$$C_2H_4 + 3 \, O_2 \rightarrow 2 \, CO_2 + 2 \, H_2O$$

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011 10.0 points

For the reaction

$$2 \, NH_3 + CH_3OH \rightarrow \text{products}$$

what mass of NH_3 is needed to react with 21 grams of CH_3OH?

1. 1.3 g

2. 22.3 g **correct**

3. 710 g

4. 11 g

Explanation:

$m_{CH_3OH} = 21.0$ g

The balanced equation for the reaction indicates that 2 mol NH_3 are needed for each mole CH_3OH reacted. First we calculate moles CH_3OH present using the molar mass:

$$\begin{aligned} ? \text{ mol } CH_3OH &= 21 \text{ g } CH_3OH \\ &\times \frac{1 \text{ mol } CH_3OH}{32 \text{ g } CH_3OH} \\ &= 0.656 \text{ mol } CH_3OH \end{aligned}$$

Using the mole ratio from the chemical equation, we find the moles NH_3 needed to completely react 0.656 mol CH_3OH:

$$\begin{aligned} ? \text{ mol } NH_3 &= 0.656 \text{ mol } CH_3OH \\ &\times \frac{2 \text{ mol } NH_3}{1 \text{ mol } CH_3OH} \\ &= 1.312 \text{ mol } NH_3 \end{aligned}$$

We convert from moles to grams NH_3:

$$? \text{ g } NH_3 = 1.312 \text{ mol } NH_3 \times \frac{17 \text{ g } NH_3}{1 \text{ mol } NH_3} = 22.3 \text{ g } NH_3$$

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012 10.0 points

60.0 g O_2 and 50.0 g S are reacted according to the equation

$$2\,S + 3\,O_2 \to 2\,SO_3\,.$$

Which reactant is in excess and by how many grams?

1. S; 24.8 g

2. O_2; 24.8 g

3. O_2; 10.0 g

4. S; 20.0 g

5. S; 10.0 g **correct**

6. O_2; 20.0 g

Explanation:

$m_{O_2} = 60.0$ g $\qquad m_S = 50.0$ g

From the balanced equation we see that we need

$$\frac{3 \text{ mol } O_2}{2 \text{ mol S}} = \frac{1.5 \text{ mol } O_2}{1 \text{ mol S}}$$

From this ratio we see that each mole of S that reacts requires exactly 1.5 moles of O_2. Next we need to determine how many moles of each reactant we actually have:

$$? \text{ mol } O_2 = 60.0 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32 \text{ g } O_2} = 1.875 \text{ mol } O_2$$

$$? \text{ mol S} = 50.0 \text{ g S} \times \frac{1 \text{ mol S}}{32 \text{ g S}} = 1.56 \text{ mol S}$$

Now we calculate the available ratio of reactants and compare that to what is required:

$$\frac{1.875 \text{ mol } O_2}{1.56 \text{ mol S}} = \frac{1.2 \text{ mol } O_2}{1 \text{ mol S}}$$

We have 1.2 mol of O_2 for every mole of S. This is less than the 1.5 mol required, so O_2 is the limiting reactant and S is in excess. To determine by how much S is in excess, we need to calculate how many moles of S will react with the 60.0 g or 1.875 mol O_2:

$$? \text{ mol S} = 1.875 \text{ mol } O_2 \times \frac{2 \text{ mol S}}{3 \text{ mol } O_2} \times \frac{32 \text{ g S}}{1 \text{ mol S}} = 40.0 \text{ g S}$$

Finally we subract the amount of S that reacts from the amount of S that we started with to determine how much is left over:

$$50.0 \text{ g S} - 40.0 \text{ g S} = 10.0 \text{ g S}$$

40.0 grams of S will react leaving 10.0 grams S unreacted.

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013 10.0 points

Consider the reaction

$$2\,H_2 + O_2 \to 2\,H_2O\,.$$

How much water will be formed when 32 grams of hydrogen and 32 grams of oxygen are mixed and allowed to react?

1. 36 g **correct**

2. 64 g

3. 2.0 g

4. 18 g

Explanation:

$m_{hydrogen} = 32$ g $\qquad m_{oxygen} = 32$ g

We recognize this as a limiting reactant problem because the amounts of *more than one* reactant are given. We must determine which of these would be used up first (the limiting reactant). We calculate moles of each:

$$? \text{ mol } H_2 = 32 \text{ g } H_2 \times \frac{1 \text{ mol } H_2}{2 \text{ g } H_2} = 16 \text{ mol } H_2$$

$$? \text{ mol } O_2 = 32 \text{ g } O_2 \times \frac{1 \text{ mol } O_2}{32 \text{ g } O_2} = 1 \text{ mol } O_2$$

We have exactly 1 mole of O_2 present and we know from the balanced equation that we need 2 mol H_2 to completely react 1 mol O_2. We have 16 mol of H_2 present, far more than needed. Therefore, H_2 is in excess and O_2 is the limiting reactant. We use the moles of O_2 present as the basis for further calculations. We use the mole ratio from the chemical equation and the molar mass of water to calculate grams water produced:

$$? \text{ g } H_2O = 1 \text{ mol } O_2 \times \frac{2 \text{ mol } H_2O}{1 \text{ mol } O_2} \times \frac{18 \text{ g } H_2O}{1 \text{ mol } H_2O} = 36 \text{ g } H_2O$$

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014 10.0 points

Consider the reaction

$$N_2 + 3\,H_2 \rightarrow 2\,NH_3\,.$$

14.0 moles of N_2 and 48.0 moles of H_2 are reacted, producing 21.5 moles of NH_3. What is the percent yield?

1. 76.8% **correct**

2. 148.8%

3. 130.2%

4. 29.9%

5. 67.2%

6. Not enough information is given.

7. 100.0%

Explanation:

This question is a limiting reagent and percent yield problem.

Find the limiting reagent:

$$(14 \text{ mol } N_2) \times \frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2} = 28 \text{ mol } NH_3$$

$$(48 \text{ mol } H_2) \times \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2} = 32 \text{ mol } NH_3$$

So N_2 is the limiting reagent: 28 moles of NH_3 is the THEORETICAL yield. The ACTUAL yield is 21.5 mol HN_3.

Thus the percent yield is

$$\frac{21.5 \text{ mol } NH_3}{28 \text{ mol } NH_3} \times 100\% = 76.7857\%$$

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015 10.0 points

How much of a 4.45 M $CaBr_2$ solution can be prepared if one has 79.6 g of $CaBr_2$ available?

1. 1.00 L

2. 0.0356 L

3. 0.115 L

4. 1.77 L

5. 1.65 L

6. 0.564 L

7. 0.0895 L **correct**

8. 3.54 L

Explanation:

$[CaBr_2] = 4.45$ M   m = 79.6 g

$$? \text{ L } CaBr_2 = 79.6 \text{ g } CaBr_2 \times \frac{1 \text{ mol } CaBr_2}{199.9 \text{ g } CaBr_2} \times \frac{1 \text{ L soln}}{4.45 \text{ mol } CaBr_2} = 0.0895 \text{ L } CaBr_2$$

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016 10.0 points

What is the molarity of a solution prepared by dissolving 19.8 g of glucose (of MW 180 amu) in 115 mL of solution?

1. 0.00096 M

2. 172.2 M

3. 0.96 M **correct**

4. 0.172 M

Explanation:
m = 19.8 g $\qquad V = 115$ mL
MW = 180 amu = 180 g/mol

$$\text{Molarity} = \frac{\text{mol}}{\text{L}}\text{ solution} = \frac{\text{g/MW}}{\text{L}}\text{ solution}$$

$$? \text{ M} = \frac{19.8\text{ g glucose}}{115\text{ mL soln}} \times \frac{1\text{mol glucose}}{180\text{ g glucose}} \times \frac{1000\text{ mL soln}}{\text{L soln}} = 0.956522\text{ M}$$

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017 10.0 points

How many mL of 12.0 M HCl are needed to make 2.0 L of 0.40 M HCl solution?

1. 420 mL

2. 17 mL

3. 15 mL

4. 96 mL

5. 67 mL **correct**

Explanation:
$M_1 = 12.0$ M $\qquad V_2 = 2.0$ L
$M_2 = 0.40$ M

A portion of the 12.0 M HCl solution will be diluted with water to form 2.0 L of the 0.4 M HCl solution. All of the moles of HCl in the new dilute solution must come from the more concentrated solution. (There is no HCl in the water!) We use the desired volume and molarity of the dilute solution to determine the number of moles of HCl needed to make this solution:

$$? \text{ mol HCl} = 2.0\text{ L soln} \times \frac{0.40\text{ mol HCl}}{1\text{ L soln}} = 0.80\text{ mol HCl}$$

We need enough of the 12.0 M solution to provide 0.80 mol HCl. We use the molarity to convert form moles to volume of the solution:

$$? \text{ mL soln} = 0.80\text{ mol HCl} \times \frac{1\text{ L soln}}{12.0\text{ mol HCl}} \times \frac{1000\text{ mL soln}}{1\text{ L soln}} = 3.26\text{ mL soln}$$

66.67 mL of the 12.0 M solution diluted to 2.0 L with water would give us the desired solution.

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018 10.0 points

If 200 mL of water is evaporated from 400 mL of 0.5 M aqueous salt solution, what is the resulting concentration?

1. 2.5×10^{-1} M

2. 2.5×10^{0} M

3. None of these **correct**

4. 2.5×10^{1} M

5. 2.5×10^{-2} M

Explanation:

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019 10.0 points

The oxidation numbers of nitrogen in NH_3, NO_3^- and NO are

1. +3, +6, and +2, respectively.

2. −3, +5, and +1, respectively.

3. −3, +5, and +2, respectively. **correct**

4. −3, +6, and +2, respectively.

Explanation:

To calculate oxidation numbers, remember that the sum of the numbers must equal the total charge on the molecule or in the case of neutral species, zero.

For MnO : $\quad N^x + 3(H^{+1}) = 0$

$$x + 3 = 0$$
$$x = -3$$

For NO_3^- :
$$N^x + 3(O^{2-}) = -1$$
$$x + 3(-2) = -1$$
$$x - 6 = -1$$
$$x = 5$$

For NO :
$$N^x + O^{2-} = 0$$
$$x + (-2) = 0$$
$$x = 2$$

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020 10.0 points

Calculate the oxidation numbers for each element in RbO.

1. Rb = 0, O = 0

2. Rb = +3, O = −2

3. Rb = +2, O = −2

4. Rb = +1, O = −2

5. Rb = +1, O = −1 **correct**

Explanation:
O in RbO is a peroxide.

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021 10.0 points

Which of the displacement reactions below occurs as written (don't worry about balancing)?

1. Fe^{3+} + Ag → Fe + Ag^+

2. Fe^{3+} + Mg → Fe + Mg^{2+} **correct**

3. Na^+ + Zn → Na + Zn^{2+}

4. Ca^{2+} + Au → Ca + Au^+

5. None of the reactions occurs as written.

Explanation:
More active metals displace less active metals from compounds. Mg is more active than Fe.

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022 10.0 points

Identify the solid product that forms when the following aqueous solutions are mixed:

$$CoCl_2(aq) + Na_2S(aq) \rightarrow$$

1. CoS and NaCl

2. No solid products are formed.

3. CoS and 2NaCl

4. NaCl

5. CoS **correct**

Explanation:
Both cobalt(II) chloride and sodium sulfide are soluble. This is a metathesis reaction with the products cobalt(II) sulfide (CoS) and sodium chloride (NaCl). NaCl is soluble but CoS is insoluble and will form a precipitate.

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023 10.0 points

Which of the following is best described as an acid-base reaction?

1. $2\,HgO \rightarrow 2\,Hg + O_2$

2. $Ca + 2\,H_2O \rightarrow Ca(OH)_2 + H_2$

3. $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$

4. $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ **correct**

5. $KCl + NH_4NO_3 \rightarrow KNO_3 + NH_4Cl$

Explanation:
An acid is defined as a proton donor and a base as a proton acceptor. In the reaction

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-,$$

water donates a proton and acts as an acid. NH_3 accepts a proton and acts as a base.

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024 10.0 points

The observed product from the reaction of $FeCl_2$ and K_2CO_3 is

1. There is no reaction.

2. KCl electrolyte.

3. CO_2 gas.

4. $FeCO_3$ precipitate. **correct**

5. Cl_2 gas.

Explanation:
Iron(II) chloride and potassium carbonate are both soluble. This would be a metathesis reaction. The cation from one compound combines with the anion from the other compound and vice-versa. The products would be iron(II) carbonate ($FeCO_3$) and potassium chloride, KCl. KCl is soluble and would not be visually observable. $FeCO_3$ would form a precipitate.

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025 10.0 points

Zn is an active metal above H on the activity series. When zinc is placed in an acidic solution one of the products produced is

1. There is no reaction because Zn is above H.

2. H_2. **correct**

3. H_2O.

4. $Zn(OH)_2$.

Explanation:
Zn is above H on the activity series and will therefore displace H from nonoxidizing acid solutions. Since H normally exists as a diatomic, the H atoms formed would be expected to combine to form H_2 molecules.

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026 10.0 points

Which of the following aqueous solutions should form a precipitate with aqueous $Fe(NO_3)_3$?

1. K_2SO_4

2. KCl

3. KOH **correct**

4. KNO_3

Explanation:
All of the answer choices are soluble compounds and would dissociate to form ions in solution. These ions could react with the Fe^{3+} and NO_3^- ions from $Fe(NO_3)_3$. All answer choices contain the cation K^+ that could combine with NO_3^- to form KNO_3, a soluble compound. Next we look at the possible products of the combination of Fe^{3+} with anions from the answer choices. $FeCl_3$, $Fe(NO_3)_3$, and $Fe_2(SO_4)_3$ are all soluble. $Fe(OH)_3$ is insoluble. A mixture of $Fe(NO_3)_3$ and KOH would form the precipitate $Fe(OH)_3$.

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027 10.0 points

Which aqueous solution should form a precipitate with aqueous $Cu(NO_3)_2$?

1. K_2SO_4

2. KNO_3

3. K_2S **correct**

4. $CuSO_4$

Explanation:
All of the answer choices are soluble compounds and would dissociate to form ions in solution. These ions could react with the Cu^{2+} and NO_3^- ions from $Cu(NO_3)_2$. All common nitrate compounds are soluble so we would not expect a precipitate to form from the combination of the NO_3^- ion with any available cations. Next we look at the possible products from the combination of Cu^{2+} with anions from the answer choices. CuS is insoluble; a mixture of $Cu(NO_3)_2$ and K_2S would form the precipitate CuS.

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028 10.0 points

Choose the pair of names and formulas that do not match.

1. $NaNO_3$: sodium nitrate

2. $MgSO_3$: magnesium sulfate **correct**

3. $SiCl_4$: silicon tetrachloride

4. N_2O_3 : dinitrogen trioxide

5. $SnCl_4$: stannic chloride

Explanation:

The $SO_3{}^{2-}$ ion is sulfite ion. $MgSO_3$ should be correctly named magnesium sulfite.

$SiCl_4$ and N_2O_3 are both covalent compounds and are named correctly using the appropriate prefixes.

The stannic ion is Sn^{4+}; the chloride ion is Cl^-. Four Cl^- are needed to balance the charge of each Sn^{4+}, so the formula is $SnCl_4$ is correct.

The sodium ion is Na^+; the nitrate ion is $NO_3{}^-$. One $NO_3{}^-$ is needed to balance the charge of each Na^+, so the formula $NaNO_3$ is correct.

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029 10.0 points

Name the compound K_2CO_3.

1. potassium carbide

2. potassium(II) carbonate

3. potassium carboxide

4. potassium carbonate **correct**

Explanation:

A potassium atom will lose one electron to form K^+. CO_3^{2-} is a carbonate ion. Since we can determine the charge on a potassium ion directly from the periodic table, it does not require the use of roman numerals to indicate the charge of the ion.

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030 10.0 points

Write the correct formula for ammonium phosphate.

1. $(3NH_4)PO_4$

2. $(NH_4)_3PO_4$ **correct**

3. NH_4PO_4

4. $NH_4(PO_4)_3$

Explanation:

The ammonium ion is $NH_4{}^+$; the phosphate ion is PO_4^{3-}. Three NH_4^+ are needed to balance the charge on each PO_4^{3-}, so the formula is $(NH_4)_3PO_4$.

---

031 10.0 points

What is the name of the compound with the formula CCl_4?

1. carbon chloride

2. carbon(IV) chloride

3. carbon tetrachloride **correct**

4. chlorine carbonide

Explanation:

This is a covalent compound and should be named using prefixes to indicate the number of atoms of each element in the compound. Binary covalent compounds are named with the name of the first element followed by the name of the second element with the suffix "-ide" added. CCl_4 is carbon tetrachloride.

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032 10.0 points

The correct name for the compound $AgBrO_3$ is

1. silver perbromate.

2. gold bromite.

3. silver bromoxide.

4. argon oxybromide.

5. silver bromate. **correct**

Explanation:

Ag is silver; BrO_3^{1-} is the bromate ion. $AgBrO_3$ is silver bromate.

---

033 10.0 points

Choose the formula for the compound nitrous acid.

1. HNO_4

2. HN

3. HNO_3

4. HNO

5. HNO_2 **correct**

6. H_2NO_3

7. H_2NO_2

8. H_3N

Explanation:

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034 10.0 points

How many fluorine atoms are in 4.0 moles of fluorine molecules?

1. 1.5×10^{23} atoms

2. 4.8×10^{24} atoms **correct**

3. 6.6×10^{-24} atoms

4. 2.4×10^{24} atoms

Explanation:
$n_\text{F} = 4.0$ mol

Fluorine is diatomic. Each F_2 molecule contains two fluorine atoms. We can use Avogadro's number and the ratio of F atoms to F_2 molecules to find the number of fluorine atoms:

$$\begin{aligned} ?\ \text{atoms F} &= 4.0\ \text{mol F}_2 \\ &\times \frac{6.022 \times 10^{23}\ \text{F}_2}{1\ \text{mol F}_2} \\ &\times \frac{2\ \text{atoms F}}{1\ \text{molec F}_2} \\ &= 4.8 \times 10^{24}\ \text{atoms F} \end{aligned}$$

---

035 10.0 points

Name the compound SO_3.

1. sulfite

2. sulfate

3. sulfur trioxide **correct**

4. sulfur oxide

5. sulfur(VI) oxide

Explanation:

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036 10.0 points

Name the compound Na_2O.

1. sodium(I) oxide

2. sodium peroxide

3. disodium monoxide

4. sodium oxide **correct**

5. sodium(II) oxide

Explanation:

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037 10.0 points

The following reactions are observed to take place in aqueous solution, and the reverse reactions do not occur.

$$\begin{aligned} \text{Ca} + \text{Zn}^{2+} &\rightarrow \text{Zn} + \text{Ca}^{2+} \\ \text{Al} + \text{Zn}^{2+} &\rightarrow \text{Al}^{3+} + \text{Zn} \\ \text{Ca} + \text{Al}^{3+} &\rightarrow \text{Al} + \text{Ca}^{2+} \\ \text{Zn} + \text{Ag}^{+} &\rightarrow \text{Zn}^{2+} + \text{Ag} \end{aligned}$$

Which of the following lists the metals from most reactive to least reactive?

1. Zn; Ag; Al; Ca

2. Ag; Al; Ca; Zn

3. Ca; Al; Zn; Ag **correct**

4. Al; Zn; Ag; Ca

Explanation:
More active metals displace less active metals from solution. Since we are told that these reactions do occur, we can derive information about the relative activity of the metals involved. Ca and Al must both be more active than Zn since they displace Zn ions from solution. Of the two, Ca must be more active than Al since it displaces Al ions from solution. Zn must be more active than Ag since it displaces Ag ions from solution.

---

038 10.0 points

How many moles of the element carbon are in 10 moles of the compound benzene (C_6H_6)?

1. 60 mol **correct**

2. 12 mol

3. 10 mol

4. 1 mol

5. 0 mol

Explanation:
$n = 10$ mol

Each mole of benzene (C_6H_6) contains 6 mol of carbon atoms. We can use this ratio to calculate the moles of carbon atoms in 10 mol C_6H_6:

$$\begin{aligned} ?\text{ mol C} &= 10\text{ mol } C_6H_6 \cdot \frac{6\text{ mol C}}{1\text{ mol } C_6H_6} \\ &= 60\text{ mol C} \end{aligned}$$

---

039 10.0 points

The name for $KC_2H_3O_2$ is

1. potassium(I) carbon hydroxide.

2. potassium acetate. **correct**

3. potassium oxalate.

4. potassium(I) acetate.

Explanation:

$KC_2H_3O_2$ is an ionic compound (named by first naming the cation and then the anion). The cation name is simply the element name. The anion $C_2H_3O_2^-$ is the polyatomic acetate ion.

The potassium ion always has a charge of +1, so we do not need to use the Roman numeral notation to indicate the charge on K.

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040 10.0 points

Of the four compounds

HF, $HClO_2$, $NaOH$, $Ba(OH)_2$

which are either strong acids or strong bases in water?

1. All are either strong acids or strong bases.

2. NaOH

3. $HClO_2$ and NaOH

4. None are strong acids nor strong bases.

5. NaOH and $Ba(OH)_2$ **correct**

Explanation:

Memorize the strong acids and strong bases. All others are weak. Only NaOH and $Ba(OH)_2$ are strong; they are strong bases.