Question Analysis – Exam 1 MC

#	Topics	Corr. Ans.	% Corr.	My Explanation
1.	Oxidation Numbers	B	78	F forms a 1- ion, S forms a 2- ion, Mg forms a 2+ ion. Ar does not usually ionize – though it is used in Geiger counters where high-energy particles from radioactive decay processes produce Ar^+ ions when they travel through matter. The probe of the Geiger counter is filled with argon gas, which can be ionized by a rapidly moving particle. Mn forms 2+, 3+, 4+, 6+ and 7+ ions.
2.	Oxidation Numbers/ Compounds	E	68	Using possible oxidation states from above, the only possible choice is Mn.
3.	Oxides/ Acid Anhydrides	B	74	Non-metal oxides react with water to form acidic solutions. F can only be 1- so it won't form oxides. S reacts with oxygen to form SO_2 and SO_3. These oxides react with water to form H_2SO_3 and H_2SO_4. I did a demo showing this.
4.	Isotopes	D	87	Isotopes have the same number of protons but different amounts of neutrons and as a result, different mass numbers.
5.	Redox Balancing	E	82	Separate into two half reactions: $4Mg \rightarrow 4Mg^{2+} + 8e^-$ $8e^- + 10H^+ + NO_3^{1-} \rightarrow NH_4^{1+} + 3H_2O$
6.	Stoichiometry	D	67	$4P + 5O_2 \rightarrow P_4O_{10}$ $\frac{14.2 \text{ g } P_4O_{10}}{1} \times \frac{1 \text{ mole } P_4O_{10}}{284 \text{ grams } P_4O_{10}} \times \frac{5 \text{ moles } O_2}{1 \text{ mole } P_4O_{10}} = 0.250$ mole
7.	Organic Chemistry/ Stoichiometry	A	59	Pick any alkene. I chose ethene (C_2H_4). $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ $0.561 \text{ g } C_2H_4 \times \frac{1 \text{mole } C_2H_4}{28.0 \text{ grams}} \times \frac{2 \text{ moles } H_2O}{1 \text{ mole } C_2H_4} = 0.0400$ moles
8.	Solutions/ Molarity	D	38	Na_2CO_3: 3.0M x 0.070L = 0.210 moles x 2 = 0.420 $NaHCO_3$: 1.0 x 0.030 = 0.030 0.420 + 0.030 = 0.450 moles/0.100 L = 4.50 M
9.	Oxidizing Agent	E	38	An oxidizing agent is reduced in a chemical reaction. Reduction means gaining electrons. I^- can't gain any more electrons; all the rest can.
10.	Solutions	B	48	$Ba(NO_3)_2 + K_2CO_3 \rightarrow BaCO_3 + 2KNO_3$ $\frac{0.400}{1} = \frac{x}{0.030}$ $\frac{0.200}{1} = \frac{x}{0.020}$ x = 0.012 x = 0.0040 0.012 – 0.004 = 0.008 mol excess 0.008 ÷ 0.050 = 0.160
11.	Empirical Formula	D	44	C: 12/44 x 88 = 24 ÷ 12 = 2 H: 2/18 x 27 = 3 ÷ 1 = 3 Empirical formula is C_2H_3. C_4H_6 is a multiple of this empirical formula.
12.	Molarity	C	88	6.00 = x/0.050; x = 0.300 moles; 0.300 x 98.1 = 29.4 grams
13.	Redox	E	82	I^- is oxidized by MnO_4^-. MnO_4^- is reduced by I^-. The oxidation number for iodine changes from -1 to 0. The oxidation number of manganese changes from +7 to +4.
14.	Redox Balancing	D	82	Rules for redox balancing: 1. Balance all non hydrogen and oxygen elements. 2. Balance oxygen using water. 3. Balance hydrogen using H^+. 4. Balance the charge using e-.
15.	Molar Mass	E	75	I would set up a ratio. $\frac{96 \text{ grams O}}{164 \text{ grams } Ca(NO_3)_2} = \frac{24 \text{ grams of O}}{x}$ 96 is 4 times larger than 24, so divide 164 by 4 and x = 41.

16.	Empirical Formula	D	74	N: 36.8÷14 = approx. 2.5 but a little larger O: 63.2÷ 16 = approx. 4 but a little smaller At this point the best answer is D. If you wanted to go through all of the steps using the exact numbers you can but it takes up extra needed time. Hopefully you were able to eliminate A & B right off the bat.
17.	Dilutions	C	65	$M_1V_1=M_2V_2 \rightarrow$ (3)(1000) =11.6 x $\rightarrow$ 3000 ÷10 (rounded down for easy math) = 300. 11.6 is bigger than 10 so my answer should be a little lower. C is the only one that is close.
18.	Atoms/ Thomson/ Electrons	A	34	Thomson used a cathode ray tube and a magnet to prove that atoms had particles with negative charges….electrons.
19.	Balancing Chemical Equation	D	57	It is just regular balancing. Balance carbon first, then hydrogen and lastly oxygen. 1, 3.5, 3, 3
20.	Decomposition of Hydrates	B	51	Na_2CO_3: 45.7 ÷ 106 = 0.4X ÷ 0.4X = 1 H_2O: 54.3 ÷ 18 = 3 ÷ 0.4X = ~7
21.	Stoichiometry/ Gas Laws	D	71	At STP you can use 22.4. 0.400 mol K x $\frac{\text{1 mole } H_2}{\text{2 mole K}}$ x 22.4 L = 4.48 L
22.	Electrolytes	A	46	Ionic compounds dissociate in water, covalent compounds do not. Methanol is a covalent compound so it will not dissociate and will not be an electrolyte.
23.	Stoichiometry/ Limiting Reagent	B	39	0.200 = x/25; x = 5 mmole x 3/1 = 15 mmole 0.450 = x/30; x = 13.5 mmole x 3/5= 8.1 mmole
24.	Solutions/ Stoichiometry	A	20	0.200 = x/0.300 0.060 mol x 3 = 0.18 mol Need 0.12 mol NO_3^{1-} more 0.12 mol NO_3^{1-} x 1 mole $Ba(NO_3)_2$/2 mole NO_3^{1-} = 0.060 mol
25.	Oxidizing Agent	E	62	An oxidizing agent must be a reactant. The oxidizing agent must contain an element that is reduced and thus, gains electrons. In MnO_4^{1-}, Mn has a +7 charge. In MnO_2 Mn has a +4 charge.
26.	Empirical Formula	B	83	I guess the only way to do this one is to plug in the weights of each and then try the obvious ones by dividing each by the smallest. You are looking for a ratio that is greater than 1.5:1.0. For example: CrO_3: 52: 48, too small; CrO_2: 52: 48 possible; CrO: 52:32 too high; Cr_2O 104:16 impossible; Cr_2O_3 104:48 too high.
27.	Density/Significant Figures	D	39	D= m/V. To find mass: 25.0 – 3.0 = 22.0. To find density: 22.0/11.0 = 2.00. In subtraction your answer can only be as precise as your least precise measurement; both numbers were precise to the tenths place. In division, your answer can only have as many significant figures as the number in the problem with the fewest number of significant figures; each has three so your answer must have three.
28.	Molarity	E	55	There is a 2:1 ratio between K^+ and SO_4^{2-} so off the bat eliminate, A, B & D. Now, to solve, 87/174 = 0.5 moles. 0.5 moles/0.250 L = 2.0 M. Due to the 2:1 ratio, the molarity of K^+ is 4.0 M and SO_4^{2-} is 2.0 M.
29.	Chemical Reactions/ Percent Composition/ Stoichiometry	D	29	$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$ Use grams of CO_2 to find grams of $CaCO_3$: 0.38g CO_2 x 1mol CO_2/44g x 1mol $CaCO_3$/ 1mol CO_2 x 100g $CaCO_3$/1mol $CaCO_3$ = 0.86 grams $CaCO_3$. 0.86/1.0 x 100 = 86%
30.	Balancing Equations	C	33	This is a tricky balancing problem but do-able especially if you have the time. The coefficients of the balanced equations are: 4,1,2,4

31.	Stoichiometry	B	55	Write the balanced equation and then do mole to mass stoichiometry $Au_2S_3 + 3H_2 \rightarrow 3H_2S + 2Au$ 0.0500 x 2 moles of Au / 1 mole Au_2S_3 x 197.0 g Au / 1 mole Au = 19.7 g Au_2S_3
32.	Balancing Chemical Equations	C	74	Be sure to account for all oxygen atoms. Oxygen is very reactive and will react with all nonmetals in combustion reactions. Often students miscount because of oxygen's high reactivity. We balance chemical equations to observe the fact that matter is not created or destroyed.
33.	Oxidation Number	D	75	Know how to calculate the oxidation number of each element in a compound. H = +1, F = -1, O = -2. Usually the rest have to be determined. Non-metals can have both positive and negative charges.
34.	Stoichiometry / Solubility	C	54	A solution of 0.10 M NaCl contains 0.10 mol of chloride ions. A solution of 0.10 M calcium chloride contains 0.20 mol of chloride ions. 0.1 + 0.2 = 0.3 Cl^-. 0.3 mol Cl- = 0.3 mol Ag^+.
35.	Balancing Equations	C	71	It's just balancing. Be sure to do a double check at the end by writing down how many of each element there are in each molecule on each side of the equation.
36.	Empirical Formula	C	50	Divide each percent by the elements atomic weight. Divide by the smallest result. Multiply (if necessary) to make it a whole number.
37.	Nucleus / Rutherford	E	59	Ernest Rutherford discovered that atoms are mostly empty space and there is a large mass of positive charge contained in the nucleus. He did this in his gold foil experiment where positively charged alpha particles were shot at gold foil. Most passed through the foil but some were deflected and some even bounced back. Since positively charged alpha particles were repelled, it meant the atom had some positive charge inside it.
38.	Stoichiometry / Limiting Reagent	D	69	When you are given amounts of more than one substance, perform stoichiometry using each and see which produces the least amount. The limiting reactant determines the greatest amount of product that can be produced.
39.	Solutions / Molarity	C	28	Determine the moles of hydroxide in each solution and divide by the new volume. Note: When $Ba(OH)_2$ dissociates, two hydroxide ions are produced. The KOH solution produces 10 mmol of OH-. The $Ba(OH)_2$ solution produces 18 mmol of OH^-. 28 mmol in 100 mL produces a 0.28 M OH^- solution.
40.	Chemical Reactions / Precipitates / Stoichiometry / Limiting Reagent	C	31	Write the equation, balance it. H_2SO_4 is the limiting reagent. Determine how many moles of barium that do not form the barium sulfate precipitate. Divide unreacted barium moles by the total volume. $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$ 0.050 moles of H_2SO_4(L.R.) uses up 0.050 moles of $BaCl_2$. The new volume is 200 mL. 0.050 0.200 = 0.025 M [Ba^{2+}]

Difficulty	% of Questions	Question Numbers
80–100% correct	15%	4, 5, 12, 13, 14, 26
60–79% correct	32.5%	1, 2, 3, 6, 15, 16, 17, 21, 25, 32, 33, 35, 38
40–59% correct	27.5%	7, 10, 11, 19, 20, 22, 28, 31, 34, 36, 37
20–39% correct	25%	8, 9, 18, 23, 24, 27, 29, 30, 39, 40
0–19% correct	0%	

Average Nation Score using questions above: 58.4%.

Exam 1 Analysis: Multiple Choice

	2012-2013	2011-2012	2010-2011	2009-2010	2008-2009	2007-2008	2006-2007
High	**35/40 87.5%**	**28/40 70%**	**36/40 90%**	**31/40 78%**	**31/45 69%**	**29/42 69%**	**36/45 80%**
Average	**21.2/40 53%**	**16/40 41%**	**20/40 50%**	**19/40 48%**	**21/45 46%**	**18/42 42%**	**24/45 53%**
Low	**12/40 30%**	**9/40 23%**	**8/40 20%**	**11/40 28%**	**7/45 16%**	**5/42 12%**	**8/45 18%**

Exam 1 Analysis: Free Response

	2012-2013	2011-2012	2010-2011	2009-2010	2008-2009	2007-2008	2006-2007
High	**33/34 97%**	**23/32 72%**	**31/33 94%**	**33/33 100%**	**29/33 88%**	**38/47 81%**	**38/45 84%**
Average	**15/34 44%**	**13/32 40%**	**11/33 33%**	**12/33 36%**	**12/33 36%**	**19/47 41%**	**16/45 35%**
Low	**2/34 6%**	**3/32 9%**	**1/33 3%**	**1/33 3%**	**2/33 6%**	**6/47 13%**	**3/45 7%**