

Avogadro's Number, $N_A = 6.022 \times 10^{23}$

1. [7 points] Carry out the following mathematical operation:

$$6.06 \times 10^3 + 1.1 \times 10^2$$

Which of the following answers is correct **and** has the correct number of significant figures?

- (a) 617 (b) 6.2×10^3 **(c) 6.17×10^3** (d) 6.170×10^3 (e) 7.16×10^3

2. [7 points] From the list below identify those substances that are examples of molecular substances?

- (a) Helium
(b) Carbon in it's Diamond Form
(c) Nitrogen
(d) Aluminum oxide
(e) All of the above

3. [7 points] What is the empirical formula of sodium sulfite?

- (a) NaS
(b) Na_2S
(c) NaSO_3
(d) Na_2SO_3
(e) Na_2SO_4

4. [7 points] What is the empirical formula of the ionic compound that forms between magnesium and sulfur?

- (a) Mg_2S
(b) MgS
(c) MgS_2
(d) MnS_2
(e) MnS

5. [7 points] If two atoms are isotopes, which of the following statements is false?

- (a) They must have the same atomic number
- (b) They must have the same mass number**
- (c) They must have the same number of protons
- (d) They must have different numbers of neutrons
- (e) They must be atoms of the same element

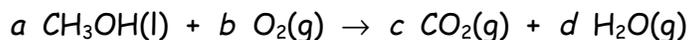
6. [7 points] Which of the following pairs of atoms/ions have the same number of electrons?

- (a) ^{14}C and ^{14}N
- (b) $^{16}\text{O}^{2-}$ and ^{20}Ne
- (c) ^{63}Cu and ^{65}Cu
- (d) $^{39}\text{K}^+$ and $^{39}\text{Mg}^{2+}$
- (e) both (b) and (c)**

7. [7 points] In which of the following substances do the valence electrons have the most freedom to move from atom to atom to atom?

- (a) Metallic substances**
- (b) Ionic substances
- (c) Molecular substances
- (d) Diatomic substances
- (e) Gaseous substances

8. [7 points] Balance the following reaction and determine the coefficients a , b , c , and d . What number do you get when you then sum the coefficients together ($a + b + c + d$)? (Don't forget the 1's if there are any).



- (a) 5
- (b) 4
- (c) 11**
- (d) 9
- (e) None of the above

9. [7 points] What is the oxidation state (oxidation number) of manganese in KMnO_4 ?

- (a) +2**
- (b) +4
- (c) +5
- (d) +6
- (e) +7**

10. [7 points] Which of the following atoms has 17 protons and 20 neutrons?

- (a) ^{37}Cl
- (b) ^{37}Ca
- (c) ^{20}Cl
- (d) ^{37}Tc
- (e) None of the above

11. [7 points] How many oxygen atoms are there in 446 g of magnesium perchlorate?

- (a) 9.63×10^{24} oxygen atoms
- (b) 8 oxygen atoms
- (c) 1.20×10^{24} oxygen atoms
- (d) 4.82×10^{24} oxygen atoms
- (e) None of the above

12. [7 points] What is the empirical formula of a compound that is 57.9% platinum and 42.1% chlorine by mass?

- (a) PtCl_2
- (b) Pt_6Cl_4
- (c) PtCl_3
- (d) Pt_4Cl
- (e) PtCl_4

13. [7 points] Consider the reaction between ethanol ($\text{C}_2\text{H}_5\text{OH}$) and oxygen to form carbon dioxide and water. Write a balanced equation for this reaction and use it to determine the number of CO_2 molecules that are produced in the reaction between 120 O_2 molecules and 45 $\text{C}_2\text{H}_5\text{OH}$ molecules.

- (a) 90 CO_2 molecules are produced
- (b) 120 CO_2 molecules are produced
- (c) 45 CO_2 molecules are produced
- (d) 80 CO_2 molecules are produced
- (e) 170 CO_2 molecules are produced

14. [7 points] What would be the theoretical yield of both CO_2 and H_2O if you reacted 46 g of ethanol ($\text{C}_2\text{H}_5\text{OH}$) with 91 g of oxygen?

- (a) 83 g CO_2 and 51 g of H_2O
- (b) 88 g CO_2 and 54 g of H_2O
- (c) 83 g CO_2 and 54 g of H_2O
- (d) 88 g CO_2 and 51 g of H_2O
- (e) None of the above

15. [7 points] Which of the following solutions contains a weak electrolyte?

- (a) **H₃PO₄ solution**
- (b) HNO₃ solution
- (c) C₂H₅OH (ethanol) solution
- (d) NaNO₃ solution
- (e) KOH solution

16. [7 points] What is the molarity of the solution formed by dissolving 56.0 g of potassium chloride in water to form 325 mL of solution?

- (a) 2.31×10^{-3} M
- (b) **2.31 M**
- (c) 172 M
- (d) 1.72 M
- (e) 3.05 M

17. [7 points] What is the concentration of the solution which results when 85.0 mL of 5.5 M NaCl solution is mixed with 115 mL of 1.5 M NaCl solution?

- (a) 3.5 M
- (b) 7.0 M
- (c) **3.2 M**
- (d) 2.1 M
- (e) None of the above

18. [7 points] Which of the following reactions would you expect to produce a gaseous product?

- (a) **CaCO₃(s) + HCl(aq) →**
- (b) NaOH(aq) + H₃PO₄(aq) →
- (c) Na₂CO₃(aq) + CuCl₂(aq) →
- (d) AgNO₃(aq) + HNO₃(aq) →
- (e) None of the above reactions will produce a gaseous product

19. [7 points] In each of the following instances two solutions are mixed together. Which reaction(s) will lead to the formation of a precipitate?

- (a) potassium carbonate solution + calcium hydroxide solution
- (b) hydrochloric acid solution + strontium hydroxide solution
- (c) calcium nitrate solution + lithium chloride solution
- (d) ammonium chloride solution + lead (II) acetate solution
- (e) None of the above reactions will lead to formation of a precipitate

20. [7 points] Which of the following is an oxidation-reduction reaction?

- (a) $(\text{NH}_4)_2\text{CO}_3(\text{aq}) + \text{CoCl}_2(\text{aq}) \rightarrow \text{CoCO}_3(\text{s}) + 2\text{NH}_4\text{Cl}(\text{aq})$
- (b) $\text{HNO}_3(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{KNO}_3(\text{aq})$
- (c) $\text{AgNO}_3(\text{aq}) + \text{NaCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{NaNO}_3(\text{aq})$
- (d) $\text{Mg}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{H}_2(\text{g}) + \text{MgCl}_2(\text{aq})$
- (e) None of the above reactions are oxidation-reduction

21. [7 points] By studying Cathode rays J.J. Thompson proposed the existence of what subatomic particles?

- (a) protons
- (b) neutrons
- (c) electrons
- (d) alpha particles
- (e) gold atoms

22. [7 points] If you were to mix 50.0 mL of 1.25 M sodium iodide solution with 50.0 mL of 0.75 M lead nitrate solution and separate out the lead (II) iodide precipitate that forms. What ions will be present in the resulting solution?

- (a) NO_3^- , Na^+ and I^-
- (b) Pb^{2+} , Na^+ and I^-
- (c) Pb^{2+} , NO_3^- and I^-
- (d) Pb^{2+} , NO_3^- and Na^+
- (e) NO_3^- and Na^+

23. [7 points] Which of the following reactants will be capable of oxidizing copper metal to Cu^{2+} ions?

- (a) NaCl solution
- (b) HCl solution
- (c) AgNO_3 solution**
- (d) ZnCl_2 solution
- (e) Both (b) HCl and (c) AgNO_3 solutions

24. [7 points] Which of the following represents the balanced net ionic equation for the reaction between chloric acid and ammonia?

- (a) $\text{HCl (aq)} + \text{NH}_3 \text{ (aq)} \rightarrow \text{NH}_4\text{Cl (aq)}$
- (b) $\text{H}^+ \text{ (aq)} + \text{OH}^- \text{ (aq)} \rightarrow \text{H}_2\text{O (l)}$
- (c) $\text{H}^+ \text{ (aq)} + \text{NH}_3 \text{ (aq)} \rightarrow \text{NH}_4^+ \text{ (aq)}$**
- (d) $\text{HClO}_3 \text{ (aq)} + \text{NH}_3 \text{ (aq)} \rightarrow \text{NH}_4\text{ClO}_3 \text{ (aq)}$
- (e) $\text{HClO}_3 \text{ (aq)} + \text{OH}^- \text{ (aq)} \rightarrow \text{H}_2\text{O (l)} + \text{ClO}_3^- \text{ (aq)}$

25. [7 points] What volume of 2.00 M H_2SO_4 solution will be needed to neutralize 87.5 mL of 3.50 M KOH solution?

- (a) 76.6 mL**
- (b) 153 mL
- (c) 306 mL
- (d) 52.5 mL
- (e) None of the above