PLEASE DO NOT WRITE ON THIS TEST PAPER

Arabia Mountain High School	Mole Concept and Stoichiometry
Chemistry	Use a #2 pencil to bubble the correct answer on the scantron.
Version A1 Make sure you write the test version on the scantron	ANSWER KEY ANSWER KEY

1. How many moles is 400.0 g of $Al_2(SO_4)_3$?

Mol = mass/molar mass

Mol = 400.0g/342g/mol = 1.169 mol

2. Which is the percent composition of bromine in the compound NaBr?

% Br = (mass Br/mass NaBr) x 100

% Br = (79.90g/102.88g) x 100 = 77.7%

3. How many molecules are in 3.6 grams of NaCl?

Molecules NaCl = $3.6\text{g NaCl} \times \frac{6.02 \times 10^{23} \text{ NaCl molecules}}{58.43\text{g NaCl}} = 3.7 \times 10^{22}$ molecules

4. How many grams are in 1.946 moles of NaCl?

From Mol = mass/molar mass,

Mass = mol x molar mass

Mass NaCl = 1.946 mol x 58.43 g = 113.7 g

5. For the reaction: P_4 (s) + $5O_2$ (g) → P_4O_{10} (s), if 3 mol of phosphorus react with 10 mol of oxygen, the theoretical yield of phosphorus (V) oxide will be _____.

From P_4,

Mol P_4O_{10} = 3 mol P_4 x $\frac{1 \text{ mol } P_4O_{10}}{1 \text{ mol } P_4}$ = 3 mol P_4O_{10}

From O_2,

Mol P_4O_{10} = 10 mol O_2 x $\frac{1 \text{ mol } P_4O_{10}}{5 \text{ mol } O_2}$ = 2 mol P_4O_{10}

Therefore, O_2 is limiting reactant and the theoretical yield = 2 mol P_4O_{10}

6. How many moles of sulfur will combine with 0.4 moles of carbon to form CS_2?

$C + 2S \rightarrow CS_2$

1 mol 2 mol

Mol S = $0.4\ \text{mol C} \times \frac{2 \text{ mol S}}{1\ \text{mol C}}$ = 0.8 mol S

7. According to this chemical reaction, which is the number of grams of Fe produced from 14 moles of H_2?

Fe_3O_4 (s) + $4H_2$ (g) → 3Fe (s) + $4H_2O$ (l)

4 mol 3(55.845)g

gram Fe = $14\ \text{mol } H_2 \times \frac{167.535 \text{ g Fe}}{4\ \text{mol } H_2}$ = 586g = 5.9×10^2 g Fe

8. Which is the correct mole ratio of K_3PO_4 to KNO_3 in the following chemical reaction?

$$3Mg(NO_3)_2 + 2K_3PO_4 \rightarrow Mg_3(PO_4)_2 + 6KNO_3$$

3 2 1 6

Mol ratio of K_3PO_4 to KNO_3
2: 6 which is 1:3

9. Which is the correct mole ratio for aluminum chloride to chlorine in the following chemical reaction?

$$2AlCl_3 + 3Br_2 \rightarrow 2AlBr_3 + 3Cl_2$$

2 3 2 3

Mole ratio **$AlCl_3$ to Cl_2**
2:3

10. How many moles of KBr will be produced from 7.0 moles of $BaBr_2$?

$$BaBr_2 + K_2SO_4 \rightarrow 2KBr + BaSO_4$$

1 mol 2 mol

Mol KBr = 7.0 ~~mol $BaBr_2$~~ x $\frac{2 \text{ mol KBr}}{1 \text{ ~~mol } BaBr_2}$ = 14 mol

11. How many moles of Al would be produced from 20 moles of Al_2O_3?

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

2 mol 4 mol

Mol Al = 20 ~~mol Al_2O_3~~ x $\frac{4 \text{ mol Al}}{2 \text{ ~~mol } Al_2O_3}$ = 40 mol Al

12. How many moles of Cu are needed to react with 5.8 moles of $AgNO_3$?

$$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$$

1 mol 2 mol

Mol Cu = 5.8 ~~mol $AgNO_3$~~ x $\frac{1 \text{ mol Cu}}{2 \text{ ~~mol } AgNO_3}$ = 2.9 mol Cu

13. Which is the number of moles of carbon dioxide produced from the complete combustion of 5.42 moles of ethanol?

$$C_2H_6O + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

1 mol 2 mol

Mol CO_2 = 5.42 ~~mol C_2H_6O~~ x $\frac{2 \text{ mol } CO_2}{1 \text{ ~~mol } C_2H_6O}$ = 10.8 mol CO_2

14. Which is the correct number of moles of NO that is produced from 13.2 moles of oxygen gas in the presence of excess ammonia?

$$4NH_3\,(g) + 5O_2\,(g) \rightarrow 4NO\,(g) + 6H_2O\,(l)$$

5 mol 4 mol

Mol NO = 13.2 ~~mol O_2~~ x $\frac{4 \text{ mol NO}}{5 \text{ ~~mol } O_2}$ 10.6 mol NO

15. How many grams of water are produced when 2.50 mol oxygen reacts with hydrogen?

$$2H_2 + O_2 \rightarrow 2H_2O$$
$$1\text{mol} \quad 36\ g$$

gram H_2O = 2.50 ~~mol O_2~~ x $\frac{36\ g\ H_2O}{1\ \text{~~mol } O_2\text{~~}}$ = 90.0 g H_2O

Use the information below to answer questions 16 and 17.

Hydrazine, N_2H_4, reacts with dinitrogen tetroxide, N_2O_4, to produce nitrogen gas, N_2 (g), and water vapor, H_2O (g). This reaction has been used to lunch rockets into space. The unbalanced equation is shown below:

$$\_\_\_2N_2H_4(l) + \_\_1N_2O_4(l) \rightarrow \_\_\_3N_2(g) + \_\_\_4H_2O(g)$$

16. When the equation is balanced, the coefficients are ___, ___, ___, ___.

a. 1,1,2,2 b. 2,2,3,4
c. 2,1,3,4 d. 2,1,4,4

17. How many moles of water vapor can be produces from 14.0 moles of N_2H_4?

Mol H_2O = 14 ~~mol N_2H_4~~ x $\frac{4\ \text{mol } H_2O}{2\ \text{~~mol } N_2H_4\text{~~}}$ = 112 mol H_2O

Use the information below to answer questions 18 and 19.

Ammonium nitrate, NH_4NO_3, is an important fertilizer and is also used in the manufacture of explosives and fireworks. It is produced by treating nitric acid, HNO_3, with ammonia gas, NH_3.

$$HNO_3 + NH_3 \rightarrow NH_4NO_3$$
$$1\text{ mol} \quad 1\text{ mol} \quad 1\text{ mol}$$

18. If 14 moles of ammonia gas are used with 16 moles of nitric acid for the reaction, which is the limiting reactant?

Since mol ratio is 1:1:1,

a. 14 mol NH_3 will produce 14 mol NH_4NO_3
b. 16 mol HNO_3 will produce 16 mol NH_4NO_3

Therefore, NH_3 is the limiting reactant since it produces smaller amount of product.

19. How many moles of ammonium nitrate would you make from the ingredients in the problem above?

From #18 above, 14 mol NH_4NO_3 would be produced

20. The equation for the reaction between $FeCl_3$ and NH_4OH is:

$$FeCl_3 + 3NH_4OH \rightarrow Fe(OH)_3 + 3NH_4Cl$$
$$3\text{ mol} \qquad\qquad 160.5\ g$$

According to this equation, how many grams of NH_4Cl would be produced when two moles of NH_4OH reacts completely?

gram NH_4Cl = 2 ~~mol NH_4OH~~ x $\frac{160.5\ g\ NH_4Cl}{3\ \text{~~mol } NH_4OH\text{~~}}$ = 107 g NH_4Cl

21. Examine the following balanced reaction:

$$2AlCl_3 + 3MgSO_4 \rightarrow Al_2(SO_4)_3 + 3MgCl_2$$
$$2\ mol \quad 3\ mol \quad 1\ mol$$

If you have 8 moles of $AlCl_3$ and 9 moles of $MgSO_4$, which is your limiting reactant?

From $AlCl_3$,

mol $Al_2(SO_4)_3$ = 8 ~~mol $AlCl_3$~~ x $\frac{1\ mol\ Al_2(SO_4)_3}{2\ \text{~~mol } AlCl_3\text{~~}}$ = 4 mol $Al_2(SO_4)_3$

From $MgSO_4$,

Mol $Al_2(SO_4)_3$ = 9 ~~mol $MgSO_4$~~ x $\frac{1\ mol\ Al_2(SO_4)_3}{3\ \text{~~mol } MgSO_4\text{~~}}$ = 3 mol $Al_2(SO_4)_3$

Therefore, $MgSO_4$ is limiting reactant since it produced smaller amount of product.

$$CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$$
$$1\ mol \quad 1\ mol \quad 1\ mol$$

22. In the chemical equation above, 3 mol of $CaCO_3$ will decompose into _____.

Since mol ratio is 1:1:1

mol of $CaCO_3$ will produce 3 mol CaO and 3 mol CO_2

23. Determine how many moles of $CaSi_2$ that would react exactly with 12 moles of $SbCl_3$:

$$3CaSi_2 + 2SbCl_3 \rightarrow 6Si + 2Sb + 3CaCl_2$$
$$3\ mol \quad 2\ mol$$

Mol $CaSi_2$ = 12 ~~mol $SbCl_3$~~ x $\frac{3\ mol\ CaSi_2}{2\ \text{~~mol } SbCl_3\text{~~}}$ = 18 mol $CaSi_2$

24. If you are given 4 moles of O_2 and 3 moles of N_2, which substance will be the limiting reactant?

$$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$$
$$1\ mol \quad 2\ mol \quad 2\ mol$$

From O_2,

Mol NO_2 = 4 ~~mol O_2~~ x $\frac{2\ mol\ NO}{2\ \text{~~mol } O_2\text{~~}}$ = 4 mol NO_2

From N_2,

Mol NO_2 = 3 ~~mol N_2~~ x $\frac{2\ mol\ NO_2}{1\ \text{~~mol } N_2\text{~~}}$ = 6 mol NO_2

O_2 is the limiting reactant since it produced smaller amount of NO_2

25. The empirical formula for a compound is CH_2O, and the molar mass is 180.2 g/mol. Which is the molecular formula for this compound?

$(CH_2O)x$ = 180.2 g/mol

$30x = 180.2$

$X = \frac{180.2}{30} = 6$

Therefore, molecular formula = $(CH_2O)6 = C_6H_{12}O_6$