

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.
<u>Version A1</u> Make sure you write the test version on the scantron	ANSWER KEY ANSWER KEY

1. How many moles is 400.0 g of  $\text{Al}_2(\text{SO}_4)_3$ ?

$$\text{Mol} = \text{mass/molar mass}$$

$$\text{Mol} = 400.0\text{g}/342\text{g/mol} = 1.169 \text{ mol}$$

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

$$\% \text{ Br} = (\text{mass Br}/\text{mass NaBr}) \times 100$$

$$\% \text{ Br} = (79.90\text{g}/102.88\text{g}) \times 100 = 77.7\%$$

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

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

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

$$\text{From Mol} = \text{mass/molar mass,}$$

$$\text{Mass} = \text{mol} \times \text{molar mass}$$

$$\text{Mass NaCl} = 1.946 \text{ mol} \times 58.43 \text{ g} = 113.7 \text{ g}$$

5. For the reaction:  $\text{P}_4 (\text{s}) + 5\text{O}_2 (\text{g}) \rightarrow \text{P}_4\text{O}_{10} (\text{s})$ , if 3 mol of phosphorus react with 10 mol of oxygen, the theoretical yield of phosphorus (V) oxide will be \_\_\_\_\_.

From  $\text{P}_4$ ,

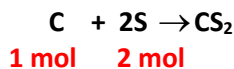
$$\text{Mol P}_4\text{O}_{10} = 3 \text{ mol P}_4 \times \frac{1 \text{ mol P}_4\text{O}_{10}}{1 \text{ mol P}_4} = 3 \text{ mol P}_4\text{O}_{10}$$

From  $\text{O}_2$ ,

$$\text{Mol P}_4\text{O}_{10} = 10 \text{ mol O}_2 \times \frac{1 \text{ mol P}_4\text{O}_{10}}{5 \text{ mol O}_2} = 2 \text{ mol P}_4\text{O}_{10}$$

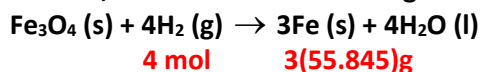
Therefore,  $\text{O}_2$  is limiting reactant and the theoretical yield = 2 mol  $\text{P}_4\text{O}_{10}$

6. How many moles of sulfur will combine with 0.4 moles of carbon to form  $\text{CS}_2$ ?



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

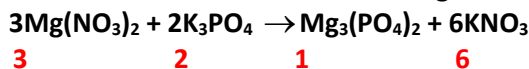
7. According to this chemical reaction, which is the number of grams of Fe produced from 14 moles of  $\text{H}_2$ ?



$$\text{gram Fe} = 14 \text{ mol H}_2 \times \frac{167.535 \text{ g Fe}}{4 \text{ mol H}_2} = 586 \text{ g} = 5.9 \times 10^2 \text{ g Fe}$$

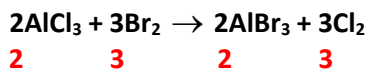
PLEASE DO NOT WRITE ON THIS TEST PAPER

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



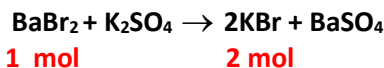
Mol ratio of  $K_3PO_4$  to  $KNO_3$   
2: 6 which is 1:3

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



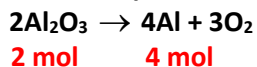
Mole ratio  $AlCl_3$  to  $Cl_2$   
2:3

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



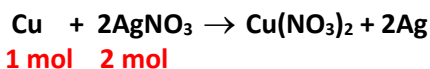
$$\text{Mol KBr} = 7.0 \text{ mol BaBr}_2 \times \frac{2 \text{ mol KBr}}{1 \text{ mol BaBr}_2} = 14 \text{ mol}$$

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



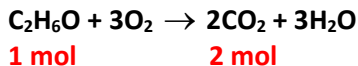
$$\text{Mol Al} = 20 \text{ mol Al}_2\text{O}_3 \times \frac{4 \text{ mol Al}}{2 \text{ mol Al}_2\text{O}_3} = 40 \text{ mol Al}$$

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



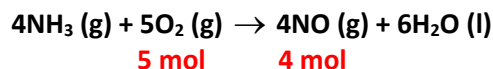
$$\text{Mol Cu} = 5.8 \text{ mol AgNO}_3 \times \frac{1 \text{ mol Cu}}{2 \text{ mol AgNO}_3} = 2.9 \text{ mol Cu}$$

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



$$\text{Mol CO}_2 = 5.42 \text{ mol C}_2\text{H}_6\text{O} \times \frac{2 \text{ mol CO}_2}{1 \text{ mol C}_2\text{H}_6\text{O}} = 10.8 \text{ mol CO}_2$$

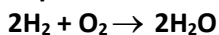
14. Which is the correct number of moles of  $NO$  that is produced from 13.2 moles of oxygen gas in the presence of excess ammonia?



$$\text{Mol NO} = 13.2 \text{ mol O}_2 \times \frac{4 \text{ mol NO}}{5 \text{ mol O}_2} = 10.6 \text{ mol NO}$$

PLEASE DO NOT WRITE ON THIS TEST PAPER

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



1 mol 36 g

$$\text{gram H}_2\text{O} = 2.50 \text{ mol O}_2 \times \frac{36 \text{ g H}_2\text{O}}{1 \text{ mol O}_2} = 90.0 \text{ g H}_2\text{O}$$

Use the information below to answer questions 16 and 17.

Hydrazine,  $\text{N}_2\text{H}_4$ , reacts with dinitrogen tetroxide,  $\text{N}_2\text{O}_4$ , to produce nitrogen gas,  $\text{N}_2$  (g), and water vapor,  $\text{H}_2\text{O}$  (g). This reaction has been used to launch rockets into space. The unbalanced equation is shown below:



16. When the equation is balanced, the coefficients are \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_.

a. 1,1,2,2

b. 2,2,3,4

c. 2,1,3,4

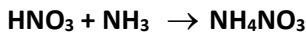
d. 2,1,4,4

17. How many moles of water vapor can be produced from 14.0 moles of  $\text{N}_2\text{H}_4$ ?

$$\text{Mol H}_2\text{O} = 14 \text{ mol N}_2\text{H}_4 \times \frac{4 \text{ mol H}_2\text{O}}{2 \text{ mol N}_2\text{H}_4} = 112 \text{ mol H}_2\text{O}$$

Use the information below to answer questions 18 and 19.

Ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , is an important fertilizer and is also used in the manufacture of explosives and fireworks. It is produced by treating nitric acid,  $\text{HNO}_3$ , with ammonia gas,  $\text{NH}_3$ .



1 mol 1 mol 1 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  $\text{NH}_3$  will produce 14 mol  $\text{NH}_4\text{NO}_3$

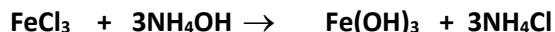
b. 16 mol  $\text{HNO}_3$  will produce 16 mol  $\text{NH}_4\text{NO}_3$

Therefore,  $\text{NH}_3$  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  $\text{NH}_4\text{NO}_3$  would be produced

20. The equation for the reaction between  $\text{FeCl}_3$  and  $\text{NH}_4\text{OH}$  is:



3 mol

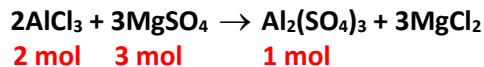
160.5 g

According to this equation, how many grams of  $\text{NH}_4\text{Cl}$  would be produced when two moles of  $\text{NH}_4\text{OH}$  reacts completely?

$$\text{gram NH}_4\text{Cl} = 2 \text{ mol NH}_4\text{OH} \times \frac{160.5 \text{ g NH}_4\text{Cl}}{3 \text{ mol NH}_4\text{OH}} = 107 \text{ g NH}_4\text{Cl}$$

PLEASE DO NOT WRITE ON THIS TEST PAPER

21. Examine the following balanced reaction:



If you have 8 moles of  $\text{AlCl}_3$  and 9 moles of  $\text{MgSO}_4$ , which is your limiting reactant?

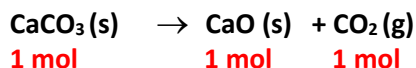
From  $\text{AlCl}_3$ ,

$$\text{mol Al}_2(\text{SO}_4)_3 = 8 \text{ mol AlCl}_3 \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{2 \text{ mol AlCl}_3} = 4 \text{ mol Al}_2(\text{SO}_4)_3$$

From  $\text{MgSO}_4$ ,

$$\text{Mol Al}_2(\text{SO}_4)_3 = 9 \text{ mol MgSO}_4 \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{3 \text{ mol MgSO}_4} = 3 \text{ mol Al}_2(\text{SO}_4)_3$$

Therefore,  $\text{MgSO}_4$  is limiting reactant since it produced smaller amount of product.

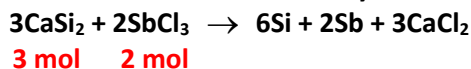


22. In the chemical equation above, 3 mol of  $\text{CaCO}_3$  will decompose into \_\_\_\_\_.

Since mol ratio is 1:1:1

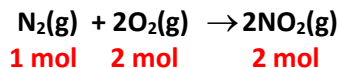
mol of  $\text{CaCO}_3$  will produce 3 mol  $\text{CaO}$  and 3 mol  $\text{CO}_2$

23. Determine how many moles of  $\text{CaSi}_2$  that would react exactly with 12 moles of  $\text{SbCl}_3$ :



$$\text{Mol CaSi}_2 = 12 \text{ mol SbCl}_3 \times \frac{3 \text{ mol CaSi}_2}{2 \text{ mol SbCl}_3} = 18 \text{ mol CaSi}_2$$

24. If you are given 4 moles of  $\text{O}_2$  and 3 moles of  $\text{N}_2$ , which substance will be the limiting reactant?



From  $\text{O}_2$ ,

$$\text{Mol NO}_2 = 4 \text{ mol O}_2 \times \frac{2 \text{ mol NO}_2}{2 \text{ mol O}_2} = 4 \text{ mol NO}_2$$

From  $\text{N}_2$ ,

$$\text{Mol NO}_2 = 3 \text{ mol N}_2 \times \frac{2 \text{ mol NO}_2}{1 \text{ mol N}_2} = 6 \text{ mol NO}_2$$

$\text{O}_2$  is the limiting reactant since it produced smaller amount of  $\text{NO}_2$

25. The empirical formula for a compound is  $\text{CH}_2\text{O}$ , and the molar mass is 180.2 g/mol. Which is the molecular formula for this compound?

$$(\text{CH}_2\text{O})_x = 180.2 \text{ g/mol}$$

$$30x = 180.2$$

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

$$30$$

Therefore, molecular formula =  $(\text{CH}_2\text{O})_6 = \text{C}_6\text{H}_{12}\text{O}_6$