Mole Ratio Worksheet

Mole ratios, conversions, limiting reactant & gas volumes • 15 parts • 150 questions • Answers at the back

Name: _____ Class: _____ Date: _____

What is a mole ratio?

A **mole ratio** compares the number of moles of any two substances in a **balanced** equation. It comes straight from the coefficients.

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

$N_2 : H_2 = 1 : 3$ • $N_2 : NH_3 = 1 : 2$ • $H_2 : NH_3 = 3 : 2$

Example: How many moles of NH_3 form from 6.0 mol H_2? 6.0 mol H_2 × (2 mol NH_3 / 3 mol H_2) = **4.0 mol NH_3**

The mole ratio bridge

Moles of A (given) → × $\frac{\text{coefficient of B}}{\text{coefficient of A}}$ → **Moles of B (wanted)**

What's inside

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Part 1: Reading Mole Ratios

Score: _____ / 10

The mole ratio comes from the coefficients in the balanced equation. A missing coefficient means 1.

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

Write the mole ratio of N_2 to NH_3.

Answer: _____

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

Write the mole ratio of O_2 to H_2O.

Answer: _____

3. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

Write the mole ratio of CH_4 to O_2.

Answer: _____

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

Write the mole ratio of Al to Al_2O_3.

Answer: _____

5. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

Write the mole ratio of $KClO_3$ to O_2.

Answer: _____

6. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

Write the mole ratio of O_2 to CO_2.

Answer: _____

7. $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

Write the mole ratio of Cl_2 to $FeCl_3$.

Answer: _____

8. $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

Write the mole ratio of HCl to H_2.

Answer: _____

9. $P_4 + 5\ O_2 \rightarrow P_4O_{10}$

Write the mole ratio of P_4 to O_2.

Answer: _____

10. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

Write the mole ratio of C_2H_6 to H_2O.

Answer: _____

Part 2: The Complete Mole Ratio

Score: _____ / 10

List the coefficients of every reactant and product, in the order written.

11. $2\ Na + Cl_2 \rightarrow 2\ NaCl$

Write the complete mole ratio for every substance, in order.

Answer: _____

12. $2\ Mg + O_2 \rightarrow 2\ MgO$

Write the complete mole ratio for every substance, in order.

Answer: _____

13. $CaCO_3 \rightarrow CaO + CO_2$

Write the complete mole ratio for every substance, in order.

Answer: _____

14. $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

Write the complete mole ratio for every substance, in order.

Answer: _____

15. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

Write the complete mole ratio for every substance, in order.

Answer: _____

16. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

Write the complete mole ratio for every substance, in order.

Answer: _____

17. $2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$

Write the complete mole ratio for every substance, in order.

Answer: _____

18. $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

Write the complete mole ratio for every substance, in order.

Answer: _____

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

Write the complete mole ratio for every substance, in order.

Answer: _____

20. $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

Write the complete mole ratio for every substance, in order.

Answer: _____

Part 3: Balance First, Then Find the Ratio

Score: _____ / 10

These equations are NOT balanced. Fill in the coefficients first.

21. ___ Fe + ___ O_2 → ___ Fe_2O_3

Balance the equation, then write the mole ratio of Fe to Fe_2O_3.

Answer: _____

22. ___ Na + ___ H_2O → ___ $NaOH$ + ___ H_2

Balance the equation, then write the mole ratio of Na to H_2.

Answer: _____

23. ___ C_2H_4 + ___ O_2 → ___ CO_2 + ___ H_2O

Balance the equation, then write the mole ratio of O_2 to CO_2.

Answer: _____

24. ___ NaN_3 → ___ Na + ___ N_2

Balance the equation, then write the mole ratio of NaN_3 to N_2.

Answer: _____

25. ___ Al + ___ $CuSO_4$ → ___ $Al_2(SO_4)_3$ + ___ Cu

Balance the equation, then write the mole ratio of Al to Cu.

Answer: _____

26. ___ SO_2 + ___ O_2 → ___ SO_3

Balance the equation, then write the mole ratio of O_2 to SO_3.

Answer: _____

27. ___ C_5H_{12} + ___ O_2 → ___ CO_2 + ___ H_2O

Balance the equation, then write the mole ratio of C_5H_{12} to O_2.

Answer: _____

28. ___ Li + ___ N_2 → ___ Li_3N

Balance the equation, then write the mole ratio of Li to N_2.

Answer: _____

29. ___ $NaHCO_3$ → ___ Na_2CO_3 + ___ H_2O + ___ CO_2

Balance the equation, then write the mole ratio of $NaHCO_3$ to CO_2.

Answer: _____

30. ___ C_8H_{18} + ___ O_2 → ___ CO_2 + ___ H_2O

Balance the equation, then write the mole ratio of C_8H_{18} to O_2.

Answer: _____

Part 4: Moles of Reactant to Moles of Product

Score: _____ / 10

moles wanted = moles given × (coefficient wanted ÷ coefficient given)

31. **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
How many moles of NH_3 are produced from 4.00 mol of N_2?

Answer: _____

32. **$2\ H_2 + O_2 \rightarrow 2\ H_2O$**
How many moles of H_2O are produced from 6.00 mol of H_2?

Answer: _____

33. **$2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$**
How many moles of O_2 are produced from 4.00 mol of $KClO_3$?

Answer: _____

34. **$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$**
How many moles of Al_2O_3 are produced from 8.00 mol of Al?

Answer: _____

35. **$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
How many moles of H_2O are produced from 3.00 mol of CH_4?

Answer: _____

36. **$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$**
How many moles of H_2 are produced from 5.00 mol of Mg?

Answer: _____

37. **$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$**
How many moles of CO_2 are produced from 2.00 mol of C_3H_8?

Answer: _____

38. **$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$**
How many moles of Fe are produced from 3.00 mol of Fe_2O_3?

Answer: _____

39. **$2\ Na + Cl_2 \rightarrow 2\ NaCl$**
How many moles of NaCl are produced from 2.50 mol of Cl_2?

Answer: _____

40. **$P_4 + 5\ O_2 \rightarrow P_4O_{10}$**
How many moles of P_4O_{10} are produced from 1.50 mol of P_4?

Answer: _____

Part 5: Moles of Product to Moles of Reactant

Score: _____ / 10

Work backwards: put the substance you want on top of the ratio.

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

How many moles of H_2 are needed to produce 10.0 mol of NH_3?

Answer: _____

42. $2\ H_2 + O_2 \rightarrow 2\ H_2O$

How many moles of O_2 are needed to produce 8.00 mol of H_2O?

Answer: _____

43. $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$

How many moles of Cl_2 are needed to produce 6.00 mol of $AlCl_3$?

Answer: _____

44. $CaCO_3 \rightarrow CaO + CO_2$

How many moles of $CaCO_3$ are needed to produce 2.50 mol of CO_2?

Answer: _____

45. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

How many moles of O_2 are needed to produce 12.0 mol of CO_2?

Answer: _____

46. $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$

How many moles of Fe are needed to produce 5.00 mol of Fe_2O_3?

Answer: _____

47. $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

How many moles of HCl are needed to produce 1.50 mol of H_2?

Answer: _____

48. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

How many moles of $C_6H_{12}O_6$ are needed to produce 18.0 mol of H_2O?

Answer: _____

49. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

How many moles of O_2 are needed to produce 8.00 mol of NO?

Answer: _____

50. $2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$

How many moles of Al are needed to produce 9.00 mol of H_2?

Answer: _____

Part 6: Reactant to Reactant and Product to Product

Score: _____ / 10

The same method works between any two substances in the equation.

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

How many moles of H_2 react with 3.00 mol of N_2?

Answer: _____

52. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

How many moles of CH_4 react with 7.00 mol of O_2?

Answer: _____

53. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

How many moles of O_2 react with 1.20 mol of C_3H_8?

Answer: _____

54. $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

How many moles of Fe_2O_3 react with 9.00 mol of CO?

Answer: _____

55. $2\ Al + Fe_2O_3 \rightarrow Al_2O_3 + 2\ Fe$

How many moles of Fe_2O_3 react with 4.00 mol of Al?

Answer: _____

56. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

How many moles of H_2O are produced along with 6.00 mol of CO_2?

Answer: _____

57. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

How many moles of O_2 are produced along with 4.00 mol of KCl?

Answer: _____

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

How many moles of $Cu(NO_3)_2$ are produced along with 3.00 mol of Ag?

Answer: _____

59. $2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

How many moles of CO_2 are produced along with 2.50 mol of H_2O?

Answer: _____

60. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

How many moles of H_2O are produced along with 8.00 mol of CO_2?

Answer: _____

Part 7: Decimal and Small Amounts

Score: _____ / 10

Give answers to 3 significant figures.

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

How many moles of NH_3 are produced from 0.450 mol of H_2?

Answer: _____

62. $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

How many moles of Al react with 0.0750 mol of O_2?

Answer: _____

63. $2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$

How many moles of O_2 react with 0.250 mol of C_8H_{18}?

Answer: _____

64. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

How many moles of $KClO_3$ are needed to produce 0.0360 mol of O_2?

Answer: _____

65. $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

How many moles of H_2O are produced from 0.125 mol of C_4H_{10}?

Answer: _____

66. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

How many moles of O_2 react with 0.640 mol of NH_3?

Answer: _____

67. $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

How many moles of Cl_2 are needed to produce 0.0820 mol of $FeCl_3$?

Answer: _____

68. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

How many moles of CO_2 are produced from 0.0150 mol of $C_6H_{12}O_6$?

Answer: _____

69. $2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$

How many moles of H_2 are produced from 0.333 mol of Al?

Answer: _____

70. $P_4 + 5\ O_2 \rightarrow P_4O_{10}$

How many moles of P_4 react with 0.725 mol of O_2?

Answer: _____

Part 8: From Word Equations

Score: _____ / 10

Write and balance the equation yourself, then use the mole ratio.

71. Nitrogen (N_2) reacts with hydrogen (H_2) to form ammonia (NH_3). Write the balanced equation. How many moles of NH_3 are produced from 9.00 mol of H_2?

Answer: _____

72. Methane (CH_4) burns in oxygen (O_2) to form carbon dioxide (CO_2) and water (H_2O). Write the balanced equation. How many moles of O_2 react with 2.50 mol of CH_4?

Answer: _____

73. Sodium (Na) reacts with chlorine (Cl_2) to form sodium chloride (NaCl). Write the balanced equation. How many moles of Cl_2 react with 6.00 mol of Na?

Answer: _____

74. Iron (Fe) reacts with oxygen (O_2) to form iron(III) oxide (Fe_2O_3). Write the balanced equation. How many moles of O_2 react with 8.00 mol of Fe?

Answer: _____

75. Hydrogen peroxide (H_2O_2) decomposes into water (H_2O) and oxygen (O_2). Write the balanced equation. How many moles of O_2 are produced from 5.00 mol of H_2O_2?

Answer: _____

76. Aluminium (Al) reacts with chlorine (Cl_2) to form aluminium chloride ($AlCl_3$). Write the balanced equation. How many moles of $AlCl_3$ are produced from 4.50 mol of Cl_2?

Answer: _____

77. Propane (C_3H_8) burns in oxygen to form carbon dioxide and water. Write the balanced equation. How many moles of H_2O are produced from 1.50 mol of C_3H_8?

Answer: _____

78. Calcium (Ca) reacts with water to form calcium hydroxide ($Ca(OH)_2$) and hydrogen (H_2). Write the balanced equation. How many moles of H_2 are produced from 3.00 mol of H_2O?

Answer: _____

79. Sulfur dioxide (SO_2) reacts with oxygen to form sulfur trioxide (SO_3). Write the balanced equation. How many moles of SO_3 are produced from 2.25 mol of O_2?

Answer: _____

80. Glucose ($C_6H_{12}O_6$) ferments to ethanol (C_2H_5OH) and carbon dioxide. Write the balanced equation. How many moles of C_2H_5OH are produced from 0.500 mol of $C_6H_{12}O_6$?

Answer: _____

Part 9: Moles of Every Product

Score: _____ / 10

Use a separate mole ratio for each product.

81. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

2.00 mol of CH_4 reacts completely. How many moles of each product form?

Answer: _____

82. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

1.50 mol of C_3H_8 reacts completely. How many moles of each product form?

Answer: _____

83. $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

6.00 mol of $KClO_3$ reacts completely. How many moles of each product form?

Answer: _____

84. $2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

4.00 mol of $NaHCO_3$ reacts completely. How many moles of each product form?

Answer: _____

85. $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

2.50 mol of Fe_2O_3 reacts completely. How many moles of each product form?

Answer: _____

86. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

3.00 mol of C_2H_6 reacts completely. How many moles of each product form?

Answer: _____

87. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

8.00 mol of NH_3 reacts completely. How many moles of each product form?

Answer: _____

88. $2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$

4.00 mol of Al reacts completely. How many moles of each product form?

Answer: _____

89. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

0.500 mol of $C_6H_{12}O_6$ reacts completely. How many moles of each product form?

Answer: _____

90. $3\ Cu + 8\ HNO_3 \rightarrow 3\ Cu(NO_3)_2 + 2\ NO + 4\ H_2O$

1.50 mol of Cu reacts completely. How many moles of each product form?

Answer: _____

Part 10: Moles of Every Reactant Needed

Score: _____ / 10

Work backwards from the product to each reactant.

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

How many moles of each reactant are needed to produce 6.00 mol of NH_3?

Answer: _____

92. $2\ H_2 + O_2 \rightarrow 2\ H_2O$

How many moles of each reactant are needed to produce 5.00 mol of H_2O?

Answer: _____

93. $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

How many moles of each reactant are needed to produce 3.00 mol of Al_2O_3?

Answer: _____

94. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

How many moles of each reactant are needed to produce 4.00 mol of CO_2?

Answer: _____

95. $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

How many moles of each reactant are needed to produce 10.0 mol of Fe?

Answer: _____

96. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

How many moles of each reactant are needed to produce 8.00 mol of H_2O?

Answer: _____

97. $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$

How many moles of each reactant are needed to produce 2.50 mol of $ZnCl_2$?

Answer: _____

98. $2\ Al + Fe_2O_3 \rightarrow Al_2O_3 + 2\ Fe$

How many moles of each reactant are needed to produce 6.00 mol of Fe?

Answer: _____

99. $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

How many moles of each reactant are needed to produce 9.00 mol of H_2O?

Answer: _____

100. $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

How many moles of each reactant are needed to produce 5.00 mol of CO_2?

Answer: _____

Part 11: Limiting Reactant (Moles Only)

Score: _____ / 10

Divide each reactant's moles by its coefficient. The smaller result is the limiting reactant.

101. **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
2.00 mol N_2 reacts with 4.50 mol H_2. Find the limiting reactant and moles of NH_3 formed.
Answer: _____

102. **$2\ H_2 + O_2 \rightarrow 2\ H_2O$**
5.00 mol H_2 reacts with 3.00 mol O_2. Find the limiting reactant and moles of H_2O formed.
Answer: _____

103. **$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$**
4.00 mol Al reacts with 2.00 mol O_2. Find the limiting reactant and moles of Al_2O_3 formed.
Answer: _____

104. **$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
3.00 mol CH_4 reacts with 5.00 mol O_2. Find the limiting reactant and moles of CO_2 formed.
Answer: _____

105. **$2\ Na + Cl_2 \rightarrow 2\ NaCl$**
6.00 mol Na reacts with 4.00 mol Cl_2. Find the limiting reactant and moles of NaCl formed.
Answer: _____

106. **$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$**
2.00 mol Fe_2O_3 reacts with 4.50 mol CO. Find the limiting reactant and moles of Fe formed.
Answer: _____

107. **$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$**
1.00 mol C_3H_8 reacts with 6.00 mol O_2. Find the limiting reactant and moles of H_2O formed.
Answer: _____

108. **$Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$**
2.50 mol Zn reacts with 4.00 mol HCl. Find the limiting reactant and moles of H_2 formed.
Answer: _____

109. **$2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$**
3.00 mol Al reacts with 3.90 mol Cl_2. Find the limiting reactant and moles of $AlCl_3$ formed.
Answer: _____

110. **$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$**
4.00 mol NH_3 reacts with 4.00 mol O_2. Find the limiting reactant and moles of NO formed.
Answer: _____

Part 12: Excess Reactant Left Over

Score: _____ / 10

Excess left = moles of excess at the start – moles used by the limiting reactant.

111. **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
3.00 mol N_2 reacts with 6.00 mol H_2. Find the excess reactant and moles left over.

Answer: _____

112. **$2\ H_2 + O_2 \rightarrow 2\ H_2O$**
4.00 mol H_2 reacts with 3.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

113. **$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
2.00 mol CH_4 reacts with 6.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

114. **$2\ Mg + O_2 \rightarrow 2\ MgO$**
5.00 mol Mg reacts with 4.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

115. **$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$**
6.00 mol Al reacts with 3.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

116. **$2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$**
2.00 mol C_2H_6 reacts with 10.0 mol O_2. Find the excess reactant and moles left over.

Answer: _____

117. **$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$**
4.00 mol Fe reacts with 4.50 mol Cl_2. Find the excess reactant and moles left over.

Answer: _____

118. **$2\ SO_2 + O_2 \rightarrow 2\ SO_3$**
5.00 mol SO_2 reacts with 4.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

119. **$Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$**
3.00 mol Zn reacts with 4.00 mol HCl. Find the excess reactant and moles left over.

Answer: _____

120. **$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$**
2.00 mol C_3H_8 reacts with 8.00 mol O_2. Find the excess reactant and moles left over.

Answer: _____

Part 13: Starting from Grams

Score: _____ / 10

Change grams to moles first (moles = mass ÷ molar mass), then use the mole ratio.

121. **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
56.0 g of N_2 (M = 28.02 g/mol) reacts. Moles of NH_3 formed?
Answer: _____

122. **$2\ H_2 + O_2 \rightarrow 2\ H_2O$**
64.0 g of O_2 (M = 32.00 g/mol) reacts. Moles of H_2O formed?
Answer: _____

123. **$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
32.0 g of CH_4 (M = 16.05 g/mol) reacts. Moles of O_2 needed?
Answer: _____

124. **$CaCO_3 \rightarrow CaO + CO_2$**
50.0 g of $CaCO_3$ (M = 100.09 g/mol) reacts. Moles of CO_2 formed?
Answer: _____

125. **$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$**
27.0 g of Al (M = 26.98 g/mol) reacts. Moles of Al_2O_3 formed?
Answer: _____

126. **$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$**
12.2 g of Mg (M = 24.31 g/mol) reacts. Moles of H_2 formed?
Answer: _____

127. **$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$**
80.0 g of Fe_2O_3 (M = 159.70 g/mol) reacts. Moles of Fe formed?
Answer: _____

128. **$2\ Na + Cl_2 \rightarrow 2\ NaCl$**
46.0 g of Na (M = 22.99 g/mol) reacts. Moles of NaCl formed?
Answer: _____

129. **$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$**
22.0 g of C_3H_8 (M = 44.11 g/mol) reacts. Moles of O_2 needed?
Answer: _____

130. **$Cu + 2\ AgNO_3 \rightarrow Cu(NO_3)_2 + 2\ Ag$**
31.8 g of Cu (M = 63.55 g/mol) reacts. Moles of Ag formed?
Answer: _____

Part 14: Gas Volume Ratios

Score: _____ / 10

All gases are at the same temperature and pressure, so the volume ratio equals the mole ratio (Avogadro's law).

131. **$N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
What volume of NH_3 is produced from 10.0 L of N_2?
Answer: _____

132. **$2\ H_2 + O_2 \rightarrow 2\ H_2O$**
What volume of O_2 react with 50.0 L of H_2?
Answer: _____

133. **$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
What volume of O_2 react with 15.0 L of CH_4?
Answer: _____

134. **$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$**
What volume of CO_2 is produced from 4.00 L of C_3H_8?
Answer: _____

135. **$2\ SO_2 + O_2 \rightarrow 2\ SO_3$**
What volume of O_2 react with 30.0 L of SO_2?
Answer: _____

136. **$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$**
What volume of O_2 react with 20.0 L of NH_3?
Answer: _____

137. **$2\ CO + O_2 \rightarrow 2\ CO_2$**
What volume of CO react with 12.5 L of O_2?
Answer: _____

138. **$H_2 + Cl_2 \rightarrow 2\ HCl$**
What volume of HCl is produced from 8.00 L of H_2?
Answer: _____

139. **$2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$**
What volume of O_2 react with 6.00 L of C_2H_6?
Answer: _____

140. **$N_2 + 2\ O_2 \rightarrow 2\ NO_2$**
What volume of O_2 is needed to produce 24.0 L of NO_2?
Answer: _____

Part 15: Challenge Problems

Score: _____ / 10

Questions 141–145: find the ratio from experimental data. Questions 146–150: chain the mole ratios of two reactions.

141. **$N_2 + H_2 \rightarrow NH_3$** (not balanced)
Data: 0.250 mol N_2, 0.750 mol H_2, 0.500 mol NH_3. Find the whole-number ratio and balanced equation.

Answer: _____

142. **$Al + O_2 \rightarrow Al_2O_3$** (not balanced)
Data: 0.400 mol Al, 0.300 mol O_2, 0.200 mol Al_2O_3. Find the whole-number ratio and balanced equation.

Answer: _____

143. **$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$** (not balanced)
Data: 0.150 mol C_3H_8, 0.750 mol O_2, 0.450 mol CO_2, 0.600 mol H_2O. Find the whole-number ratio and balanced equation.

Answer: _____

144. **$KClO_3 \rightarrow KCl + O_2$** (not balanced)
Data: 0.400 mol $KClO_3$, 0.400 mol KCl, 0.600 mol O_2. Find the whole-number ratio and balanced equation.

Answer: _____

145. **$Fe_2O_3 + CO \rightarrow Fe + CO_2$** (not balanced)
Data: 0.125 mol Fe_2O_3, 0.375 mol CO, 0.250 mol Fe, 0.375 mol CO_2. Find the whole-number ratio and balanced equation.

Answer: _____

146. **Step 1: $N_2 + 3\ H_2 \rightarrow 2\ NH_3$**
Step 2: $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$
Starting with 2.00 mol of N_2, how many moles of NO form?

Answer: _____

147. **Step 1: $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$**
Step 2: $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$
Starting with 1.50 mol of CH_4, how many moles of $CaCO_3$ form?

Answer: _____

148. **Step 1: $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$**
Step 2: $2\ Mg + O_2 \rightarrow 2\ MgO$
Starting with 0.400 mol of $KClO_3$, how many moles of MgO form?

Answer: _____

149. **Step 1: $2\ C + O_2 \rightarrow 2\ CO$**
Step 2: $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$
Starting with 6.00 mol of C, how many moles of Fe form?

Answer: _____

150. **Step 1: $S + O_2 \rightarrow SO_2$**
Step 2: $2\ SO_2 + O_2 \rightarrow 2\ SO_3$
Starting with 2.50 mol of S, how many moles of SO_3 form?

Answer: _____

Answer Key

Final answers in green, with working. Answers are given to 3 significant figures.

Part 1: Reading Mole Ratios

1. **1 : 2** (1 mol N_2 : 2 mol NH_3)
2. **1 : 2** (1 mol O_2 : 2 mol H_2O)
3. **1 : 2** (1 mol CH_4 : 2 mol O_2)
4. **4 : 2** (4 mol Al : 2 mol Al_2O_3)
5. **2 : 3** (2 mol $KClO_3$: 3 mol O_2)
6. **5 : 3** (5 mol O_2 : 3 mol CO_2)
7. **3 : 2** (3 mol Cl_2 : 2 mol $FeCl_3$)
8. **2 : 1** (2 mol HCl : 1 mol H_2)
9. **1 : 5** (1 mol P_4 : 5 mol O_2)
10. **2 : 6** (2 mol C_2H_6 : 6 mol H_2O)

Part 2: The Complete Mole Ratio

11. Na : Cl_2 : NaCl = **2 : 1 : 2**
12. Mg : O_2 : MgO = **2 : 1 : 2**
13. $CaCO_3$: CaO : CO_2 = **1 : 1 : 1**
14. Fe_2O_3 : CO : Fe : CO_2 = **1 : 3 : 2 : 3**
15. $C_6H_{12}O_6$: O_2 : CO_2 : H_2O = **1 : 6 : 6 : 6**
16. NH_3 : O_2 : NO : H_2O = **4 : 5 : 4 : 6**
17. Al : HCl : $AlCl_3$: H_2 = **2 : 6 : 2 : 3**
18. C_4H_{10} : O_2 : CO_2 : H_2O = **2 : 13 : 8 : 10**
19. Cu : $AgNO_3$: $Cu(NO_3)_2$: Ag = **1 : 2 : 1 : 2**
20. H_2O_2 : H_2O : O_2 = **2 : 2 : 1**

Part 3: Balance First, Then Find the Ratio

21. $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$; ratio **4 : 2**
22. $2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$; ratio **2 : 1**
23. $C_2H_4 + 3\ O_2 \rightarrow 2\ CO_2 + 2\ H_2O$; ratio **3 : 2**
24. $2\ NaN_3 \rightarrow 2\ Na + 3\ N_2$; ratio **2 : 3**
25. $2\ Al + 3\ CuSO_4 \rightarrow Al_2(SO_4)_3 + 3\ Cu$; ratio **2 : 3**
26. $2\ SO_2 + O_2 \rightarrow 2\ SO_3$; ratio **1 : 2**
27. $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$; ratio **1 : 8**
28. $6\ Li + N_2 \rightarrow 2\ Li_3N$; ratio **6 : 1**
29. $2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$; ratio **2 : 1**
30. $2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$; ratio **2 : 25**

Part 4: Moles of Reactant to Moles of Product

31. 4.00 mol N_2 × (2 mol NH_3 / 1 mol N_2) → **8.00 mol NH_3**

32. 6.00 mol H_2 × (2 mol H_2O / 2 mol H_2) → **6.00 mol H_2O**

33. 4.00 mol $KClO_3$ × (3 mol O_2 / 2 mol $KClO_3$) → **6.00 mol O_2**

34. 8.00 mol Al × (2 mol Al_2O_3 / 4 mol Al) → **4.00 mol Al_2O_3**

35. 3.00 mol CH_4 × (2 mol H_2O / 1 mol CH_4) → **6.00 mol H_2O**

36. 5.00 mol Mg × (1 mol H_2 / 1 mol Mg) → **5.00 mol H_2**

37. 2.00 mol C_3H_8 × (3 mol CO_2 / 1 mol C_3H_8) → **6.00 mol CO_2**

38. 3.00 mol Fe_2O_3 × (2 mol Fe / 1 mol Fe_2O_3) → **6.00 mol Fe**

39. 2.50 mol Cl_2 × (2 mol NaCl / 1 mol Cl_2) → **5.00 mol NaCl**

40. 1.50 mol P_4 × (1 mol P_4O_{10} / 1 mol P_4) → **1.50 mol P_4O_{10}**

Part 5: Moles of Product to Moles of Reactant

41. 10.0 mol NH_3 × (3 mol H_2 / 2 mol NH_3) → **15.0 mol H_2**

42. 8.00 mol H_2O × (1 mol O_2 / 2 mol H_2O) → **4.00 mol O_2**

43. 6.00 mol $AlCl_3$ × (3 mol Cl_2 / 2 mol $AlCl_3$) → **9.00 mol Cl_2**

44. 2.50 mol CO_2 × (1 mol $CaCO_3$ / 1 mol CO_2) → **2.50 mol $CaCO_3$**

45. 12.0 mol CO_2 × (7 mol O_2 / 4 mol CO_2) → **21.0 mol O_2**

46. 5.00 mol Fe_2O_3 × (4 mol Fe / 2 mol Fe_2O_3) → **10.0 mol Fe**

47. 1.50 mol H_2 × (2 mol HCl / 1 mol H_2) → **3.00 mol HCl**

48. 18.0 mol H_2O × (1 mol $C_6H_{12}O_6$ / 6 mol H_2O) → **3.00 mol $C_6H_{12}O_6$**

49. 8.00 mol NO × (5 mol O_2 / 4 mol NO) → **10.0 mol O_2**

50. 9.00 mol H_2 × (2 mol Al / 3 mol H_2) → **6.00 mol Al**

Part 6: Reactant to Reactant and Product to Product

51. 3.00 mol N_2 × (3 mol H_2 / 1 mol N_2) → **9.00 mol H_2**

52. 7.00 mol O_2 × (1 mol CH_4 / 2 mol O_2) → **3.50 mol CH_4**

53. 1.20 mol C_3H_8 × (5 mol O_2 / 1 mol C_3H_8) → **6.00 mol O_2**

54. 9.00 mol CO × (1 mol Fe_2O_3 / 3 mol CO) → **3.00 mol Fe_2O_3**

55. 4.00 mol Al × (1 mol Fe_2O_3 / 2 mol Al) → **2.00 mol Fe_2O_3**

56. 6.00 mol CO_2 × (4 mol H_2O / 3 mol CO_2) → **8.00 mol H_2O**

57. 4.00 mol KCl × (3 mol O_2 / 2 mol KCl) → **6.00 mol O_2**

58. 3.00 mol Ag × (1 mol $Cu(NO_3)_2$ / 2 mol Ag) → **1.50 mol $Cu(NO_3)_2$**

59. 2.50 mol H_2O × (1 mol CO_2 / 1 mol H_2O) → **2.50 mol CO_2**

60. 8.00 mol CO_2 × (6 mol H_2O / 4 mol CO_2) → **12.0 mol H_2O**

Part 7: Decimal and Small Amounts

61. 0.450 mol H_2 × (2 mol NH_3 / 3 mol H_2) → **0.300 mol NH_3**

62. 0.0750 mol O_2 × (4 mol Al / 3 mol O_2) → **0.100 mol Al**

63. 0.250 mol C_8H_{18} × (25 mol O_2 / 2 mol C_8H_{18}) → **3.12 mol O_2**

64. 0.0360 mol O_2 × (2 mol $KClO_3$ / 3 mol O_2) → **0.0240 mol $KClO_3$**

65. 0.125 mol C_4H_{10} × (10 mol H_2O / 2 mol C_4H_{10}) → **0.625 mol H_2O**

66. 0.640 mol NH_3 × (5 mol O_2 / 4 mol NH_3) → **0.800 mol O_2**

67. 0.0820 mol $FeCl_3$ × (3 mol Cl_2 / 2 mol $FeCl_3$) → **0.123 mol Cl_2**

68. 0.0150 mol $C_6H_{12}O_6$ × (6 mol CO_2 / 1 mol $C_6H_{12}O_6$) → **0.0900 mol CO_2**

69. 0.333 mol Al × (3 mol H_2 / 2 mol Al) → **0.499 mol H_2**

70. 0.725 mol O_2 × (1 mol P_4 / 5 mol O_2) → **0.145 mol P_4**

Part 8: From Word Equations

71. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$; 9.00 mol H_2 × (2 mol NH_3 / 3 mol H_2) → **6.00 mol NH_3**

72. $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$; 2.50 mol CH_4 × (2 mol O_2 / 1 mol CH_4) → **5.00 mol O_2**

73. $2\ Na + Cl_2 \rightarrow 2\ NaCl$; 6.00 mol Na × (1 mol Cl_2 / 2 mol Na) → **3.00 mol Cl_2**

74. $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$; 8.00 mol Fe × (3 mol O_2 / 4 mol Fe) → **6.00 mol O_2**

75. $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$; 5.00 mol H_2O_2 × (1 mol O_2 / 2 mol H_2O_2) → **2.50 mol O_2**

76. $2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$; 4.50 mol Cl_2 × (2 mol $AlCl_3$ / 3 mol Cl_2) → **3.00 mol $AlCl_3$**

77. $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$; 1.50 mol C_3H_8 × (4 mol H_2O / 1 mol C_3H_8) → **6.00 mol H_2O**

78. $Ca + 2\ H_2O \rightarrow Ca(OH)_2 + H_2$; 3.00 mol H_2O × (1 mol H_2 / 2 mol H_2O) → **1.50 mol H_2**

79. $2\ SO_2 + O_2 \rightarrow 2\ SO_3$; 2.25 mol O_2 × (2 mol SO_3 / 1 mol O_2) → **4.50 mol SO_3**

80. $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$; 0.500 mol $C_6H_{12}O_6$ × (2 mol C_2H_5OH / 1 mol $C_6H_{12}O_6$) → **1.00 mol C_2H_5OH**

Part 9: Moles of Every Product

81. CO_2 **2.00 mol**; H_2O **4.00 mol**

82. CO_2 **4.50 mol**; H_2O **6.00 mol**

83. KCl **6.00 mol**; O_2 **9.00 mol**

84. Na_2CO_3 **2.00 mol**; H_2O **2.00 mol**; CO_2 **2.00 mol**

85. Fe **5.00 mol**; CO_2 **7.50 mol**

86. CO_2 **6.00 mol**; H_2O **9.00 mol**

87. NO **8.00 mol**; H_2O **12.0 mol**

88. $AlCl_3$ **4.00 mol**; H_2 **6.00 mol**

89. CO_2 **3.00 mol**; H_2O **3.00 mol**

90. $Cu(NO_3)_2$ **1.50 mol**; NO **1.00 mol**; H_2O **2.00 mol**

Part 10: Moles of Every Reactant Needed

91. N_2 **3.00 mol**; H_2 **9.00 mol**

92. H_2 **5.00 mol**; O_2 **2.50 mol**

93. Al **6.00 mol**; O_2 **4.50 mol**

94. CH_4 **4.00 mol**; O_2 **8.00 mol**

95. Fe_2O_3 **5.00 mol**; CO **15.0 mol**

96. C_3H_8 **2.00 mol**; O_2 **10.0 mol**

97. Zn **2.50 mol**; HCl **5.00 mol**

98. Al **6.00 mol**; Fe_2O_3 **3.00 mol**

99. NH_3 **6.00 mol**; O_2 **7.50 mol**

100. C_2H_6 **2.50 mol**; O_2 **8.75 mol**

Part 11: Limiting Reactant (Moles Only)

101. H_2 needs only 1.50 mol N_2 (have 2.00) → limiting **H_2**; NH_3 = **3.00 mol**

102. H_2 needs only 2.50 mol O_2 (have 3.00) → limiting **H_2**; H_2O = **5.00 mol**

103. O_2 needs only 2.67 mol Al (have 4.00) → limiting **O_2**; Al_2O_3 = **1.33 mol**

104. O_2 needs only 2.50 mol CH_4 (have 3.00) → limiting **O_2**; CO_2 = **2.50 mol**

105. Na needs only 3.00 mol Cl_2 (have 4.00) → limiting **Na**; NaCl = **6.00 mol**

106. CO needs only 1.50 mol Fe_2O_3 (have 2.00) → limiting **CO**; Fe = **3.00 mol**

107. C_3H_8 needs only 5.00 mol O_2 (have 6.00) → limiting **C_3H_8**; H_2O = **4.00 mol**

108. HCl needs only 2.00 mol Zn (have 2.50) → limiting **HCl**; H_2 = **2.00 mol**

109. Cl_2 needs only 2.60 mol Al (have 3.00) → limiting **Cl_2**; $AlCl_3$ = **2.60 mol**

110. O_2 needs only 3.20 mol NH_3 (have 4.00) → limiting **O_2**; NO = **3.20 mol**

Part 12: Excess Reactant Left Over

111. limiting H_2; N_2 used = 6.00 × (1/3) = 2.00 mol → **N_2 in excess, 1.00 mol left**

112. limiting H_2; O_2 used = 4.00 × (1/2) = 2.00 mol → **O_2 in excess, 1.00 mol left**

113. limiting CH_4; O_2 used = 2.00 × (2/1) = 4.00 mol → **O_2 in excess, 2.00 mol left**

114. limiting Mg; O_2 used = 5.00 × (1/2) = 2.50 mol → **O_2 in excess, 1.50 mol left**

115. limiting O_2; Al used = 3.00 × (4/3) = 4.00 mol → **Al in excess, 2.00 mol left**

116. limiting C_2H_6; O_2 used = 2.00 × (7/2) = 7.00 mol → **O_2 in excess, 3.00 mol left**

117. limiting Cl_2; Fe used = 4.50 × (2/3) = 3.00 mol → **Fe in excess, 1.00 mol left**

118. limiting SO_2; O_2 used = 5.00 × (1/2) = 2.50 mol → **O_2 in excess, 1.50 mol left**

119. limiting HCl; Zn used = 4.00 × (1/2) = 2.00 mol → **Zn in excess, 1.00 mol left**

120. limiting O_2; C_3H_8 used = 8.00 × (1/5) = 1.60 mol → **C_3H_8 in excess, 0.400 mol left**

Part 13: Starting from Grams

121. 56.0 ÷ 28.02 = 1.999 mol × (2/1) → **4.00 mol NH_3**

122. 64.0 ÷ 32.00 = 2.000 mol × (2/1) → **4.00 mol H_2O**

123. 32.0 ÷ 16.05 = 1.994 mol × (2/1) → **3.99 mol O_2**

124. 50.0 ÷ 100.09 = 0.4996 mol × (1/1) → **0.500 mol CO_2**

125. 27.0 ÷ 26.98 = 1.001 mol × (2/4) → **0.500 mol Al_2O_3**

126. 12.2 ÷ 24.31 = 0.5019 mol × (1/1) → **0.502 mol H_2**

127. 80.0 ÷ 159.70 = 0.5009 mol × (2/1) → **1.00 mol Fe**

128. 46.0 ÷ 22.99 = 2.001 mol × (2/2) → **2.00 mol NaCl**

129. 22.0 ÷ 44.11 = 0.4988 mol × (5/1) → **2.49 mol O_2**

130. 31.8 ÷ 63.55 = 0.5004 mol × (2/1) → **1.00 mol Ag**

Part 14: Gas Volume Ratios

131. volume ratio = mole ratio: 10.0 × (2/1) → **20.0 L NH_3**

132. volume ratio = mole ratio: 50.0 × (1/2) → **25.0 L O_2**

133. volume ratio = mole ratio: 15.0 × (2/1) → **30.0 L O_2**

134. volume ratio = mole ratio: 4.00 × (3/1) → **12.0 L CO_2**

135. volume ratio = mole ratio: 30.0 × (1/2) → **15.0 L O_2**

136. volume ratio = mole ratio: 20.0 × (5/4) → **25.0 L O_2**

137. volume ratio = mole ratio: 12.5 × (2/1) → **25.0 L CO**

138. volume ratio = mole ratio: 8.00 × (2/1) → **16.0 L HCl**

139. volume ratio = mole ratio: 6.00 × (7/2) → **21.0 L O_2**

140. volume ratio = mole ratio: 24.0 × (2/2) → **24.0 L O_2**

Part 15: Challenge Problems

141. divide by the smallest → N_2 : H_2 : NH_3 = **1 : 3 : 2** → $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

142. divide by the smallest → Al : O_2 : Al_2O_3 = **4 : 3 : 2** → $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

143. divide by the smallest → C_3H_8 : O_2 : CO_2 : H_2O = **1 : 5 : 3 : 4** → $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

144. divide by the smallest → $KClO_3$: KCl : O_2 = **2 : 2 : 3** → $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$

145. divide by the smallest → Fe_2O_3 : CO : Fe : CO_2 = **1 : 3 : 2 : 3** → $Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

146. 2.00 mol N_2 × (2/1) = 4.00 mol NH_3 × (4/4) → **4.00 mol NO**

147. 1.50 mol CH_4 × (1/1) = 1.50 mol CO_2 × (1/1) → **1.50 mol $CaCO_3$**

148. 0.400 mol $KClO_3$ × (3/2) = 0.600 mol O_2 × (2/1) → **1.20 mol MgO**

149. 6.00 mol C × (2/2) = 6.00 mol CO × (2/3) → **4.00 mol Fe**

150. 2.50 mol S × (1/1) = 2.50 mol SO_2 × (2/2) → **2.50 mol SO_3**

Notes: 15 Key Points to Remember

01	**Balance first** A mole ratio is only correct if the equation is balanced. Always check the coefficients before you use them.
02	**Coefficients, not subscripts** The ratio uses the big numbers in front of formulas. Subscripts (the small numbers) are never part of a mole ratio.
03	**A missing coefficient is 1** In $N_2 + 3H_2 \rightarrow 2NH_3$, N_2 has a coefficient of 1, so $N_2 : NH_3 = 1 : 2$.
04	**Ratios work in both directions** 1 mol N_2 : 3 mol H_2 can be written as 1/3 or 3/1. Choose the version that cancels the units you start with.
05	**Wanted on top** Write the ratio as (moles of substance wanted) ÷ (moles of substance given). The given substance's units then cancel.
06	**Any two substances** You can compare any two substances: reactant to product, product to reactant, reactant to reactant or product to product.
07	**Moles, not grams** Mole ratios compare moles. 1 : 3 does not mean 1 g : 3 g. Change grams to moles before using a mole ratio.
08	**Gas volumes follow mole ratios** At the same temperature and pressure, equal volumes of gases contain equal numbers of moles, so volume ratios equal mole ratios.
09	**Limiting reactant** Divide each reactant's moles by its coefficient. The smallest result is the limiting reactant, and it decides how much product forms.
10	**Excess left over** Moles of excess left = moles of excess at the start – moles used, where moles used comes from the limiting reactant and the ratio.
11	**Finding a ratio from data** Divide all mole amounts by the smallest one. If you get .5 or .33, multiply all values by 2 or 3 to reach whole numbers.
12	**Chains of reactions** When one product becomes the next reactant, multiply the mole ratios of each step in order.
13	**Show units at every step** Write “mol A” and “mol B” on every number. If the units do not cancel, the ratio is upside down.
14	**Check that the answer is sensible** If the coefficient of the wanted substance is bigger, its moles should be bigger too, and vice versa.
15	**Significant figures** Coefficients are exact numbers. Round your answer to the same number of significant figures as the moles you were given.