4.7-4.57, 4.59

PART A:

$$\frac{2\ \text{mol}\ H_2}{1\ \text{mol}\ O_2},\ \frac{2\ \text{mol}\ H_2}{2\ \text{mol}\ H_2O},\ \frac{1\ \text{mol}\ O_2}{2\ \text{mol}\ H_2O},\ \frac{1\ \text{mol}\ O_2}{2\ \text{mol}\ H_2},\ \frac{2\ \text{mol}\ H_2O}{2\ \text{mol}\ H_2},\ \text{and}\ \frac{2\ \text{mol}\ H_2O}{1\ \text{mol}\ O_2}$$

PART B:

$$\frac{2\ \text{mol}\ H_2O_2}{2\ \text{mol}\ H_2O},\ \frac{2\ \text{mol}\ H_2O_2}{1\ \text{mol}\ O_2},\ \frac{2\ \text{mol}\ H_2O}{1\ \text{mol}\ O_2},\ \frac{2\ \text{mol}\ H_2O}{2\ \text{mol}\ H_2O_2},\ \frac{1\ \text{mol}\ O_2}{2\ \text{mol}\ H_2O_2},\ \text{and}\ \frac{1\ \text{mol}\ O_2}{2\ \text{mol}\ H_2O}.$$

PART C:

$$\frac{1\ \text{mol}\ P_4}{5\ \text{mol}\ O_2},\ \frac{1\ \text{mol}\ P_4}{1\ \text{mol}\ P_4O_{10}},\ \frac{5\ \text{mol}\ O_2}{1\ \text{mol}\ P_4H_{10}},\ \frac{5\ \text{mol}\ O_2}{1\ \text{mol}\ P_4},\ \frac{1\ \text{mol}\ P_4H_{10}}{1\ \text{mol}\ P_4},\ \text{and}\ \frac{1\ \text{mol}\ P_4O_{10}}{5\ \text{mol}\ O_2}.$$

PART D:

7. $\frac{2\ \text{mol}\ KClO_3}{2\ \text{mol}\ KCl},\ \frac{2\ \text{mol}\ KClO_3}{3\ \text{mol}\ O_2},\ \frac{2\ \text{mol}\ KCl}{3\ \text{mol}\ O_2},\ \frac{2\ \text{mol}\ KCl}{2\ \text{mol}\ KClO_3},\ \frac{3\ \text{mol}\ O_2}{2\ \text{mol}\ KClO_3},\ \text{and}\ \frac{3\ \text{mol}\ O_2}{2\ \text{mol}\ KCl}.$

$$C_2H_2 + 2\ H_2 \rightarrow C_2H_6$$

8. $6.5 \times 10^{14}\ \text{molecule}\ C_2H_2$

PART A: $S_8 + 8\ O_2 \rightarrow 8\ SO_2$

PART B: $25\ \text{molecule}\ S_8$

9. PART C: $200\ \text{molecule}\ SO_2$

10. (A) 11 mol O2; (B) 3.8 mol O2; (C) 3.8 mol O2; (D) 3.8 mol O2; (E) 15 mol O2
11. 11.3 mol O2
12. 453 mol H2
13. (A) 13 mol CS2; (B) 3.6 mol SO2; (C) 4.9 mol NO2; (D) 2.6×10^-3 mol H2O

PART A: $2\ C_2H_3Cl + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O + 2\ HCl$

PART B: $1.400\ \text{mol}\ O_2$

14. PART C: $35.21\ \text{g}\ CO_2$, $7.206\ \text{g}\ H_2O$, and $14.58\ \text{g}\ HCl$

15. (A) 3.6 g C2H6; (B) 3.67 g S2Cl2; (C) 2.5 mg HCl; (D) 12 kg B2O3
16. 12.7 g Cl2; 0.179 mol FeCl2; 22.7 g FeCl2
17. 3.2 g Cl2
18. C2H6
19. 0.883 metric ton C; 5.48 metric ton Fe
20. 99.4 g O2

21. 0.91 kg N2
22. 7.3 mol O2

$$2\ \mathrm{As} + 5\ \mathrm{Br_2} \rightarrow 2\ \mathrm{AsBr_5}$$

23. $$24\ \mathrm{mol\ Br_2}$$
24. 0 mol CaO remains; 0.193 mol NH4Cl remains; 3.99 mol NH3 is produced; 2.00 mol H2O is produced; 2.00 mol CaCl2 is produced
25. Yes
26. 1.40 kg Fe
27. 5.88 g SO2
28. 26.6 kg NO
29. 791 g Al2(SO4)3
30. 3.15 g NO
31. 3.3 kg HNO3
32. 190. mL H2O
33. C is the excess reactant; 11.5 g C remains
34. Theoretical yield is the hypothetical maximum amount of product that can be obtained in a chemical reaction under ideal conditions.
35. The temperature of the reaction, the possibility of side reactions, the reaction itself not proceeding to completion, and further reaction of the product to form something else are events that happen in chemical reactions that lead to percentage yields of less than 100%.
36. Percentage yields greater than 100% are common occurrences when solvent molecules have not been evaporated completely from a solution.
37. Reaction 1: 36.6% yield; reaction 2: 1.3% yield; reaction 3: 34% yield; reaction 4: 103% yield
38. 13 mg
39. 88% yield
40. 941 g Fe
41. 1.5×10^2 g S
42. 18% yield
43. 66.5% yield
44. 84.4% yield
45. 79% yield
46. 36.8% yield

$$\text{PART A: } 6.0 \times 10^3\ \mathrm{kg\ SiO_2} \text{ and } 3.6 \times 10^3\ \mathrm{kg\ SiO_2}$$

$$\text{PART B: } 0.78\ \frac{\text{metric ton coal}}{\text{metric ton sand}}$$

47.
48. 1.1×10^4 kg Ca5(PO4)3F
49. 0.302 g H2

$$Al(OH)_3 + 3\ HCl \rightarrow 3\ H_2O + AlCl_3$$

50. 114 mL HCl
51. An indicator is a dye added to a titration that shows when a reaction is complete.
52. 44.6 mL HCl
53. 22.9 mL NaOH
54. 0.126 M HNO3
55. 3.61 g N2H4
56. $1.3×10^3
57. (A) 7.62×10^-3 M H2SO4; (B) 50.1 g CuFeS2; (C) 2.2%
58.
59. 2.27 g H2