

Unit VI Answers

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1. One mole is defined as the number of atoms in exactly 12 grams of carbon-12.
2. 6.022×10^{23} particles
3. There is Avogadro's number of particles in one mole. Since we can't usually count individual atoms we count moles of atoms by measuring mass (and convert with molar mass) or volume (and convert using molarity for solutions or molar volume for gases).
4. They both have the same number of ions – one mole or 6.022×10^{23}
5. 1.11 mole is greater than 1.000 mole (6.022×10^{23} particles)
6. a) 1.20×10^{24} ions of Iron (III) ions b) 2.7×10^{24} molecules of boron trichloride
c) 1.5×10^{23} potassium ions d) 3.626×10^{24} molecules of oxygen
7. a) 3.61×10^{24} sodium ions b) 7.23×10^{24} sodium ions c) 3.08×10^{24} sodium ions
8. a) 0.500 mole water (molecules) b) 0.1661 mol carbon (atoms)c) 0.09316 mole of sodium ions
9. a) 2.86×10^{-7} grams of helium b) 15.22 grams of methane c) 200.5 grams of calcium ions
10. a) 4.745×10^{23} iodide ions
molecules b) 3.3×10^{22} copper (II) ions c) 3.97×10^{22} sulfur dioxide
11. 206.3 grams of ibuprofen
12. a) 26.7 grams of calcium b) $5\bar{0}$ grams of boron-11 c) 7.032×10^{-4} grams of sodium ions
13. a) 1.204×10^{24} molecules of hydrogen b) 1.21×10^{23} molecules HF c) 2.7×10^{24} molecules glucose

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8. 51.99 grams/mole (or amu) 9. 10.80 grams/mole (or amu)
10. a) 168.35 g/mole b) 122.55 g/mole c) 180.18 g/mole
d) 132.08 g/mole e) 75.08 g/mole
11. a) SrS; 119.69 g/mole; 1.76×10^{-2} mole SrS b) PF₃; 87.97 g/mole; 2.40×10^{-2} mole PF₃
c) Zn(C₂H₃O₂)₂; 183.49 g/mole; 1.15×10^{-2} mole zinc acetate
d) Hg(BrO₃)₂; 456.39 g/mole; 4.62×10^{-3} mole Hg(BrO₃)₂
e) Ca(NO₃)₂; 164.10 g/mole; 0.0129 mole Ca(NO₃)₂
12. a) 158.18 g/mole; 790.90 g Ca(C₂H₃O₂)₂ b) 357.49 g/mole; 1787.4 g Fe₃(PO₄)₂
c) 183.20 g/mole; 916.00 g C₇H₅NO₃S d) 180.17 g/mole; 900.85 C₉H₈O₄

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4. a) BCl₃ b) SO₂ c) NaNO₃
5. SO₂

6. a) CaSO_4 ; 29.44% Ca, 23.55% S and 47.01% O
 b) SiO_2 ; 46.75% S and 53.25% O
 c) AgNO_3 ; 63.50% Ag, 8.247% N and 28.26% O
 d) NO; 46.68% N and 53.32% O
7. a) 64.62% Ag, 14.39% C, 1.82% H and 19.17% O
 b) 55.39% Pb, 18.95% Cl and 25.66% O
 c) 27.93% Fe, 24.06% S and 48.01% O
 d) 39.81% Cu, 20.09% S and 40.10% O
8. Experimental error will affect the amounts measured.

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1. Avogadro's number is the number of particles in a mole. The mole is a standard unit to count Avogadro's number of particles.
2. Molar mass is the quantity to measure the number of grams in one mole of a substance.
3. The ratio in a formula indicates the number of atoms. Since atoms can only come in whole parts and still be atoms the formula must be in a ratio of whole numbers.
14. 10 grams of nitrogen
16. The molar mass is the value of the atomic mass in units of grams/mole.
17. To determine the molar mass of a compound, add up the molar masses of each element in the compound.
18. The percent composition indicates the ratios of the elements by mass in a substance. The percent composition can be used to determine the empirical formula for a compound.
22. 1.2×10^{24} sodium ions
23. 1.20×10^{24} molecules of sucrose
24. 3.01×10^{22} molecules of carbon dioxide
25. 7.53×10^{21} atoms of mercury
26. 1.56×10^{24} atoms of aluminum
27. 5.815×10^{24} nickel (II) ions
28. a) 1.88×10^{24} formula units MgCl_2
 b) 3.76×10^{24} chloride ions
29. 41.5 mole of magnesium oxide
30. 2.49×10^{-7} mole of gold atoms
31. 12.5 mole of benzene
32. 1.553×10^{-10} mole
33. 6.82×10^{-2} mole of sodium ions
34. 0.60 mole of oxygen
35. 0.006192 grams of phosphorous
36. 420.8 g of sodium chloride
37. 1.46×10^{-8} grams of carbon dioxide
38. 79.5 grams of iron (III) sulfate
39. 81.6 grams of oxygen
40. 0.908 grams of neon
41. 160 grams of sodium chloride

42. a) 127 g I₂ b) 675 g PbS c) 233 g C₄H₁₀ d) 103 g Al₂(SO₄)₃ e) 35.4 g CuSO₄
43. a) 58.44 g NaCl b) 36.04 g H₂O c) 260 g Ca(OH)₂ d) 163 g Ba(NO₃)₂
44. 3.24 x 10²² atoms of gold 45. 1.337 x 10²⁴ formula units of zinc chloride
46. 9.36 x 10²¹ molecules of naphthalene 47. 2.79 x 10²⁴ atoms of aluminum
48. 5.53 mole of water
49. a) 4.99 x 10⁻² moles of ammonium sulfate b) 61 moles of Ca(OH)₂ c) 7.49 x 10⁻² mole H₂SO₄
50. 0.16 mole C₁₃H₁₈O₂ 51. 7.25 mole of sodium nitrite
52. 7.236 x 10⁻³ moles of calcium 53. 57.8 mole of propane
54. 107.88 amu 55. 79.90 amu 56. 121.8 amu 57. 55.84 amu
58. a) LiCl 42.39 g/mole b) Na₂SO₄ 142.05 g/mole c) CuCN 89.57 g/mole d) C₃H₆ 42.09 g/mole
 e) K₂Cr₂O₇ 294.20 g/mole f) Mg(NO₃)₂ 148.32 g/mole g) 231.55 g/mole
 h) 112.10 g/mole i) S₄N₄ 184.32 g/mole j) CsBr₃ 372.60 g/mole k) 194.22 g/mole
62. AgNO₃ 63. P₂O₃ 64. C₂H₆O 65. C₉H₁₈N₆ 66. C₆H₆
67. Co₂C₈O₈ 68. C₁₈H₃₄O₂ 69. C₄H₄N₂
70. a) 35.00 % N, 5.05% H and 59.96 % O
 b) 21.23% O and 78.77% Sn
 c) 13.55% Y, 41.23% Ba, 28.62% Cu and 16.81% O
71. 37.56% ammonium ion 72. 40.04% Ca, 12.00% C and 47.96% O
73. 22.57% N, 6.51% H, 19.35% C and 51.56% O
74. a) 0.050 mole sodium phosphate b) 0.406 mole calcium nitrate c) 0.128 mole sulfur dioxide
75. a) 0.00152 mole sodium ions b) 0.0072 mole calcium ions
76. 2.81 x 10²² atoms Pt 77. 40 moles H 78. 27.2% Na, 16.4% N and 56.4% O; NaNO₃
79. 28.09 amu 80. 3 atoms Fe; 3 mole Fe 81. 180.18 g/mole 82. 3.00 mole chlorine
83. Aluminum phosphate is 22.12% aluminum while aluminum chloride is 20.23% aluminum so the aluminum phosphate has more aluminum per unit of mass.
84. a) 227.15 g/mole b) 37.01% C, 2.22% H, 18.50% N and 42.26% O

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2. Molarity, M, is moles of solute/liter of solution

3. Measure 5.0 grams of sodium chloride, dissolve it in some water and then increase the solution volume to 100 ml.
4. No; the total volume does not always equal the sum of the parts.
5. 438 parts per million (ppm)
6. 1.63 ppm He
7. 4.00 g NaOH
8. 1.1 M LiCl
9. 0.838 M NaOCl
10. 5.30 g AgNO₃
11. 5.8×10^3 g Ca₃(PO₄)₂ and 2.0×10^3 g water
12. KCl; there is the same number of moles of each substance but KCl has the greater formula mass.

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| 47. 0.7776 M NaOH | 48. 0.734 M H ₃ PO ₄ | 49. 2.0 mole AgNO ₃ |
| 50. 0.250 M NaOH | 51. 1.61 M CuCl ₂ | 52. 0.282 M KI |
| 53. 0.123 M H ₃ PO ₄ | 54. 6.5×10^{-5} M NaCN | 55. 5.85 g NaOH |
| 56. 6.27 g HCl | 57. 5.02 M HCl | 58. 5.4 M NaCl |
| 59. 0.259 g LiF | 60. 163 g C ₆ H ₁₂ O ₆ | 61. 0.74 M C ₆ H ₁₂ O ₆ |