# Ch 3 Practice Problems

1. The atomic mass of rhenium is 186.2. Given that 37.1% of natural rhenium is rhenium-185, what is the other stable isotope?
   A)   $^{183}_{75}$Re
   B)   $^{187}_{75}$Re
   C)   $^{189}_{75}$Re
   D)   $^{181}_{75}$Re
   E)   $^{190}_{75}$Re

2. For a new element, 67.16% is an isotope with mass 280.8 amu, 2.76% is an isotope with mass 283.7 amu, and 30.08% is an isotope with mass 284.8 amu.  Calculate the average atomic mass of this new element.
   A)   282.1 amu
   B)   283.1 amu
   C)   313.4 amu
   D)   280.8 amu
   E)   849.3 amu

3. Indium has atomic number 49 and atomic mass 114.8 g.  Naturally occurring indium contains a mixture of indium-112 and indium-115 in an atomic ratio of approximately
   A)   6/94.
   B)   25/75.
   C)   50/50.
   D)   75/25.
   E)   94/6.

4. A sample of iron weighing 16.8 g contains how many moles of iron atoms?
   A)   0.0874 moles
   B)   0.301 moles
   C)   0.646 moles
   D)   0.132 moles
   E)   3.32 moles

5. A single atom of an element weighs $5.81 \times 10^{-23}$ g.  Identify the isotope.
   A)   $^{80}$Br
   B)   $^{35}$Cl
   C)   $^{103}$Rh
   D)   $^{45}$Sc
   E)   none of these

6. An alkali metal oxide contains 83.01% metal by mass.  Determine the identity of the metal.
   A)   Cs
   B)   K
   C)   Li
   D)   Na
   E)   Rb

7. What is the molar mass of ethanol ($C_2H_5OH$)?
   A)   45.07
   B)   38.90
   C)   46.07
   D)   34.17
   E)   62.07

8. For which of the following compounds does 1.0 g represent $5.55 \times 10^{-2}$ mol?
   A)   $NO_2$
   B)   $H_2O$
   C)   $C_2H_6$
   D)   $NH_3$
   E)   CO

9. Calculate the molar mass of a sample if a single molecule weighs $5.34 \times 10^{-23}$ g.
   A)   $1.13 \times 10^{46}$ g/mol
   B)   12.0 g/mol
   C)   $5.34 \times 10^{-23}$ g/mol
   D)   32.2 g/mol
   E)   none of these

10. What is the mass (in grams) of one molecule of phosphorus pentachloride?
   A)   $1.10 \times 10^{-22}$ g
   B)   $3.46 \times 10^{-22}$ g
   C)   1.00 g
   D)   208.22 g
   E)   $1.25 \times 10^{26}$ g

11. How many molecules of ammonia are present in 3.7 g of ammonia?
   A)   $2.2 \times 10^{1}$
   B)   $2.2 \times 10^{24}$
   C)   $3.6 \times 10^{-25}$
   D)   $1.3 \times 10^{23}$
   E)   $4.5 \times 10^{23}$

12. How many atoms of hydrogen are present in 4.0 g of ammonia?
   A)   $4.2 \times 10^{23}$
   B)   $7.8 \times 10^{24}$
   C)   $1.2 \times 10^{-24}$
   D)   $1.8 \times 10^{24}$
   E)   0.70

13. The mass of 0.82 mol of a diatomic molecule is 131.3 g.  Identify the molecule.
   A)   $F_2$
   B)   $Cl_2$
   C)   $Br_2$
   D)   $I_2$
   E)   Xe

14. What mass of styrene (molar mass 104.1 g/mol) contains $4.50 \times 10^{20}$ molecules of styrene?
   A)   $7.48 \times 10^{-4}$ g
   B)   $7.48 \times 10^{-3}$ g
   C)   $7.78 \times 10^{-2}$ g
   D)   0.00778 g
   E)   $7.48 \times 10^{4}$ g

15. Phosphorus has the molecular formula $P_4$ and sulfur has the molecular formula $S_8$. How many grams of phosphorus contain the same number of molecules as 6.41 g of sulfur?
   A)   3.10 g
   B)   3.21 g
   C)   6.19 g
   D)   6.41 g
   E)   none of these

16. A given sample of xenon fluoride contains molecules of a single type, $XeF_n$, where $n$ is some whole number. Given that $9.03 \times 10^{20}$ molecules of $XeF_n$ weigh 0.311 g, calculate $n$.
   A)  1
   B)  2
   C)  4
   D)  none of these

17. $NaHCO_3$ is the active ingredient in baking soda. How many grams of oxygen are in 0.44 g of $NaHCO_3$?
   A)  0.016 g
   B)  1.3 g
   C)  0.084 g
   D)  0.0052 g
   E)  0.25 g

18. Compound $X_2Y$ is 60% X by mass. Calculate the percent Y by mass of the compound $X_2Y_2$.
   A)  20%
   B)  30%
   C)  40%
   D)  60%
   E)  80%

19. Cortisone consists of molecules, each of which contains 21 atoms of carbon (plus other atoms). The mass percentage of carbon in cortisone is 69.98%. What is the molar mass of cortisone?
   A)  176.5 g/mol
   B)  252.2 g/mol
   C)  287.6 g/mol
   D)  312.8 g/mol
   E)  360.4 g/mol

20. An oxybromate compound, $NaBrO_x$, where x is a whole number, is analyzed and found to contain 52.95% Br by mass. What is x?
   A)  0
   B)  1
   C)  2
   D)  3
   E)  4

21. What is the percent by mass of hydrogen in ammonium acetate?
   A)  5.23%
   B)  3.92%
   C)  9.15%
   D)  14.3%
   E)  7.07%

22. The empirical formula of a group of compounds is CHCl. Lindane, a powerful insecticide, is a member of this group. The molar mass of lindane is 290.8. How many atoms of carbon does a molecule of lindane contain?
   A)  2
   B)  3
   C)  4
   D)  6
   E)  8

23. What is the empirical formula of a hydrocarbon (a compound that consists of only carbon and hydrogen) that contains 81.7% carbon by mass?
   A)  $C_2H_6$
   B)  $C_3H_8$
   C)  $C_4H_{10}$
   D)  $C_5H_{12}$
   E)  none of these

24. TNT consists of carbon, nitrogen, oxygen, and hydrogen. It is 37.02% carbon by mass, 18.49% nitrogen by mass, and 42.27% oxygen by mass. The molar mass of TNT is between 210 g/mol and 245 g/mol. What is the molecular formula for TNT?
   A)   $C_7H_5N_3O_6$
   B)   $C_4H_7N_6O_6$
   C)   $C_8H_{12}N_3O_4$
   D)   $C_6H_4N_3O_6$
   E)   none of these

25. Vitamin C contains the elements C, H, and O. It is known to contain 40.9% C and 4.58% H by mass. The molar mass of vitamin C has been found to be about 180. The molecular formula for vitamin C is
   A)   $C_2H_3O_2$
   B)   $C_3H_4O_3$
   C)   $C_4H_6O_4$
   D)   $C_6H_8O_6$
   E)   none of these

26. Caffeine consists of carbon, hydrogen, oxygen, and nitrogen. When 0.1920 g of caffeine is burned in an excess of oxygen, 0.3482 g of carbon dioxide and 0.0891 g water are formed. Caffeine is 28.84% nitrogen by mass. Its molar mass is between 190 and 200 g/mol. What is the formula for caffeine?
   A)   $C_4H_5N_2O$
   B)   $C_3H_2N_2O_2$
   C)   $C_6H_4N_4O_4$
   D)   $C_8H_{10}N_4O_2$
   E)   none of these

27. When the equation $C_{10}H_{22} + O_2 \rightarrow CO_2 + H_2O$ is balanced with the smallest set of integers, the sum of the coefficients is
   A)   4
   B)   64
   C)   75
   D)   44
   E)   53

28. $wPCl_5 + xH_2O \rightarrow yPOCl_3 + zHCl$
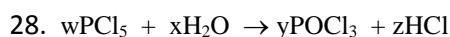
   When the equation is properly balanced, what are the coefficients?

   A)   w = 1, x = 2, y = 2, z = 4
   B)   w = 2, x = 2, y = 2, z = 2
   C)   w = 2, x = 2, y = 2, z = 4
   D)   w = 1, x = 1, y = 1, z = 2
   E)   none of these

29. When the equation $FeCr_2O_4 + K_2CO_3 + O_2 \rightarrow K_2CrO_4 + Fe_2O_3 + CO_2$ is balanced with the smallest set of integers, the sum of the coefficients is
   A)   6
   B)   9
   C)   15
   D)   24
   E)   37

30. How many moles of sodium phosphate are required to react completely with 4.6 mol of calcium nitrate to form sodium nitrate and calcium phosphate?
   A)   6.9 mol
   B)   4.6 mol
   C)   3.1 mol
   D)   2.3 mol
   E)   1.5 mol

31. A 6.32-g sample of potassium chlorate was decomposed according to the following equation:

   $2KClO_3 \rightarrow 2KCl + 3O_2$
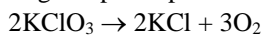
   How many moles of oxygen are formed?

   A)   1.65 mol
   B)   0.051 mol
   C)   0.0344 mol
   D)   0.0774 mol
   E)   none of these

32. How many grams of $H_2O$ will be formed when 36.8 g $H_2$ is mixed with 40.2 g $O_2$ and allowed to completely react to form water?
   A)   45.2 g
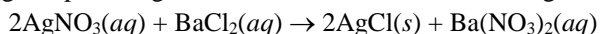   B)   77.0 g
   C)   22.6 g
   D)   331 g
   E)   51.3 g

33. 28.6 g of Al and 17.8 g of $Br_2$ react according to the following equation:

   $2Al + 3Br_2 \rightarrow 2AlBr_3$
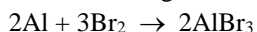
   What mass of $AlBr_3$ is formed, assuming 100% yield?

   A)   283 g
   B)   19.8 g
   C)   29.7 g
   D)   44.6 g
   E)   46.4 g

34. A 9.22-g sample of $AgNO_3$ is reacted with $BaCl_2$ according to the equation

   $2AgNO_3(aq) + BaCl_2(aq) \rightarrow 2AgCl(s) + Ba(NO_3)_2(aq)$

   to give 4.86 g of AgCl. What is the percent yield of AgCl?

   A)   44.5%
   B)   52.7%
   C)   31.2%
   D)   62.5%
   E)   18.7%

35. In the reaction

   $2A + B \rightarrow 3C + D$
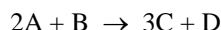
   3.0 mol A and 2.0 mol B react to form 4.0 mol C.  What is the percent yield of this reaction?

   A)   50%
   B)   67%
   C)   75%
   D)   89%
   E)   100%

36. A 15-g sample of lithium is reacted with 15 g of fluorine to form lithium fluoride:
   $2Li + F_2 \rightarrow 2LiF$. After the reaction is complete, what will be present?
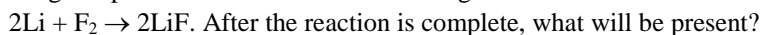
   A)   2.16 mol lithium fluoride only
   B)   0.789 mol lithium fluoride only
   C)   2.16 mol lithium fluoride and 0.395 mol fluorine
   D)   0.789 mol lithium fluoride and 1.37 mol lithium
   E)   none of these

37. Consider the following reaction:

$$4NH_3(g) + 7O_2(g) \rightarrow 4NO_2(g) + 6H_2O(l)$$

Consider an experiment in which you react ammonia and oxygen. At the end of the experiment, you find that you produced 27.0 g of water, and 8.52 g of ammonia is left over. Calculate the initial mass of ammonia. Assume the reaction went to completion.

A)  10.8 g
B)  17.0 g
C)  25.5 g
D)  34.1 g
E)  68.0 g

Answers:
1. B      2. A      3. A      4. B      5. B      6. B      7. C      8. B      9. D      10. B      11. D      12. A
13. C     14. C     15. A     16. C     17. E     18. D     19. E     20. D     21. C     22. D     23. B     24. A
25. D     26. D     27. C     28. D     29. E     30. C     31. D     32. A     33. B     34. D     35. D     36. D
37. C