Mole Problems #2 - Answer Key

1.a) Mole - a unit of amount represented by 6.02×10^{23} particles.

b) Avogadro's Number = 6.02×10^{23}

c) The molar mass has the same value as the molecular mass but is expressed in GRAMS/MOL rather than a.m.u.

2. $0.842 \text{ mol } C_{14}H_{18}N_2O_5 \left| \frac{294 \text{ g } C_{14}H_{18}N_2O_5}{1 \text{ mol } C_{14}H_{18}N_2O_5} \right. =$ **248 g aspartame**

3. $65.7 \text{ g } C_{14}H_{18}N_2O_5 \left| \frac{1 \text{ mol } C_{14}H_{18}N_2O_5}{294.0 \text{ g } C_{14}H_{18}N_2O_5} \right. =$ **0.223 mol aspartame**

4. $1.25 \times 10^{20} \text{ molec. } C_8H_{10}N_4O_2 \left| \frac{1 \text{ mol } C_8H_{10}N_4O_2}{6.02 \times 10^{23} \text{ molec. } C_8H_{10}N_4O_2} \right. \left| \frac{194.0 \text{ g } C_8H_{10}N_4O_2}{1 \text{ mol } C_8H_{10}N_4O_2} \right. =$

= 0.0403 g caffeine

5. $25 \text{ µg } C_{21}H_{30}O_2 \left| \frac{1 \text{ g}}{10^6 \text{ µg}} \right| \frac{1 \text{ mol } C_{21}H_{30}O_2}{314.0 \text{ g } C_{21}H_{30}O_2} =$ **8.0×10^{-8} mol THC**

6. $25 \text{ µg } C_{21}H_{30}O_2 \left| \frac{1 \text{ g}}{10^6 \text{ µg}} \right| \frac{1 \text{ mol } C_{21}H_{30}O_2}{314.0 \text{ g } C_{21}H_{30}O_2} \left| \frac{6.02 \times 10^{23} \text{ molec. } C_{21}H_{30}O_2}{1 \text{ mol } C_{21}H_{30}O_2} \right. =$ **4.8×10^{16} molecules THC**

7. $3.0 \times 10^{22} \text{ molec. } C_{27}H_{46}O \left| \frac{1 \text{ mol } C_{27}H_{46}O}{6.02 \times 10^{23} \text{ molec. } C_{27}H_{46}O} \right. \left| \frac{386.0 \text{ g } C_{27}H_{46}O}{1 \text{ mol } C_{27}H_{46}O} \right. =$ **19 g cholesterol**

8. $500.0 \text{ mg } C_6H_8O_6 \left| \frac{1 \text{ g}}{10^3 \text{ mg}} \right| \frac{1 \text{ mol } C_6H_8O_6}{176.0 \text{ g } C_6H_8O_6} \left| \frac{6.02 \times 10^{23} \text{ molec. } C_6H_8O_6}{1 \text{ mol } C_6H_8O_6} \right. =$ **1.71×10^{21} molec. Vit. C**

9. $100.0 \text{ mg } C_8H_9O_2N \left| \frac{1 \text{ g}}{10^3 \text{ mg}} \right| \frac{1 \text{ mol } C_8H_9O_2N}{151.0 \text{ g } C_8H_9O_2N} \left| \frac{6.02 \times 10^{23} \text{ molec. } C_8H_9O_2N}{1 \text{ mol } C_8H_9O_2N} \right| \frac{8 \text{ atoms}}{1 \text{ molecule}} =$

$= 3.19 \times 10^{21}$ atoms C

10. $28.0\ \text{g}$ Pentylacetate (PA) $\left|\frac{1\ \text{g}}{10^3\ \text{mg}}\right.$ $\left|\frac{1\ \text{mol PA}}{130.0\ \text{g PA}}\right.$ $\left|\frac{6.02\times10^{23}\ \text{molec. PA}}{1\ \text{mol PA}}\right.$ $\left|\frac{14\ \text{atoms H}}{1\ \text{molec. PA}}\right.$ = 1.82×10^{21} atoms H

11. 1.0×10^{20} atoms H $\left|\frac{1\ \text{molec. } C_{18}H_{24}O_2}{24\ \text{atoms H}}\right.$ = 4.2×10^{18} molecules estradiol

12. 4.2×10^{18} molec. $C_{18}H_{24}O_2$ $\left|\frac{1\ \text{mol } C_{18}H_{24}O_2}{6.02\times10^{23}\ \text{molec. } C_{18}H_{24}O_2}\right.$ = 7.0×10^{-6} mol estradiol

13. $5.08\ \text{g } C_7H_6O_2$ $\left|\frac{1\ \text{mol } C_7H_6O_2}{122.0\ \text{g } C_7H_6O_2}\right.$ = 0.0416 mol benzoic acid

14. $5.0\ \text{mol } Cl_2$ $\left|\frac{22.4\ \text{L } Cl_2}{1\ \text{mol } Cl_2}\right.$ = 112 L Cl_2 = 1.1×10^2 L Cl_2

15. 4.0×10^{24} molec. F_2 $\left|\frac{1\ \text{mol } F_2}{6.02\times10^{23}\ \text{molec. } F_2}\right.$ $\left|\frac{22.4\ \text{L } F_2}{1\ \text{mol } F_2}\right.$ = 1.5×10^2 L F_2

16. 1 molec. $(NH_4)_2SO_4$ $\left|\frac{8\ \text{atoms H}}{1\ \text{molec. } (NH_4)_2SO_4}\right.$ = 8 atoms H