5.56: balance each redox reactions:

a) $N_2O_4(l) + 2N_2H_4(l) \longrightarrow 3N_2(g) + 4H_2O(g)$
b) $CaH_2(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + 2H_2(g)$
c) $2Al(s) + 6H_2O(g) \longrightarrow 2Al(OH)_3(s) + 3H_2(g)$

6.20: what is a mole of a substance? How many moles are in 1 mol of a molecular compound?

- mole = an amount equal to its formula weight in grams
- 1 mol of a molecular compound = 6.022×10^{23} molecules

6.24: How many calcium atoms are in 16.2 g of calcium?

$$16.2\ \text{g of Ca} \times \frac{1\ \text{mol Ca}}{40.08\ \text{g Ca}} \times \frac{6.022 \times 10^{23}\ \text{atoms Ca}}{1\ \text{mol Ca}} = \boxed{2.43 \times 10^{23}\ \text{atoms Ca}}$$

6.29: caffine = $C_8H_{10}N_4O_2$. If an average cup of coffee contains ≈ 125 mg of caffine, how many moles of caffine are in 1 cup?

$$125\ \text{mg of caffine} \times \frac{1\ \text{g of caffine}}{1000\ \text{mg of caffine}} = .125\ \text{g of caffine}$$

$C_8 = 12.01 \times 8 = 96.08$
$H_{10} = 1.008 \times 10 = 10.08$
$N_4 = 14.0067 \times 4 = 56.0268$
$O_2 = 15.9994 \times 2 = 31.9988$
$194.1856 = 194.9$

$$.125\ \text{g of caffine} \times \frac{1\ \text{mol caff.}}{194\ \text{g caff.}} = \boxed{6.44 \times 10^{-4}\ \text{moles of caffine}}$$