**Quiz 5**

# Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work. Where appropriate answers should be boxed for clarity, written to the correct number of significant figures, and, include the proper units.

1. A person’s blood alcohol (C2H5OH) level can be determined by titrating a sample of blood plasma with a potassium dichromate solution. The balanced equation is (10 points)

16 H+ (aq) + 2 Cr2O72- (aq) + C2H5OH (aq) → 4 Cr3+ (aq) + 2 CO2 (g) + 11 H2O (l)

* 1. What is the oxidation state of C in C2H5OH (aq)? \_\_\_\_-2\_\_\_\_\_
	2. What is the oxidation state of C in CO2 (g)? \_\_\_+4\_\_\_\_\_
	3. What is the element that is oxidized? \_\_\_C\_\_\_\_
	4. What is the element that is reduced? \_\_\_Cr\_\_\_\_
	5. What is the oxidizing agent? \_\_\_\_K2Cr2O7
	6. What is the reducing agent? \_\_\_\_C2H5OH
	7. How many electrons are transferred in the reaction as it is balanced? \_\_\_\_12\_\_\_\_

Red: (Cr2O72- (aq) + 14 H+ (aq) + 6 e- → 2 Cr3+ (aq) + 7 H2O (l)) × 2

+ Ox: C2H5OH (aq) + 3 H2O (l) → 2 CO2 (g) + 12 H+ (aq) + 12 e-

2 Cr2O72- (aq) + 28 H+ (aq) + 12 e- + C2H5OH (aq) + 3 H2O (l) → 2 CO2 (g) + 12 H+ (aq) + 12 e- + 4 Cr3+ (aq) + 14 H2O (l)

1. Cr2O72- (aq) + 16 H+ (aq) + C2H5OH (aq) → 2 CO2 (g) + 12 H+ (aq) + 4 Cr3+ (aq) + 11 H2O (l)
	1. If 25.41 mL of 0.05961 M Cr2O72- is required to titrate 28.00 g of plasma, what is the mass percent of alcohol in the blood?

$$25.41 mL×\frac{1 L}{1000 mL}×\frac{0.05961 mol Cr\_{2}O\_{7}^{2-}}{1 L}×\frac{1 mol C\_{2}H\_{5}OH}{2 mol Cr\_{2}O\_{7}^{2-}}×\frac{46.069 g C\_{2}H\_{5}OH}{1 mol C\_{2}H\_{5}OH}=0.03489 g C\_{2}H\_{5}OH$$

$$mass percent=\frac{m\_{ C\_{2}H\_{5}OH}}{m\_{plasma}}×100=\frac{0.03489 g}{28.00 g}×100=0.1246\%$$

1. 25.64 g of calcium carbide powder, CaC2, is reacted with 4.525 g of water to produce acetylene gas, C2H2, and calcium hydroxide precipitate (10 points).
	1. Write the balanced conventional equation for the reaction and use an ICE table to determine the limiting reagent.

$$25.64 g CaC\_{2}×\frac{1 mol CaC\_{2}}{64.100 g CaC\_{2}}=0.4000 mol CaC\_{2}$$

$$4.525 g H\_{2}O×\frac{1 mol H\_{2}O}{18.015 g H\_{2}O}=0.2512 mol H\_{2}O$$

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | CaC2 (s) +  | 2 H2O (l) → | Ca(OH)2 (s) +  | C2H2 (g) |
| I | 0.4000 mol  | 0.2512 mol  | 0 mol | 0 mol  |
| C | -x | -2x | +x | +x |
| E | 0.4000 mol –x =0.4000 mol – 0.1256 mol =0.2744 mol  | 0.2512 mol -2x =0 mol  | x = 0.1256 mol  | x = 0.1256 mol  |

$$actual ratio= \frac{0.2512 mol H\_{2}O}{0.4000 mol CaC\_{2}}=\frac{0.6279 mol H\_{2}O}{1 mol CaC\_{2}}$$

$$theorectical ratio= \frac{2 mol H\_{2}O}{1 mol CaC\_{2}}$$

There are 0.6279 mol H2O available for the reaction, but 2 mol H2O are needed. Therefore, water is the limiting reagent.

$$0.2512 mol H\_{2}O-2x=0 mol⇒x=0.1256 mol $$

* 1. What volume of acetylene gas can be produced if the reaction takes place at 22.5 °C and 0.9983 atm?

$$PV=nRT⟹V=\frac{nRT}{P}$$

$$V=\frac{\left(0.1256 mol\right)\left(0.08206 \frac{L atm}{mol K}\right)\left(22.5+273.15\right)K}{0.9983 atm}$$

$$V=\frac{\left(0.1256 mol\right)\left(0.08206 \frac{L atm}{mol K}\right)\left(295.65 K\right)}{0.9983 atm}=3.052 L C\_{2}H\_{2}$$