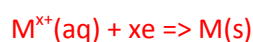


## Electrolysis worksheet 4

1) An ornament was coated with a metal, M, by electrolysis of a solution of the metal ion,  $M^{x+}$ . During the electrolysis a current of 2.46 amperes was applied for 230 seconds. The ornament was coated in  $1.95 \times 10^{-3}$  mol of metal M.

- a) What is the value of x in  $M^{x+}$



Step 1 find the mol of electrons

$$\Rightarrow n_e = 2.46 \times 230 / 96500 = 5.86 \times 10^{-3}$$

Step 2 find the ratio of  $n_e$  and  $n_M$

$$n_e / n_M = 5.86 \times 10^{-3} / 1.95 \times 10^{-3} = 3:1$$

For every one mol of M deposited 3 mol of electrons are supplied

$$x = 3$$

- b) If the mass of the metal coating on the ornament was 0.102 grams identify the metal.

Find the molar mass of the metal and hence identify it.

$$\text{Molar mass} = \text{mass/mol} = 0.102 / 1.95 \times 10^{-3} = 52.1$$

This is close enough to chromium

- c) A medal is plated with metal M in an electrolytic cell. From the data given below calculate the time, in minutes, taken to plate the medal.

Mass of medal before copper plating = 23.2 g

Mass of medal after plating with metal M = 26.4 g

Current = 0.980 A

Step 1 Calculate the mass of M deposited

$$\Rightarrow 26.4 - 23.2 = 3.20 \text{ g}$$

Step 2 find the mol of M deposited

$\Rightarrow$  Since we know the metal was chromium

$$\Rightarrow n_{Cr} = 3.20 / 52.0 = 0.06154$$

Step 3 find the mol of electrons needed to deposit this amount of metal M.

$$\Rightarrow 0.06154 \times 3 = 0.185$$

Step 4 find the charge

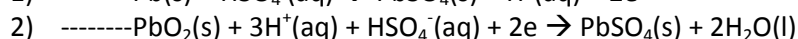
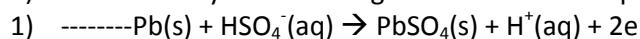
$$\Rightarrow Q = It = 0.185 \times 96500 = 17852$$

Step 5 find the time minutes

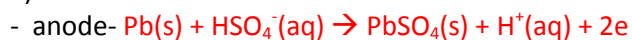
$$\Rightarrow \frac{17852}{0.980} = t = 304 \text{ minutes}$$

$$0.980$$

2) In a car battery the following two reactions take place during discharge.



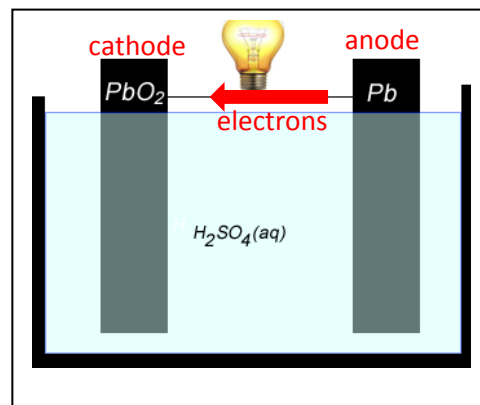
a) Which reaction occurs at the:



b) The image on the right represents a cell discharging

On this diagram indicate the:

anode,  
cathode,  
direction of electron flow.



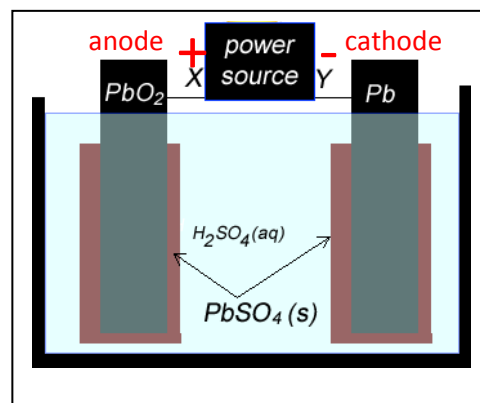
c) When the cell is being recharged it is connected to an external power source, as shown on the right.

i. What is the polarity of the X and Y terminals of the external power source?

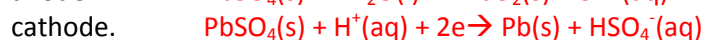
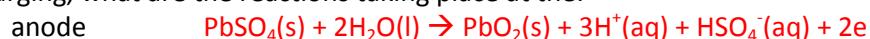
Terminal X - **positive**  
Terminal Y - **negative**

ii. Which terminal is the anode and which is the cathode

Terminal X - **anode**  
Terminal Y - **cathode**



iii. During recharging, what are the reactions taking place at the:



Keep in mind. The terminal at which oxidation takes place is always labelled as the anode while the terminal at which reduction takes place is always labelled the cathode.

During discharge the anode is negative and cathode is positive.

During recharge the anode is positive and the cathode is negative.

d) In the diagram one of the terminals is shown to consist of PbO<sub>2</sub> only. Is this right? Explain.

The electrode consists of lead impregnated with lead oxide (PbO<sub>2</sub>). Lead oxide is an ionic compound and hence cannot conduct electricity in the solid state.