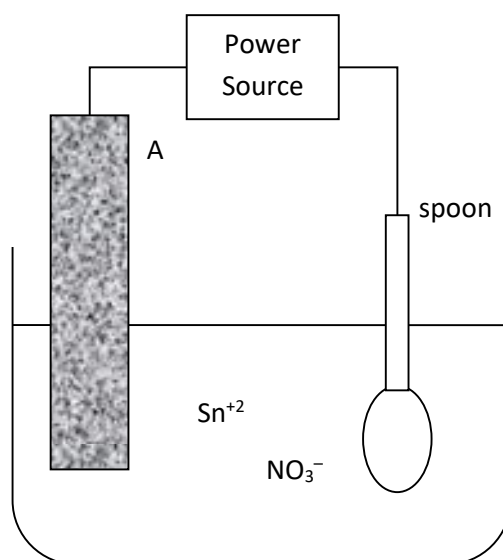


Electrolytic cells worksheet 9

- 1) An electroplating factory uses a solution of tin (II) nitrate $\text{Sn}(\text{NO}_3)_2$ to plate tin metal onto spoons made of steel. A simplified diagram of such an electroplating cell is shown below.



- a) What is the polarity of the electrode the spoon is attached to and give the equation to the half reaction taking place there?

Negative



- b) If the total surface area of the spoon is 18.0 cm^2 and a coating that has a thickness of 0.130 mm is required, calculate the mass of tin metal, in cubic centimetres, that must be deposited onto the spoon if the density of tin is 7.31 g/cm^3

Step 1 Calculate the volume of tin deposited

$$\Rightarrow 18.0 \text{ cm}^2 \times 0.0130 \text{ cm} = 0.234 \text{ cm}^3$$

Step 2 Calculate the mass of tin

$$\Rightarrow \text{mass} = \text{density} \times \text{volume} = 7.31 \text{ g/cm}^3 \times 0.234 = 1.71 \text{ g}$$

- c) What material should electrode "A" be made from?

Sn

- d) How does the $[\text{Sn}^{2+}]$ change over time? Explain using oxidation and reduction reactions.

$[\text{Sn}^{2+}]$ remains unchanged

- e) Determine the time, in seconds, for which the electroplating cell must operate to deposit the required layer of tin onto the spoon at a current of 4.50 amps and a voltage of 3.00V .

Step 1 calculate the mol of Sn^{2+}

$$\Rightarrow 1.71/119 = 0.0144 \text{ mol}$$

Step 2 calculate the mol of electrons

$$\Rightarrow 0.0144 \times 2 = 0.0288$$

Step 3 calculate the charge delivered by 0.0288 mol of electrons

$$\Rightarrow 0.0288 \times 96500 = 2778\text{C}$$

Step 4 Calculate the time in seconds

$$\Rightarrow \text{charge} = It$$

$$\Rightarrow 2778/4.50 = 618\text{s}$$