Answer on Question #65202 - Chemistry - Physical Chemistry

Question: If a water electrolysis cell operates at a current of 8.2 A , how long will it take to generate 27.0 L of hydrogen gas at a pressure of 25.0 atm and a temperature of 24 °C?

Solution:

I =8.2 A

V (H_2) = 27 L

P = 25.0 atm

T = 24 °C = 297 K

R (gas constant) = 8.31 ($J \cdot mol^{-1} \cdot K^{-1}$) = 0.0821 ($L \cdot atm \cdot mol^{-1} \cdot K^{-1}$)

F (Faraday constant) = 96485 $C \cdot mol^{-1}$

t – ?

n - ?

Using equation Mendeleev-Clapeyron find the number of moles of hydrogen gas:

$$P \cdot V = n \cdot R \cdot T$$

$$n = \frac{P \cdot V}{R \cdot T} = \frac{25 \cdot 27}{0.0821 \cdot 297} = 27.7\ mol$$

Using Faraday's law of electrolysis find time:

$$I \cdot t = z \cdot n \cdot F$$

$$t = z \cdot n \cdot F \cdot I^{-1} = 1 \cdot 27.7 \cdot 96485 \cdot 8.2^{-1} =$$

$$= 325931\,\text{sec} = 5432.2\,\text{min} = 90.5\ h = 3\ days\ 18\ h\ 30\ min$$

Answer: $90.5\ hours = 3\ days\ 18\ h\ 30\ min$