BASIC ELECTROLYSIS CALCULATIONS

1. a) $Ni^{2+}_{(aq)} + 2e^- \longrightarrow Ni_{(s)}$

(How do you know that the nickel ion has two charges? Because the name of the compound tells you.)

b) Because you know both the time and the current, you can work out the number of coulombs involved in the experiment.

Number of coulombs = current in amps x time in seconds
= 0.30 x 15 x 60
= 270

From the equation you know that 1 mole of nickel is deposited by 2 faradays (2 moles of electrons).

2 x 96500 coulombs gives 58.7 g Ni

So 270 coulombs would give 270/(2 x 96500) x 58.7 g Ni
= 0.082 g

(You can't quote this to any more significant figures because the current is only quoted to 2.)

c) either: $4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-$

or: $2H_2O_{(l)} \longrightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$

d) You have already calculated the number of coulombs, so you don't have to do that again.

From the equation you know that 1 mole of oxygen is associated with 4 faradays (4 moles of electrons).

4 x 96500 coulombs gives 24 dm^3 of oxygen at rtp

So 270 coulombs would give 270/(4 x 96500) x 24 dm^3 of oxygen at rtp
= 0.017 dm^3

(As before, don't quote this to more than 2 significant figures.)

2. a) You can't work out the number of coulombs, because you don't know the time. Instead, start with what you know everything about – the hydrogen. The equation for its formation is :

$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$

(Where there are lots of hydrogen ions present, this is the most likely equation, but you could use the alternative one if you wish.)

From the equation you know that 1 mole of hydrogen is produced by 2 faradays (2 moles of electrons).

24 dm^3 of hydrogen at rtp is produced by 2 x 96500 coulombs.

The volume of hydrogen measured is given in cm^3. You could either convert this to dm^3 or convert the 24 dm^3 into cm^3. It doesn't matter as long as your units are consistent. My personal choice would be:

24000 cm^3 of hydrogen at rtp is produced by 2 x 96500 coulombs

100 cm^3 of hydrogen is produced by 100/24000 x 2 x 96500 coulombs
= 804 coulombs

(Important! This isn't the final answer, and so shouldn't be rounded to the 2 significant figures that this questions would need. I am writing it down to one extra significant figure so that I can have a simple number to write down for the rest of the calculation. Ideally, just continue the calculation with the number on your calculator – in this case, 804.1666667. It is good practice not to round numbers until you have to – rounding errors can mount up in a long calculation, so much so that the final answer isn't exactly what the examiners want.)

Number of coulombs = current in amps x time in seconds
804 = 2.0 x t
t = 804/2.0
= 400 secs (to 2 significant figures)

b) All you are changing is the very end of the calculation.

Number of coulomb = current in amps x time in seconds
804 = i x 5 x 60
i = 804/(5 x 60)
= 2.7 amps (to 2 significant figures)