Practice exam questions for Chapter 3: Electrochemistry (Paper-saver version)

Question 1 (Bursary 2000 Question 7)

The saturated calomel electrode is a common reference electrode. In this electrode, mercury metal is in equilibrium with a solution saturated with mercury(I) chloride which actually exists as Hg_2Cl_2. The standard potential for the electrode is + 0.24 V at 25 °C.
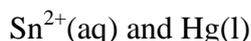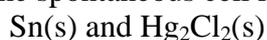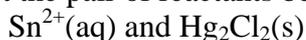
a Give the formula for the cation in Hg_2Cl_2. **A** **M**

The standard potential for $Sn^{2+}(aq)/Sn(s)$ is –0.15 V. Questions in this part refer to a cell having this electrode connected to a calomel electrode

b Select the positive half cell (electrode) below. **A**

$$Hg_2Cl_2(s)/Hg(l) \qquad\qquad Sn^{2+}(aq)/Sn(s)$$
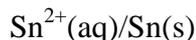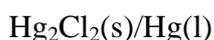
c Calculate the standard cell potential. **A** **M**

d Select the pair of reactants below that is involved in the spontaneous cell reaction. **A**

$Sn^{2+}(aq)$ and $Hg_2Cl_2(s)$ $\qquad\qquad$ $Sn(s)$ and $Hg_2Cl_2(s)$

$Sn(s)$ and $Hg(l)$ $\qquad\qquad$ $Sn^{2+}(aq)$ and $Hg(l)$

e If standard potentials were referred to the calomel electrode instead of to the standard hydrogen electrode, what would be the magnitude **and** sign of the 'standard' potential of the $Sn^{2+}(aq)/Sn(s)$ couple? **A** **M**

Question 2 (Bursary 2001 Question 1)

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The standard reduction electrode potentials for the halogens are shown below.

Reduction half equations	$E^{\bullet}$/V
$F_2 + 2e^- \rightarrow 2F^-$	+2.87
$Cl_2 + 2e^- \rightarrow 2Cl^-$	+1.36
$Br_2 + 2e^- \rightarrow 2Br^-$	+1.09
$I_2 + 2e^- \rightarrow 2I^-$	+0.54

a Explain why fluorine gas, F_2, is extremely reactive and does not occur naturally. **A** **M**

b Explain why chlorine gas can be used to extract bromine from bromide ions in sea water. **A** **M**

Question 3 (Bursary 2002 Question 9)

Dental discomfort

An amalgam filling is an alloy consisting mostly of silver, tin and mercury. When a gold filling presses against an amalgam filling, some discomfort and an unpleasant metallic taste may occur. This is because an **electrochemical cell** is created in the mouth and will eventually result in corrosion of the amalgam filling.

Standard reduction potentials for some of the species in the mouth under these conditions are:

Au^{3+}/Au $E° = +1.50$ V

Hg_2^{2+}/Hg $E° = +0.85$ V

Ag^+/Ag $E° = +0.80$ V

O_2/H_2O $E° = +0.82$ V

Sn^{2+}/Sn $E° = –0.14$ V

a   Name the metal most likely to be oxidised. **A**

b   What is acting as the anode in this cell? **A**

c   Write redox half equations for the reaction occurring between tin and oxygen. Hence write an overall equation for this reaction. **A M**

d   Calculate the $E°$ for this reaction. **A M**

e   What role does the saliva play in this electrochemical cell? **A**