

Practice exam questions for Chapter 3: Electrochemistry

Question 1 (Bursary 2000 Question 7)

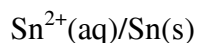
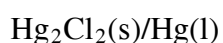
The saturated calomel electrode is a common reference electrode. In this electrode, mercury metal is in equilibrium with a solution saturated with mercury(I) chloride which actually exists as Hg_2Cl_2 . The standard potential for the electrode is + 0.24 V at 25 °C.

a Give the formula for the cation in Hg_2Cl_2 . A M _____

1 a	Hg_2^{2+}	A = Hg^+ M = Hg_2^{2+}
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The standard potential for $\text{Sn}^{2+}(\text{aq})/\text{Sn}(\text{s})$ is -0.15 V. Questions in this part refer to a cell having this electrode connected to a calomel electrode

b Circle the positive half cell (electrode) below. A

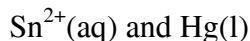
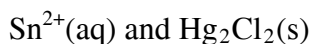


1 b	$\text{Hg}_2\text{Cl}_2(\text{s})/\text{Hg}(\text{l})$	A
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c Calculate the standard cell potential. A M

1 c	$E^\circ_{\text{cell}} = E_{\text{RHE}} - E_{\text{LHE}}$ $= + 0.24 \text{ V} - (- 0.15 \text{ V})$ $= 0.39 \text{ V}$	A = correct equation, but minor error, M = correct voltage with units
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d Circle the pair of reactants below that is involved in the spontaneous cell reaction. A



1 d	$\text{Sn}(\text{s})$ and $\text{Hg}_2\text{Cl}_2(\text{s})$	A
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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 $\text{Sn}^{2+}(\text{aq})/\text{Sn}(\text{s})$ couple? A M

1 e	<p>Calomel electrode will be LHE</p> $E^\circ_{\text{cell}} = E_{\text{RHE}} - E_{\text{LHE}}$ $= - 0.15 \text{ V} - (+ 0.24 \text{ V})$ $= - 0.39 \text{ V}$	A = correct equation, but minor error, M = correct voltage with units
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Question 2 (Bursary 2001 Question 1)

Group 17

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

Reduction half equations	E°/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

2 a	Fluorine is a very strong oxidising agent (oxidant) / Fluorine has a high E°	A = one point, M = both points
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- b** Explain why chlorine gas can be used to extract bromine from bromide ions in sea water. A M

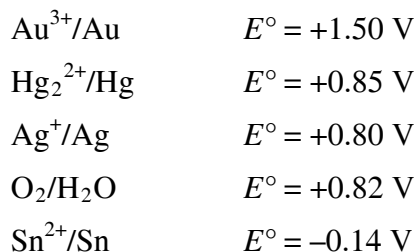
2 b	$E^\circ(Cl_2) > E^\circ(Br_2)$ Cl_2 is the stronger oxidising agent Calculation of $E^\circ_R > 0$	A = one point, M = both points
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Question 3 (Bursary 2002 Question 9)

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:



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

3 a	tin/Sn	A
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b What is acting as the anode in this cell? **A** _____

3 b	The amalgam filling/Sn	A
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c Write redox half equations for the reaction occurring between tin and oxygen. Hence write an overall equation for this reaction. **A M**

3 c	$\begin{array}{l} \text{Sn(s)} \rightarrow \text{Sn}^{2+}(\text{aq}) + 2\text{e}^- \\ \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l}) \\ \hline 2 \text{Sn(s)} + \text{O}_2(\text{g}) \rightarrow 2\text{Sn}^{2+}(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) \end{array}$	A = correct half equations, M = correct balanced ionic equation (state symbols not required)
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d Calculate the E° for this reaction. **A M**

3 d	$\begin{array}{l} E^\circ_{\text{cell}} = E_{\text{RHE}} - E_{\text{LHE}} \\ = + 0.82 \text{ V} - (- 0.14 \text{ V}) \\ = + 0.96 \text{ V} \end{array}$	A = correct equation, but minor error, M = correct voltage with units
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e What role does the saliva play in this electrochemical cell? **A M**

3 e	The saliva acts as the electrolyte/salt bridge and allows the ions to move.	A = one point, M = both points
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Achieve

Merit

Overall level of performance