UNIT 5B PRACTICE QUIZ 3 – ELECTROCHEMICAL CELLS

Do not answer these questions on this document.
Write your answers on a sheet of paper; then click on the answer sheet provided at the end of the questions.

Use your Periodic Table and the reactivity series in your course notes.

Use this information to answer questions 1 – 3:
Bryce decides to set up a galvanic cell.
He uses an iron electrode dipped in a solution of iron (II) chloride (1 mol/L) and a magnesium electrode dipped in a solution of magnesium chloride (1 mol/L).
Iron (II) chloride is green; magnesium chloride is colorless.
He connects the two electrodes with a voltmeter and connects the two solutions with a salt bridge. The voltmeter records an emf of 1.93 V.
Note: magnesium is more reactive than iron – you know this from the reactivity series – therefore oxidation must take place at the Mg electrode and reduction must take place at the Fe electrode

1.	Which one of the following statements is true?	
	A	The iron electrode is the negative electrode. No, it is the reduction electrode so will be positive.
	B	The iron electrode is the cathode. Yes, reduction ALWAYS happens at the cathode (by definition)
	C	The following half-equation takes place at the anode: $Fe^{2+} + 2e^- \rightarrow Fe$ This reaction does take place, but at the cathode (it's reduction)
	D	The electrons move through the wire from iron to magnesium. No, electrons move from the oxidation electrode (anode) to the reduction electrode (cathode)
	E	Chloride ions move through the salt bridge from the $MgCl_2$ into the $FeCl_2$ No, they move from the $FeCl_2$ to the $MgCl_2$, because the concentration of Fe^{2+} is decreasing and the concentration of Mg^{2+} is increasing
		1

2.	Which one of the following statements is false?	
	A	The overall net ionic equation is: $Fe^{2+} + Mg \rightarrow Fe + Mg^{2+}$ True - the Fe is reduced and the Mg oxidised
	B	Chloride ions are spectator ions in this cell True – of course they are
	C	The overall equation is $FeCl_2 + Mg \rightarrow Fe + MgCl_2$ True (notice that the Cl ions move from the Fe to the Mg)
	D	Reduction is taking place at the cathode True – reduction always takes place at the cathode (by definition)
	E	The magnesium electrode will get gradually bigger. False – it will get gradually smaller as Mg dissolves and becomes Mg^{2+} (ie is oxidised)
		1

3.	Which one of the following statements is false?	
	A	The iron (II) chloride solution will get gradually darker False – it will get gradually paler as the concentration of Fe^{2+} decreases
	B	The color of the magnesium chloride solution will not change True – the concentration of Mg^{2+} increases but you won't notice as it is colorless
	C	If the cell is re-charged, the following reaction will take place: $Fe + Mg^{2+} \rightarrow Fe^{2+} + Mg$ Yes, definitely – it's the reverse reaction
	D	The magnesium chloride solution will gradually become more concentrated True – it's one of the products (see B)
	E	In this cell, chemical energy is being converted into electrical energy. It's a galvanic cell, so yes
		1

Use this information to answer questions 4 – 5:
The lead-acid battery is used in cars. The reaction which takes place is:
$PbO_2 + Pb + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$

4.	Which one of the following statements is true?	
	A	The lead-acid battery is not easily rechargeable not true
	B	The cathode of the battery is made of Pb no, the anode is – Pb is oxidised
	C	The electrolyte in both compartments is sulfuric acid True – it's in the equation as a reactant so must be the electrolyte in one compartment; not obvious that it's in both but the other statements are definitely false
	D	The anode of the battery is made of PbO_2 no, the cathode is – PbO_2 is reduced
	E	The battery is easily portable because of its low density not true
		1

5.	Which one of the following statements is not true?	
	A	lead atoms are both oxidised and reduced in this reaction true - Pb is reduced from +4 (in PbO_2) to +2 (in $PbSO_4$) and oxidised from 0 (in Pb) to +2 (in $PbSO_4$)
	B	a disproportionation reaction takes place when the battery is charging true – in reverse, Pb in $PbSO_4$ (+2) would be both oxidised (to +4 in PbO_2) and reduced (to 0 in Pb) – this is disproportionation
	C	oxidation takes place at the anode – true, always, by definition
	D	The positive terminal of the battery is made of Pb no, the Pb is oxidised so it is the negative terminal
	E	the sulfate ions are neither oxidised nor reduced true, they are present in both reactants and products
		1

6.	The electrolysis of molten calcium chloride	
	A	is one of the only ways to make calcium metal true - the only way to make reactive metals is to electrolyse their molten chlorides or oxides
	B	involves the following reaction at the anode: $Ca^{2+} + 2e^- \rightarrow Ca$ this does happen, but at the cathode (it is reduction)
	C	involves the following reaction at the cathode: $Cl_2 + 2e^- \rightarrow 2Cl^-$ this does not happen: $2Cl^- \rightarrow Cl_2 + 2e^-$ happens at the anode
	D	is a way of producing an electric current no, in electrolysis we use an electric current to create a chemical reaction
	E	is not possible yes it is possible; not easy, but possible
		1

7.	Which of the following processes does not take place during the electrolysis of brine (concentrated aqueous sodium chloride)	
	A	$2Cl^- \rightarrow Cl_2 + 2e^-$ this is the oxidation half-equation at the anode
	B	$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ this is the reduction half-equation at the cathode
	C	$Na^+ + e^- \rightarrow Na$ no – this only happens in molten sodium compounds
	D	$2NaCl + 2H_2O \rightarrow H_2 + Cl_2 + 2NaOH$ this is the overall equation
	E	$2Cl^- + 2H_2O \rightarrow H_2 + Cl_2 + 2OH^-$ this is the overall net ionic equation
		1

8.	Which of the following is true of galvanic cells but not true of electrolytic cells?	
	A	Oxidation takes place at the anode. Always true. Always.
	B	Reduction takes place at the cathode. Always true. Always.
	C	The anode is the positive electrode. Only in electrolytic cells.
	D	The anode is the negative electrode. Only in galvanic cells.
	E	Electrical energy is converted into chemical energy. Only in electrolytic cells.
		1

9.	The electrolysis of aqueous copper sulfate produces At the cathode: Cu^{2+} or H^+? Cu^{2+}, because Cu is less reactive than H, so you get Cu At the anode: OH^- or SO_4^{2-}? OH^-, because SO_4^{2-} is hard to oxidise, so you get O_2	
	A	copper at the cathode and sulfur at the anode (sulfur at the anode – never!)
	B	copper at the cathode and oxygen at the anode (yes)
	C	hydrogen at the cathode and oxygen at the anode (often, but not when Cu^{2+} is also around)
	D	hydrogen at the cathode and sulfur at the anode (never sulfur)
	E	copper at the anode and sulfur at the cathode (never sulfur)
		1

10.	Iron is often covered with a layer of zinc to stop it from rusting. To do this, the iron is dipped in molten zinc in a process called "galvanising". It is not possible to electroplate iron with a layer of zinc from an aqueous solution of zinc sulfate. This is because Note: the only ions which can be electroplated out of an aqueous solution are those below hydrogen in the reactivity series (ie Cu, Ag and Au)	
	A	iron is more reactive than zinc
	B	zinc is more reactive than iron
	C	zinc is more reactive than hydrogen
	D	iron is more reactive than hydrogen
	E	oxygen is more reactive than sulfur
		1

Go to the answer sheet