

6.1 Energetics of a reaction

01. 0620_s15_qp_33 Q: 6

Chemical reactions are always accompanied by an energy change.

(a) Aluminium is extracted by the electrolysis of a molten mixture which contains aluminium oxide, Al_2O_3 . This decomposes to form aluminium at the negative electrode and oxygen at the positive electrode.

(i) Write an ionic equation for the reaction at the negative electrode.

..... [2]

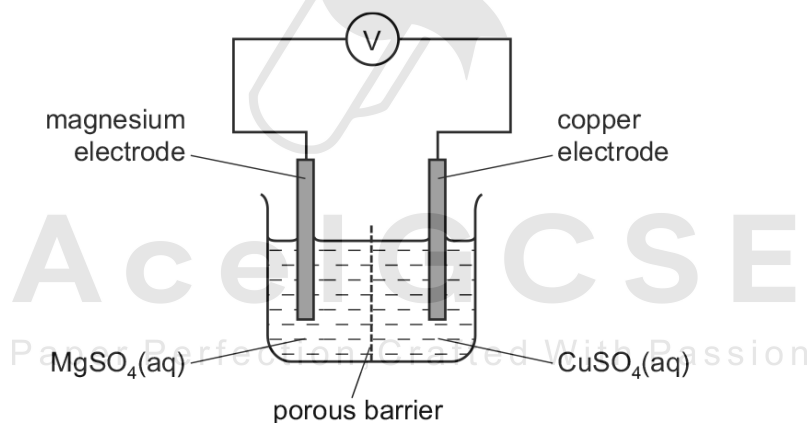
(ii) Complete the ionic equation for the reaction at the positive electrode.



(iii) Is the reaction exothermic or endothermic? Explain your answer.

.....
 [1]

(b) The cell shown below can be used to determine the order of reactivity of metals.



(i) Is the reaction in the cell exothermic or endothermic? Explain your answer.

.....
 [1]

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- (ii) Explain why the mass of the magnesium electrode decreases and the mass of the copper electrode increases.

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..... [2]

- (iii) How could you use this cell to determine which is the more reactive metal, magnesium or manganese?

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..... [2]

- (c) The combustion of propane, C_3H_8 , is exothermic.

Give an equation for the complete combustion of propane.

..... [2]

- (d) Photosynthesis is an unusual endothermic reaction.

- (i) Where does the energy for photosynthesis come from?

..... [1]

- (ii) Give the word equation for photosynthesis.

..... [1]

[Total: 14]

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(a)(i)	$Al^{3+} + 3e \rightarrow Al$ formula of Al^{3+} ion; rest correct;	2	A multiples I state symbols A – 3e on right
(a)(ii)	$2O^{2-} \rightarrow O_2 + 4e$ species; balancing;	2	A multiples I state symbols A – 4e on left
(a)(iii)	endothermic AND (electrical) energy supplied;	1	A energy required to break bonds
(b)(i)	exothermic AND (electrical) energy release;	1	I heat energy
(b)(ii)	magnesium forms ions (in solution) OR magnesium loses electrons OR magnesium is oxidised; copper is deposited (on the electrode) OR copper ions become copper atoms OR copper ions gain electrons OR copper ions are reduced;		A magnesium dissolves / goes into solution A equation (balanced or unbalanced) A equation (balanced or unbalanced) I use of terms anode or cathode
(b)(iii)	M1 set up a magnesium / manganese cell; M2 the negative electrode (is the more reactive) OR the electrode that loses mass (is more reactive); OR M1 replace magnesium with manganese; M2 if voltage less (positive) manganese is less reactive OR if voltage is more (positive) manganese is more reactive;	2	A replace Cu with Mn A converse
(c)	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ species; balancing;	2	A multiples I state symbols
(d)(i)	(light from the) sun/sunlight;	1	A uv
(d)(ii)	carbon dioxide + water \rightarrow glucose + oxygen;	1	A starch / sugar / (named) carbohydrate I energy or light on LHS