CATHODIC PROTECTION

5.3.1

(a) Titanium is produced by the reduction of its chloride. This is heated with magnesium in an inert atmosphere of argon.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

(i) Explain why it is necessary to use argon rather than air.

..... [1]

(ii) Name another metal that would reduce titanium chloride to titanium.

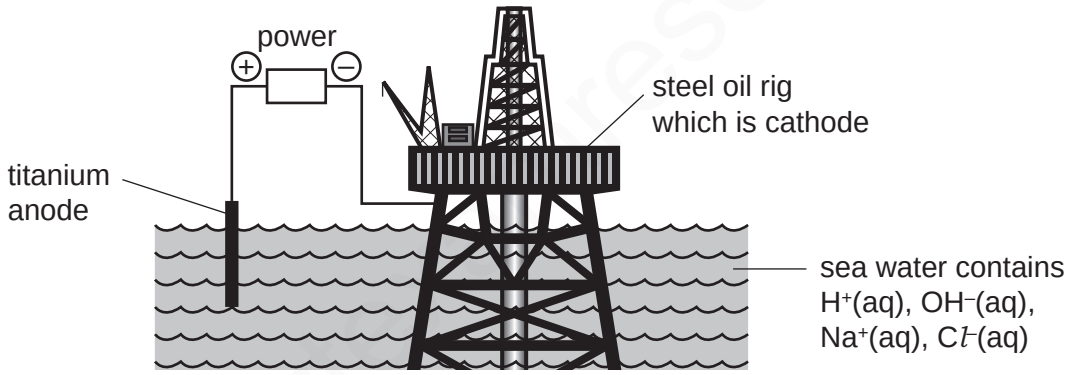
..... [1]

(iii) Suggest how you could separate the metal, titanium, from the soluble salt magnesium chloride.

.....

..... [2]

(b) Titanium is very resistant to corrosion. One of its uses is as an electrode in the cathodic protection of large steel structures from rusting.



(i) Define oxidation in terms of electron transfer.

..... [1]

(ii) The steel oil rig is the cathode. Name the gas formed at this electrode.

..... [1]

(iii) Name the **two** gases formed at the titanium anode.

..... and ..... [2]

(iv) Explain why the oil rig does not rust.

.....

..... [2]

(v) Another way of protecting steel from corrosion is sacrificial protection.
Give **two** differences between sacrificial protection and cathodic protection.

.....

..... [2]

[Total: 12]

(a) (i) air would react (with the magnesium **or** titanium)
OR argon would not react (with the metals) [1]
NOT argon is inert

(ii) any metal higher than magnesium in reactivity series [1]

(iii) add water (to dissolve salt) [1]
filter **or** centrifuge [1]

(b) (i) electron loss [1]

(ii) hydrogen [1]

(iii) oxygen [1]
chlorine [1]

(iv) it cannot lose electrons (because) [1]
it receives electrons (from the battery) [1]

OR reduction occurs at the cathode [1]
oxidation at the anode (not cathode) [1]

OR electrons are "pushed" to rig [1]
preventing it from being oxidised [1]

for comments of the type – rusting needs oxygen, it is formed on titanium not iron **ONLY** [1]

NOT the idea that titanium is more reactive etc

(v) **SET 1**
sacrificial protection is a cell
does not need electricity
cathodic protection is electrolysis
cathodic protection needs electricity

SET 2
sacrificial protection needs a more reactive metal (in contact with iron or steel)
this metal corrodes instead of steel
cathodic protection needs an inert electrode accept unreactive or less reactive metal as an electrode
has to be **ONE** comment from each set [2]
all comments about oxide layers and coating are neutral

[Total: 12]