



# 12

## SULFUR

*Learning Outcomes:*

Candidates should be able to:

Supplement

- (a) Name some sources of sulfur
- (b) Name the use of sulfur in the manufacture of sulfuric acid
- (c) Name the uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper and as a food preservative (by killing bacteria)
- (d) Describe the manufacture of sulfuric acid by the Contact process, including essential conditions
- (e) Describe the properties of dilute sulfuric acid as a typical acid

# 12 Sulfur

## MCCQs

12-1-M-01

examined in 2012 Nov P1 Q2

**B**

Since both sulfur and iron filings are insoluble in water, water cannot be used to separate the mixture.

Sulfur is soluble in carbon disulfide but not iron filings, hence carbon disulfide can be used to separate the mixture.

Iron filings are attracted to a magnet, but not sulfur, hence a magnet can be used to separate the mixture.

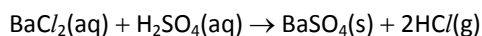


12-1-M-02

examined in 2012 Nov P1 Q16

**A**

Barium chloride is soluble in water. It reacts with sulfuric acid:

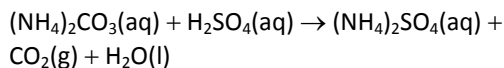


Barium sulfate is insoluble in water and dilute sulfuric acid. Hence a white precipitation is formed. Bubbles of hydrogen chloride gas can be seen given off.

Barium carbonate is insoluble in water and sulfuric acid. Hence it cannot form an ionic solution.

Ammonium chloride is soluble in water and dissociates into  $\text{NH}_4^+$  and  $\text{Cl}^-$ , while sulfuric acid dissociates to form  $\text{H}^+$  and  $\text{HSO}_4^-$ . There is no reaction and no precipitation will form.

Ammonium carbonate is soluble in water and reacts with sulfuric acid to give ammonium sulfate and carbon dioxide:



Ammonium sulfate is soluble in water and hence no precipitation will form.



## Questions – 12

12-1-Q-01

examined in 2012 Nov P2 Q7

- (a) Number of atoms in 3 molecules of sulfur is  
 $8 \times 3 = 24$
- (b)  $A_r$  of sulfur = 32  
 $M_r$  of sulfur =  $32 \times 8 = 256$
- (c) Crude oil contains a small percentage of sulfur. When crude oil is burnt, the sulfur reacts with oxygen to form sulfur dioxide.  
 Sulfur dioxide then reacts with oxygen to form sulfur trioxide.  
 Sulfur trioxide react with water to form sulfuric acid.  
 $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$   
 $\text{SO}_3(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$
- (d) Nitrogen and phosphorus.
- (e) Test: add acidified barium chloride  
 Result: a white precipitate is observed



12-1-Q-02

examined in 2012 Jun P3 Q4

A catalyst would not affect the yield and change the position of equilibrium of the reaction.

Increasing the temperature would reduce the yield and favour the backward reaction.



12-1-Q-03

examined in 2011 Jun P3 Q4

In order for the Contact Process to achieve a high yield, a low temperature is needed.

However, setting a low temperature would reduce the rate of reaction and render the process uneconomic. Hence the optimum temperature is chosen at  $450^\circ\text{C}$ .

The use of catalyst would increase the rate of reaction at a given temperature, without lowering the yield at that temperature.

Hence the catalyst enables a higher yield at lower temperature.



Increasing the pressure would increase yield, but would increase the cost of operation.



12-1-Q-04

examined in 2011 Nov P2 Q5

- (i) sodium chloride
- (ii) Group VI
- (iii) Sulfur dioxide dissolves in water in the atmosphere to form acid rain. Acid rain acidifies lakes and rivers, killing the fishes in these water bodies
- (iv) Calcium oxide
- (v) Magnesium gains oxygen and increases its oxidation number  
Sulfur dioxide loses oxygen and decreases its oxidation number



**Notes:**