SULPHUR AND ITS COMPOUNDS   MARKING SCHEME

1. **1989 Q31**

    SO_2 and SO_3 react with water vapour in atmosphere to form sulphurous acid or sulphuric (acid rain)

2. **1991 Q20**

    Oxidation /reduction/redox

3. **1993 Q16**

    SO_3 gives alot of heat / highly exothermic/explosive hence fumes are formed/little acid is Formed

4. **1994 Q6**

    V = $BaSO_3$
    W = SO_2

5. **1995 Q17**

    (a) (I) molten sulphur
        (II) Steam (hot water)

    (b) To melt the sulphur into molten

6. **1996 Q24 P1**

    a) H_2S because it is oxidized by losing hydrogen/oxidation number s us increased from -2 to 0. Cl_2 is reduced from 0 to -1.
    b) Theoretical yield of S = 2.4 x $\underline{100}$ =3.2g
         75
         Mole of $H_2S(g)$ = Moles of S(s) = $\underline{3.2}$ = 0.1mol
         32

7. **1999 Q5 P1**

    i) $SO_2(g)$ + NO_2 (g) $\longrightarrow$ SO_3 (g) + NO(g)
        Oxidation number of sulphur increases (I)
         OR
        Oxidation number of nitrogen decreases
    ii) Sulphur dioxide or SO_2 is the reducing reagent (I)

8. **1999 Q11 P1**

    Sulphuric acid reacts with Ba^{2+} to form insoluble Barium Sulphate (I) which covers the sulphate and stops reaction (I)
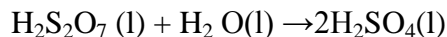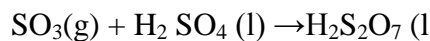
9. **2000 Q23**

    Solid sulphur is made of S8 rings. It melts into a liquid of S8 rings, On further heating the rings open up to form long chains of sulphur atoms, which then entangle making it viscous and dark, or sulphur melts into S8 molecules. The molecules join up to form long chain which entangle making it viscous and dark.

10.   **2001 Q11**

SO_2 which is poisonous is released in the air. Acid rain which may cause corrosion will be formed

11.   **2001 Q12**

Add dilute acid (e.g. HCI or H_2SO_4) to each substances separately. If Na_2S, colourless gas, smell of rotten eggs

12.   **2001 Q20**

(a) A black solid formed

(b) $Zn(NO_3)_2$ (aq) + H_2S (g) →ZnS + $2HNO_3$ (aq)

   Or Zn^{2+}(aq) + S^{2-}(g) →ZnS(s)

   Or Zn^{2+}(aq) + HS(g) →ZnS(s) + H^+ (aq)

13.   **2002 Q8**

(a) C_2 = Fes, Zns (1)

(b) It is soluble in cold water (1)

(c) it turns black (1)

14.   **2002 Q12**

Concentrated nitric acid is a strong oxidizing agent (½). It oxidizes pale iron (II) (½) to yellow iron (III) (½) and it is   reduced to nitrogen dioxide (1) which is brown (½)

(3 marks)

15.   **2002 Q21**

a) $2NaOH$(aq)   + H_2SO_4(aq) ⟶ Na_2SO_4(aq) +H_2O(l)   (3 marks)

b) Blue litmus paper turn remains red

(c) The acid was in excess (l)

16.   **2003 Q15 P1**

a) Add water to the oluem carefully

b) - Making NH_4SO_4 fertilizer

   - Paints manufacture

   - Manufacture of detergents

   - Esters

   - Explosives

   - HCl acid

   - Dehydration

   - Drying gases

17.   **2004 Q4 P1**

a) Sulphur dioxide

   Thistle funnel dip in the non mixture

b) (i) The gas escape through the thistle funnel (1)

   -the gas should be shorter or rising ½ the delivery tube above the mixture.
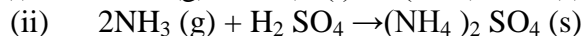
18.   2004 Q3 P2

    (a)   Accept outermost pipe

    (b) (i)   Platinum/ vanadium (v) Oxide

       (ii) I   The yield decreases. The extra heat decomposes or the forward rxn
             is exothermic/ equilibrium shifts to the left. Rej. Forward rxn is favoured

          II   Yield increases. There is increase in pressure/ equilibrium shifts to the right

      (iii)   Dissolve in Conc H_2SO_4 to make oleum. The Oleum is diluted with water to
            make sulphuric acid.
        Accept equation

$$SO_3(g) + H_2SO_4\ (l) \rightarrow H_2S_2O_7\ (l$$

$$H_2S_2O_7\ (l) + H_2O(l) \rightarrow 2H_2SO_4(l)$$

    (c) Formation of acid rain
       It is poisonous / Harmful

    (d) (i) $2NH_3(g) + H_2S)_4\ (l) \rightarrow (NH_4)_2\ SO_4(s)$

       (ii) $2NH_3\ (g) + H_2SO_4 \rightarrow (NH_4\ )_2\ SO_4\ (s)$
           R.m.m of H_2SO_4 = 98
           R.m.m of $(NH_4)_2\ SO_4$ = 132
            Moles of fertilizer = $\dfrac{25 \times 1000}{132}$

                = 189.4 or 189.3
             Moles of H_2SO_4 = 189.4
            Mass of H_2SO_4 = $\dfrac{189.4 \times 98}{1000}$

                = 18.56 KG
          Mass of H_2SO_4 = $\dfrac{25 \times 98}{132}$ = 18.56 kg

19.   2005 Q8 P1

    Let the oxidation state of S be x:
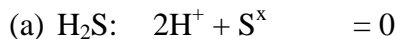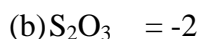
    (a) H_2S: $2H^+ + S^x$ = 0
        + 2 + x   = 0
            x   = -2
    (b) S_2O_3 = -2
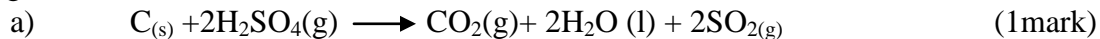   2x + 3x -2 =2
       2x + 6 = 2
       2x = 4
        x =2

20.   2005 Q24 P1

    a)   A yellow deposit of sulphur and a colourless liquid are formed.
    b)   The experiment should be performed in a fume chamber as both the
        reactants are poisonous.

21.   2006 Q6 P1

    a) $C_{(s)} + 2H_2SO_4(g) \longrightarrow CO_2(g) + 2H_2O\ (l) + 2SO_{2(g)}$ (1mark)
    b) Carbon changes from 0 to +4 .. Oxidation has taken place
       Sulphur changes from +6to +4.. Reduction has occurred   (2marks)

22. 2006 Q16 P1

a) The solution changed from brown/yellow to light/pale green.   (1mark)

b) $2FeCl_{3(aq)} + H_2S_{(g)} \longrightarrow 2FeCl_{2(aq)} + 2HCl_{(aq)} + S_{(s)}$ (1mark)

c) Oxidation.   (1mark)

23. 2006 Q4 P2

a) (i) $2\,PbS_{(s)} + 3O_2(g) \longrightarrow 2PbO(s) + 2SO_2(g)$ (1mark)

(ii) To avoid poisoning of the catalyst   (1mark)

(iii) SO_3 is absorbed in 98% conc. Sulphuric acid to make Oleum

Or $SO_2 + H_2SO_4 \longrightarrow H_2S_2O_{7(l)}$ (1 mark)

(iv) $SO_2(g)$ and $SO_3(g)$ (1mark)

(v) They form acid rain which corrodes buildings / toxic – kills
/causes respiratory problems.   (1mark)

(vi) To minimize costs   (1mark)

b) i)
Substance	Observations
Iron filings	-Effervescence starts and stops immediately.
	- Bubbles of a colourless gas with a pungent smell.
	- A brown solution is formed (1mark)
Crystal of white sugar	- Black spongy solid (1mark)

ii) I Heating is required for conc.H_2SO_4 to react
Some SO_2 is formed /produced   (1mark)

II Formation of Carbon by dehydration of sugar.   (1mark)

c) $(NH_4)SO_4$ – Ammonium sulphate.   (1mark)
$2CaSO_4 + Ca(H_2Po_4)_2$ Calcium super phosphate   (1mark)

d) it is insoluble in water hence cannot be washed easily.   (1mark)

23. 2007 Q30 P1

The molecules which were inform of a ring open up to give chained molecules (S_8).
This entangles each other reducing the flow of molten sulphur and increases its
Viscosity

24. 2008 Q8 P1

(a) A black solid

(b) Fes (s) + 2 HCL_2(aq) → $FeCL_2$ (aq) + H_2S(g)

(c) The powder has a larger surface area than the iron fillings hence the
Reaction is faster

25. 2008 Q9 P1

$Zn(s) + H_2SO_4 (aq) \rightarrow ZnSO_4(aq) + H_2(g)$

$Zn(s) + 2H_2SO_{4\,(I)} \rightarrow ZnSO_4(aq) + SO_2 (g) + 2H_2O_{(l)}$
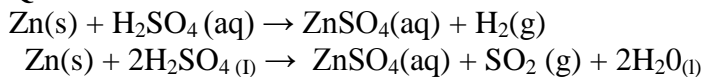
26. 2008 Q30 P1

It burns to form SO_2SO_3 which is a pollutant
Accept any other effect e.g. – Acid rain
- Corrosion of buildings
- Irritation of respiratory systems

- Yellowing of leaves of plants

27.   2009 Q22 P1

Tests 2 (½) and 3 (½) for test 2 iron is above hydrogen in the reactivity series hence it displaces hydrogen (i) for test 3. Dilute sulphuric acid is not an oxidizing agent (1).

28.   2010 Q11 P1

a) Iron(II) sulphide   or conc sulphide / copper sulphide (Accpt. formula: Fes/ HCl)
   Hydrochloric acid or lead (II) sulphide/ HNO_3

b) Hydrogen sulphide
   The sulphur changes from -2 to zero/(it reduces SO_2 to S) i.e. +4
   to 0 /sulphur lost e's in the H_2S to form sulphur.

c) Vulcanization of rubber
   Manufacture of sulphur drugs
   Manufacture of gun powder/ match sticks / explosives/ fungicides

29.   2011 Q1 P2

a)

Purify to remove impurities, bubble through NaOH/KOH to remove CO_2, Reduce the temperature to remove water vapour, compress to liquidify the residue air, then fractional distillation to obtain oxygen at -183^oC.

b)   (i) Concentrated sulphuric (VI) acid

       (ii) $SO_{3(g)}$ + $H_2SO_{4(l)}$ $\longrightarrow$ $H_2S_2O_{7\ (l)}$
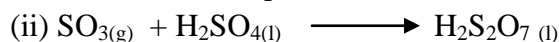
c) (i) Platinum / platinum asbestos

   (ii)
     It is cheap / cheaper
     Not easily poisoned / action stopped by impurities

(d)
   ▪ Turns blue to white. Forms white powder.
   ▪ Sulphuric (VI) acid dehydrates copper (II) sulphate crystals
   ▪ Removes water of crystallization

e)   -It is less volatile/ volatility/ in volatile

(f)
   ▪ Manufacture of sulphate fertilizer
   ▪ Superphosphate fertilizer
   ▪ production of Rayon/ making dyes/
   ▪ Used in car batteries/ as an electrolyte
   ▪ Manufacture of soaps, detergents/ cleaning of metals.
   ▪ Manufacture of paints HCl/HNO_3, oleum
   ▪ As a drying agent a dehydrating agent/ manufacture of nylon/ AI_2SO_4/ $ALCOH_3$/ sulphate drugs, pigments

30. 2012 Q18 P1

(a) SO_2/ sulphur (vi) oxide

Oxidation number of S increases from +4 to +6

(b) –food preservative
- bleaching agent
- Fumigant
- Disinfectant

31. 2012 Q25

– vol of 2M KOH = 100cm3 (or mols = $\underline{0.4}$ = 0.2)

                                                             2

-    Mix the KOH(aq) and H_2SO_4 acid
- Concentrate the mixture / heat the mixture
- Crystalise/cool the solution (or heating the solution to dryness)
- Dry crystals