

- 1 (i) USA **or** Texas **or** Poland **or** Mexico **or** Japan **or** Ethiopia  
Australia **or** Sicily [1]  
accept other sources of sulphur eg petroleum  
**or** natural gas **or** metal sulphides **or** volcanoes  
**NOT** coal, **NOT** underground
- (ii) Preserving food **or** bleaching **or** sterilising **or**  
disinfecting **or** making paper **or** bleaching wood pulp [1]  
**or** wine **or** jam **or** fumigation **or** making paper  
**NOT** making wood pulp
- (iii) burnt/roast in oxygen **or** air [1]
- (iv) vanadium(V) oxide **or** vanadium oxide **or** platinum [1]  
ignore oxidation state of vanadium
- (v) Increase temperature (increases rate) but reduces yield [1]  
catalyst only increases rate **or** a catalyst does not [1]  
influence position of equilibrium  
**NOT** a definition of a catalyst
- (vi) sulphur trioxide + sulphuric acid = oleum [1]  
correct symbol equation acceptable
- (vii)  $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} = 2\text{H}_2\text{SO}_4$  [1]
- (b) potassium [1]
- (ii) ammonium sulphate [1]
- (iii)  $\text{Ca}_3(\text{PO}_4)_2$  [1]  
 $\text{Ca}(\text{H}_2\text{PO}_4)_2$  [1]
- (iv) only acceptable responses are:  
accepts a proton [2]  
accepts  $\text{H}^+$  [1] only
- TOTAL = [14]**

- 2 (a) (i) preserve food **or** sterilising [1]  
(ii) making paper [1]
- (b) (i) making sulphuric acid **or** Contact Process [1]  
(ii) oxygen [1]  
(iii) vanadium oxide as catalyst (ignore oxidation state)  
400 to 500 °C  
pressure less than 10 atm  
**Any TWO** [2]
- (c) (i) pink **or** purple [1]  
colourless **NOT** clear [1]  
(ii) barium sulphate [1]  
**cond** bromine oxidises **or** reacts with [1]  
sulphur dioxide to form sulphate ion [1]
- (d) the number of moles of SO<sub>2</sub> in the mixture = 0.125  
the number of moles of Cl<sub>2</sub> in the mixture = 0.2  
**cond** reagent was not in excess? SO<sub>2</sub>  
**cond** moles of SO<sub>2</sub>Cl<sub>2</sub> formed = 0.125  
**cond** the mass of sulphuryl chloride formed = 16.9g

[5]

TOTAL = 16

TOTAL for PAPER = 80

- 3 (a) (i) vanadium(V) oxide as catalyst - ignore oxidation state  
and accept no oxidation state  
temperature 300 to 600 °C  
pressure up to 10 atmos, accept atmospheric pressure  
volume ratio of gases either 2:1 or slight excess of oxygen  
ANY three [3]
- (ii) decrease [1]  
COND back reaction is endothermic or same argument based on  
forward reaction is exothermic [1]  
or increase in temp favours back reaction
- (iii) dissolve in (conc) sulphuric acid NOT dilute [1]  
add water or dilute [1]
- (b) sodium hydroxide or carbonate or hydrogencarbonate [1]  
zinc oxide or hydroxide or carbonate [1]  
NOT zinc  
barium nitrate or chloride or hydroxide or barium ions [1]  
neutralisation NOT acid/base [1]
- (c) (i) copper sulphate or anhydrous copper sulphate [1]  
accept "unhydrated"  
NOT formula  
(ii) goes blue or becomes hot or steam [1]  
(iii) copper oxide [1]  
(iv)  $5/250 = 0.02$  moles [1]  
Mr = 80 [1]  
 $80 \times 0.02 = 1.6$  g [1]  
NB (iv) to be marked **conseq** to (iii)  
Correct answer no working **ONLY** [1]

TOT =17

Question	Answer	Marks
4(a)	$\frac{2}{2}^2$ ; <b>or</b> S ;	1
(b)	test conductivity; gold conducts/ora; <b>or</b> malleability / hit with a hammer; gold malleable / only gold produces ringing sound / ora; <b>or</b> density; gold denser / ora; <b>or</b> add acid / any named / formula of acid; gold does not react (ignore products with pyrites) / ora; <b>or</b> heat (both strongly) in air / oxygen; iron pyrite reacts (ignore products); <b>or</b> melting point; gold lower / ora; <b>or</b> heat with a more reactive metal than iron; gold does not react / ora;	2
(c)(i)	$2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$ all formulae; balancing;	2
(c)(ii)	bleaching (in the manufacture of) wood pulp (for paper or straw or wool or cotton) / (food) preservative or killing bacteria in food or wine / fumigant / refrigerant / tanning(leather);	1

Question	Answer	Marks	Guidance
5(a)	Any <b>two</b> fossil fuels from: crude oil / petroleum; natural gas / methane; petrol / gasoline; kerosene / paraffin; diesel (oil) / gas oil; fuel oil; refinery gas / LPG; propane; butane;	2	I ethane / oil / naphtha / coal / gas  R coke / bitumen / lubricating oil / wood
(b)	hydrog oxygen, nitrogen; <i>All three for 2 marks two for 1 mark</i>	2	H, O, N I H <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub>
(c)(i)	M1 oxygen and nitrogen (from air) react;  M2 oxides of nitrogen <b>OR</b> nitrogen oxide(s) are formed;  M3 nitrogen oxides formed react with water (to form acid);	3	A nitrogen combust for M1 R M1 if oxygen or nitrogen originate from the fuel  A named oxide of nitrogen e.g. nitrogen dioxide A correct formulae A NO <sub>x</sub>

Question	Answer	Marks	Guidance
5(c)(ii)	<p>Any <b>two</b> from:</p> <p>M1 lowers pH or acidifies lakes/ rivers or kills fish;</p> <p>M2 changes composition of soils or reduces fertility of soil or reduces crop yields deforestation or kills crops/trees/plants/leaves;</p> <p>M3 attacks (limestone) buildings or statues;</p> <p>M4 attacks metal (structures)/bridges;</p>	3	<p>R 'global warming/ greenhouse effect'</p> <p>R 'increases pH of lakes so kills fish' for M1</p> <p>A removes nutrients/leaches the soil</p> <p>A alternative words for 'attacks' e.g. damages/ reacts with/ corrode/ erode for M3 and M4</p> <p>I rusting but A 'enhances rusting' for M4</p> <p>I toxicity to humans</p>
(d)	<p>Any <b>three</b> from:</p> <p>M1 wood burns to produce (less) carbon dioxide;</p> <p>M2 trees (wood) take in carbon dioxide;</p> <p>M3 by photosynthesis;</p> <p>M4 wood is carbon neutral fuel;</p>	3	