

- 1 (a) M1 brass [1]
M2 copper **COND** on M1 [1]
- (b) (i) $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$ [2]
species (1) balancing (1)
- (ii) Manufacture of sulfuric acid
or bleach or making wood pulp or making paper
or food or fruit juice or wine preservative
or fumigant or sterilising [1]
- (c) (i) sulfuric acid [1]
- 4 (c) (ii) $\text{Zn}^{2+} + 2\text{e} \rightarrow \text{Zn}$ [1]
oxygen or water Allow O_2 and H_2O if no name seen [1]
sulfuric acid [1]
Allow: H_2SO_4 if no name seen
- 4 (d) (i) from zinc to carbon
(clockwise direction on or near the wire) [1]
- (ii) to allow ions to flow [1]
- (iii) oxidation
and loss of electron(s) or increase in oxidation number/state [1]
reduction
and decrease in oxidation number/state or gain of electron(s) [1]

[Total: 13]

- 2 (a) (i) named noble gas [1]
accept: any noble gas
accept: symbol
- (ii) H_2O / CO_2 [1]
not: names **not:** equations
- (b) oxygen and nitrogen (in air) (react) [1]
at high temperature [1]
accept: in engines / lightning **not:** in exhausts
- (ii) fossil fuels / fuels which contain sulfur [1]
accept: named fossil fuel such as coal / oil / natural gas
burn / combust [1]
- (iii) any two from:
damage buildings / soil acidification / leaching from soil / soil nutrients become
unavailable / kill microbes / acidify lakes / kill fish / damage trees / reduction in plant
growth / crop loss [2]
- (c) oxygen reacts with copper [1]
to form copper oxide (which is black) [1]
- (ii) measure volume at room temperature / gas has different volumes at different
temperatures / volume of gas depends on temperature / hot gas has higher volume /
heat causes expansion (of gases) / ORA [1]
- (iii) no oxygen left **or** all the oxygen has reacted (with copper) [1]
- (iv) $39-40 \text{ cm}^3$ **note:** units required [1]

- 3 (a) (i) bleach for wood pulp **or** preserving food **or** sterilising
or in wine making **or** as a refrigerant **or** in metallurgy **or**
 (liquid) sulphur dioxide is used in the petroleum industry
or kill microbes(etc) **or** insecticide [1]
- (ii) (react with) oxygen **or** air [1]
NOT burnt/burn in air/oxygen [1]
 450°C [1]
 vanadium oxide catalyst (if oxidation state given has to be correct) **or** platinum [1]
 If four conditions are given which include high pressure then **MAX** [2]
 High pressure is incorrect **MAX** 10 atm.
- (iii) ammonium sulphate **or** superphosphate [1]
or potassium sulphate **or** magnesium sulphate
- (b) (vapourisation **or** boiling **or** evaporation [1]
 condensation **or** liquefaction [1]
NOTE order in which changes are given is not important
NOT liquid => gas => liquid
- (ii) to get maximum yield of zinc **or** reduce all zinc oxide [1]
NOTE the above mark is awarded for why add excess carbon moves equilibrium to
 right **or** to favours the products **or** removes CO₂ from equilibrium [1]
NOTE this mark is awarded for how does the addition of excess carbon give max
 yield of zinc
NOTE Allow any coherent explanation flexibly based on the above ideas
EXAMPLES:
 moves equilibrium to right [1] because carbon dioxide removed [1]
 to get maximum yield of zinc [1] as equilibrium moves to right [1]
NOT just to make CO from CO₂
- (c) $Zn^{2+} + 2e = Zn$ [1]
- (ii) $4OH - 4e = O_2 + 2H_2O$ [2]
or $4OH = O_2 + 2H_2O + 4e$
or $2H_2O = 4H^+ + O_2 + 4e$
or $2H_2O - 4e = 4H^+ + O_2$
 oxygen as product [1]
- (iii) sulphuric acid [1]
NOTE there are no alternative answers to the above
- (d) prevent iron from rusting **NOT** with galvanising **or** sacrificial protection
 making brass **or** making alloys **NOT** bronze
 electroplating **or** as an electrode in electrolysis
 cells
 roofing
 sacrificial protection
 coinage
TWO uses [2]

[Total: 15]

- 4 (a) (i) correct word equation (carbon dioxide and water) [1]
Accept correct symbol equation
- (ii) Must have a correct reagent otherwise wc = 0 [1]
 add (acidified) barium chloride(aq) **or** nitrate **or** add barium ions [1]
COND white precipitate [1]
NOT lead(II) compounds
- (iii) low pH **or** universal indicator turns red(aq) [1]
 pH 3 **or** less
- (b) $\text{H}_2\text{S} + 2\text{O}_2 = \text{H}_2\text{SO}_4$ [2]
 unbalanced [1]
- (ii) unpleasant smell **or** it is poisonous **or** when burnt forms acid rain **or** forms sulphur dioxide **or** forms sulphuric acid [1]
NOT it is a pollutant
- (iii) 2H to 1S
COND 8e around sulphur atom
 2e per hydrogen atom
THREE correct [2]
TWO from above [1]
 Ionic structure = [0]
- (c) vanadium oxide **or** vanadium(V) oxide **or** vanadium pentoxide or V_2O_5 [1]
 Must be correct oxidation state if one given
- (ii) 400 to 500° C [1]
- (iii) add to (concentrated) sulphuric acid **NOT** dilute [1]
COND (upon sulphuric acid) above then add water [1]
- (d) mass of one mole of $\text{CaSO}_4 = 136$
 moles of CaSO_4 in 79.1g = 0.58 accept 0.6 [1]
 moles of H_2O in 20.9 g = 1.16 accept 1.2 [1]
conseq x = 2 x given as an integer [1]

TOTAL = 16