RECOGNISING ACHIEVEMENT

Subject: …Environmental Chemistry
……Code:2815/03…….
Post stand 02/2/05

Session: January... Year: 2005…….

Mark Scheme

MAXIMUM MARK	45

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

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Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit ___ = (underlining) key words which **must** be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument	

1.(a)(i)	By oxidation and reaction with water✓ $SO_2 + 0.5O_2 + H_2O \longrightarrow H_2SO_4$ ✓ Accept formation of sulphurous acid and subsequent oxidation for the first mark. If they split the process and provide two equations give the second mark. If they only go as far as sulphurous acid give max one mark.	**2**
(ii)	Find two marks for the correct answer by any viable route eg Moles of H_2SO_4 = moles SO_2 = 1.2×10^{13} /64 /= 1.87×10^{11} mol ✓ Mass of H_2SO_4 = $98 \times 1.2 \times 10^{13}/64$ g = 1.84×10^{13} g = 18 400 000 tonnes ✓ Max ½ if answer given to 4 or more sig figs.	**2**
(b)	Dissolves/erodes them ✓ Not corrosion. $CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$ ✓ Accept H_2CO_3	**2**
(c)(i)	$CaCO_3 + H_2CO_3 \longrightarrow Ca(HCO_3)_2$ One ✓ for either H_2CO_3 or $Ca(HCO_3)_2$ and ✓ for rest. Accept $H_2O + CO_2$	**2**
(ii)	Limestone is basic and CO_2 acidic AW ✓. Accept answer based on proton transfer.	**1**
	Question total	**9**

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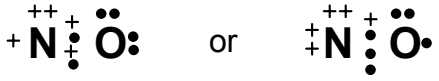
Question	**Expected Answers**			**Marks**
2.(a)	Lower part of atmosphere/first 10 to 16 km of atmosphere above earth.✓ Accept any figure in this range.			**1**
(b)(i)	Electromagnetic/UV radiation. Accept sunlight/light energy✓, but not radiation alone. Accept h = Planck's constant and f=frequency.			**1**
(ii)	 or ✓			**1**
(iii)				**1**
(c)	It has an unpaired electron ✓			
(d)(i)	Oxygen split by solar radiation/equation ✓ Oxygen atom/radical combines with oxygen molecule/equation ✓ (no need to mention energy sink M)			**2** **2**
(ii)	Ozone adds to double bonds ✓ and breaks them/forming carbonyl compounds ✓			**1**
(e)(i)	Cracking /perishing/becoming brittle AW✓			**1**
(ii)	It absorbs infrared radiation. AW ✓			**1**
(f)	Concentration/residence time is low ✓			**1**
	Does not produce toxic organochlorine compounds AW ✓.			**12**
		Question total		

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3.	Look for 9 points from the following: • Landfill anaerobic – Incineration aerobic ✓ • Landfill gas can be burnt to provide energy as heat or electricity – incineration provides heat and electricity directly ✓ • Landfill releases greenhouse gases (methane and carbon dioxide✓) slowly – incineration releases greenhouse gas CO_2 fast✓. • Landfill produces toxic hydrogen sulphide ✓ - incineration can produce acidic HCl, SO_2 and NO_x by burning polymers/plastics✓. • Landfill has about ten times the bulk of incineration ash✓. • Need to control leachate (of heavy metal ions or soluble organic compounds) from landfill ✓ - need to control temperature of incineration to prevent dioxin etc formation✓ and need to scrub/clean flue gas from incineration to prevent acid rain etc ✓. • Non –biodegradable plastics persist a long time in landfill – destroyed by incineration✓. • Landfills unsightly/attract rodents/ smelly ✓. The QWC mark is for good organisation with at least two similarities or comparisons clearly stated. Question total	**9** **1** **10**
Question	**Expected Answers**	**Marks**

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4. (a)	2:1 clays have no hydrogen bonding between layers ✓ and water can easily enter swelling the clay✓ it can leave equally easily causing clay to contract✓ 1:1 clays are hydrogen bonded between layers ✓ (detail of this – between OH on octahedral sheet and O on tetrahedral sheet AW ✓) and water cannot get in. Find any 4 marks	**4**
(b)(i)	Particles1 to 100 nm/not visible with microscope/ do not sediment or filter. ✓	**1**
(ii)	By addition of aluminium sulphate or aluminium ions ✓ (do not allow plain aluminium) Either neutralises ✓ negative charge on colloid particles ✓ allowing them to coagulate and form a floc/precipitate ✓ Or forms a gelatinous precipitate ✓ of aluminium hydroxide/formula ✓ Which absorbs other ions and solids ✓	**4**
(c)(i)	Answers should be in terms of the equilibrium: ClayK (s) + H_2O(l) = clayH(s) + OH^-(aq) + K^+(aq) ✓ State symbols not essential for the mark. Or ✓ for negative charge on clay attracts K^+.	
(ii)	If the aqueous potassium ion concentration falls , the potassium ions must be released from the reserves in the clay ✓ to reestablish equilibrium ✓ Hydrogen ions could replace cations on the ion exchange surface of clays ✓ releasing nutrient ions which could then be leached away and lost ✓/releasing toxic ions eg aluminium ✓ AW	**3** **2**
	Question total	**14**
	Paper total	**45**

Question	Expected Answers	Marks

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Question	Expected Answers	Marks

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Question	**Expected Answers**			**Marks**
6				**Total:**

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Question	**Expected Answers**			**Marks**
7				**Total:**

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Question	**Expected Answers**			**Marks**
8				**Total:**

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Question	**Expected Answers**			**Marks**
9				**Total:**

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Question	**Expected Answers**			**Marks**
10				**Total:**