2815/03 Environmental Chemistry

January 2004

Mark Scheme

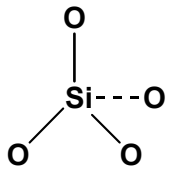
The following annotations may be used when marking:

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

Abbreviations, annotations and conventions used in the Mark Scheme:

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

Question	Expected Answers	Marks
1 (a)(i)	Region of atmospere closest to earth/first 15km ✓	1
(ii)	Photosynthesis ✓	1
(iii)	$CO_2 + H_2O + CaCO_3 \rightarrow Ca(HCO_3)_2$ Equation ✓ Accept H_2CO_3	1
(b)(i)	Burning of fossil fuels/oil/coal ✓ Not deaforerstation.	1
(ii)	Carbon dioxide is a <u>greenhouse</u> gas ✓ Then three points from: Greenhouse gases absorb the infrared radiation ✓ that is emitted (not reflected) by the earth ✓ and radiate it back ✓ to the earth; increased KE of molecules✓ means increased temperature.	4
(c)	Advantages: reduces bulk of waste/for landfill ✓ Provides energy for heat/electricity ✓ Disposes of non-biodegradable plastics✓ Any two points. Disadvantage: may produce pollutants such as HCl from PVC or dioxins at low temperature etc✓ AW throughout	3
		Total: 11

Question	Expected Answers	Marks
2(a)(i)	Tetrahedral ✓  or similar ✓	2
(ii)	$Si_2O_7^{6-}$ ✓ for formula and ✓ for charge (ecf)	2
(b)(i)	The silicate/aluminate/silicate ✓ layers in 2:1 clays have only weak attractions between them which allows cations (and water) easy access for ion exchange ✓. AW The layers in the 1:1 clay are hydrogen bonded ✓ which makes it difficult for cations to penetrate. AW	3
(ii)	Hydrogen ions✓ attach to negative sites (on surface of layers eg Mg–O^-)✓.AW	2
(iii)	Hydrogen ions displace cations ✓ which are the available for uptake into plants/ washed away or thereby reducing the storage capacity of the clay ✓. AW	2
		Total: 11

Question	Expected Answers	Marks
3	**Find 10 points from the following:** **Stratosphere:** **Ozone formed photochemically/ UV ✓ via O free radicals ✓** **Both equations for ✓ ie $O_2 \rightarrow O + O^*$** **$O^* + O_2 \rightarrow O_3$** **(No need for the * or for the M needed to remove heat)** **It absorbs harmful UV ✓, preventing skin cancer etc ✓** **Troposphere:** **Ozone formed photochemically/UV ✓ from NO_x ✓ which is formed in petrol engines ✓ and oxygen .** **Static discharge in electric motors etc ✓.** **(Details and equations not required)** **Three effects from** **Impaired lung function/ Irritation of eyes ✓** **Inhibits photosynthesis/leaf lesions ✓** **Greenhouse gas✓** **Forms photochemical smog✓** **QWC Correct use of terms troposphere, stratosphere and radicals (in words or through two appropriate equations).**	**10** **1** **Total: 11**

Question		Marks
4(a)(i)	Aerobic ✓ decay using oxygen trapped in refuse✓.	2
(ii)	Oxygen in refuse has been used up / more air cannot get in because of the clay seal.✓ Bacteria for anaerobic decay ✓ multiply/grow (exponentially) ✓producing methane. Any two marks.	2
(iii)	Organic refuse beginning to run out ✓.	1
(iv)	Explosive/inflammable ✓.	1
(b)(i)	Smelly/toxic✓.	1
(ii)	Sulphate/sulphuric acid. ✓ Accept sulphite,sulphurous acid,sulphur dioxide, sulphur.	1
(c)(i)	Forms insoluble scum with soap/ scale on pipes✓. OR contains <u>dissolved</u> calcium ions/compounds	1
(ii)	Either boiling✓ - decomposition of calcium hydrogen carbonate ✓ produces insoluble $CaCO_3$ ✓. A correct equation can score the last two marks . Or ion exchange ✓ - Calcium ions ✓ are swapped with sodium/hydrogen ions ✓ on the resin. An equation can gain these last two marks but the charges on the ions must be correct.	3
	Question total	12
	TOTAL FOR PAPER	45