2815/03 Environmental Chemistry

June 2003

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

1 (a) (i) More plastic/packaging/batteries/non-biodegradable/etc AW ✓ 1

(ii) more landfill sites needed/plastic takes long time to decompose or is not biodegradable/more recycling. Answer must match their (i).AW ✓ 1

(b) (i) Without oxygen ✓ 1

(ii) $C_6H_6 + 7^1/_2\ O_2 \rightarrow 6CO_2 + 3H_2O$ or doubled ✓ 1

(iii) 1 mole of benzene produces 6 moles of carbon dioxide,ecf ✓
Molar mass of benzene is 78g ✓

Volume of carbon dioxide = 6 x 24 x 1000/78 dm^3
= 1850 dm^3 (accept 1840 to 1850) ✓
Find 3 marks similarly for route via moles of benzene = 12.82 mol. 3

Question total 7

2 Look for seven points from the following:
Addition of <u>aluminium sulphate/Al^{3+} ✓</u> solution neutralises the charge on small ✓ (colloidal) particles, letting them clump together (flocculation)✓
<u>or</u> gelatinous precipitate of $Al(OH)_3$ ✓ which absorbs the particles✓.

Water is filtered✓. Filters are cleaned ✓ by backwash.

Chlorination kills bacteria✓Detail of chlorination -- production of HClO ✓, an oxidising agent✓, and use of ammonia to make chloramine ✓

Use of ozone✓to prevent formation of toxic organochlorine ✓ compounds.
Other relevant chemical points , eg aeration oxidises Mn^{2+}/Fe^{2+} can earn ✓ each.
Not removal of hardness.
AW throughout , but note that the question asks for chemistry.
7

QWC mark for correct use of technical vocabulary – two of flocculation/ colloid/ filtration/precipitation/ sedimentation✓. 1

Question total 8

3 (a) (i) Gas which traps/absorbs ✓ IR radiation emitted ✓ from earth/re-emits IR to earth.
Not reflected. 2

(ii) Water (vapour)✓ 1

(iii) Symmetrical diatomic molecule/only one type of atom in N_2 / does not absorb IR ✓ 1

(iv) Two of: Concentration ✓/residence time✓/ where it absorbs in IR ✓ 2

(b) Acid-base/ calcium hydroxide neutralises carbon dioxide/precipitation✓ 2
Not carbonation.
$CO_2 + Ca(OH)_2 = CaCO_3 + H_2O$ ✓

(c) (Gas was dissolved under increased/high pressure) 2

Pressure reduced ✓when bottle is opened and gas becomes less soluble ✓.AW

Question total 10

4	(a)	Al^{3+} ✓ swapped for Si (+4) ✓ in the silicate structure/ Mg^{2+} for Al^{3+} ✓ leaving negative charge ✓. Give 1 mark for a second exchange in place of the negative charge mark.	3
	(b)(i)	Large surface area ✓ The negative charge attracts positive ions/cations, such as Ca^{2+} ✓ which can be exchanged for other cations✓	3
	(ii)	Water will not pass through beds of small clay particles quickly/ will need filtering AW ✓	1
	(c)	Clays act as reservoirs for nutrient ions, such as K^+/ prevent leaching of ions ✓ The ions can replace K^+ in the soil water as the concentration falls. ✓ (Equilibria need not be mentioned for the marks).	2
	(d)	Layers are hydrogen bonded ✓ together, using OH on octahedral layers✓, and do not absorb water/ therefore do not crack on drying out/easily break up or crumble ✓.	3
		Question total	12
5	(a) (i)	UV light/sunlight ✓	1
	(ii)	It absorbs damaging <u>UV ✓</u>AW	1
	(b)	CFCs are unreactive / slowly get up to the stratosphere ✓ There CFC + UV light = CF + Cl /Cl produced from CFC and UV light ✓ $Cl + O_3 = ClO + O_2$ /or in words ✓ Ozone concentratioon decreases ✓ (Accept is destroyed) ($ClO + O = Cl + O_2$)/ catalytic ✓ cycle or chain involving Cl . Any four marks	4
	(c)	Broken down chemically in troposphere ✓; breaking of C-H bonds ✓	2
		Question total	8
		PAPER TOTAL	45