2815/04 Methods of Analysis and Detection

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)	Molecular ion containing ^{13}C (allow ^{13}C)	(1)
(b) (i)	$CH_3CH_2{}^{81}Br^+$ (allow ^{81}Br)	(1)
(ii)	50 : 50 or 1 : 1	(1)
(c)	Atomic masses of H and O are not 1 and 16 respectively / not whole numbera	(1)
	M_r values are given to 1 unit, and do not show minor differences from whole numbers / High res MS gives masses to several decimal places	(1)
(d) (i)	I CH_3^+ } one +ve charge to be shown	(1)
	II $^+CH_2OH$ / CH_3O^+ }	(1)
(ii)	M:M+1 = 14.6 : 0.32	
	No of carbon atoms = $\frac{0.32 \times 100}{14.6 \times 1.1}$ = 2 (1.99)	(1)
	Hence x =2	
	Since M_r = 46 and it contains one oxygen atom y = 6	(1)
	Allow C_2H_6O	
		Total : 9

2 (a)	Energy is released	(1)
	When electrons drop from higher to lower energy states / orbitals	(1)
(b)	An electron dropping to a single energy level	(1)
	Electrons dropping from different energy levels	(1)
(c) (i)	$f = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}}{564 \times 10^{-9}} = 5.32 \times 10^{14}$ Hz	(1)
(ii)	$\Delta E = hf = 5.32 \times 10^{14} \times 6.63 \times 10^{-34}$ $= 3.53 \times 10^{-19}$ J *Incorrect units penalised once, allow ecf*	(1)
(d)	Non-bonding / lone-pair electrons	(1)
	Unsaturated / multiple / π bonds If functional groups only quoted give max 1	(1)
(e)	Acid solution – red Alkaline solution – yellow	(1) (1)
(f)	**X** has the longest chromophore / greatest delocalisation / greatest conjugation	(1)
	The electronic energy levels are closest together	(1)
		Total : 12

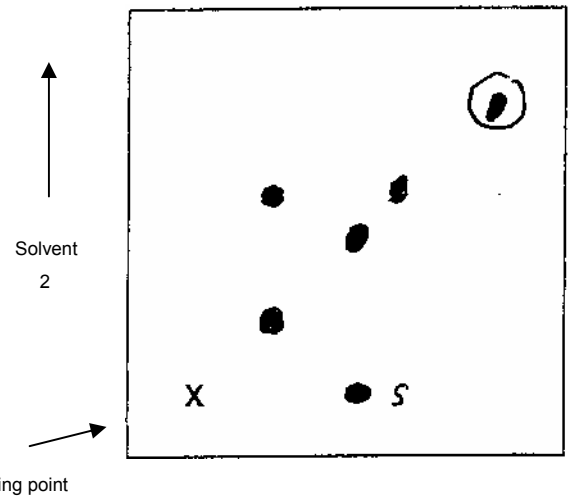
3 (a) Partition : Solutes move between the mobile and stationary phases based on their relative solubility (1)

Adsorption : Solutes are held on the stationary phase depending on the differences in polarity (1)

(b) $\frac{\text{Distance travelled by component}}{\text{Distance travelled by solvent}}$ (1)

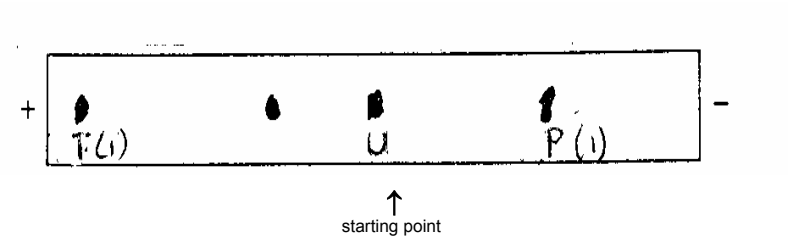
(c) (i) 6 (1)

(ii) Ninhydrin (allow iodine vapour) NOT uv light (1)



2 x (1)

(d) (i) and (ii)



2 x (1)

(iii) Acid would become negatively charged (1)

It would move to the left / towards the positive electrode (1)

(e) (i) Radioactive ^{32}P; allow radioactive phosphorus (1)

(ii) One of : establishing relationships (inc paternity)
testing for tissue / blood matches
archaeology (1)

Total : 13

4 (a)	**(i)**	uv/visible	(1)
	(ii)	radio frequency	(1)
(b)	**Ir :** Broad peak at 3200 – 3600 cm^{-1} suggests –OH		(1)
	C-O at 1100 cm^{-1} (or other peak in the range 1000-1300 cm^{-1})		(1)
	Nmr : OH proton (disappears in D_2O) at 4.9 δ		(1)
	CH_3 protons at 2.25 δ		(1)
	4 aromatic protons at around 6.8 δ *Only give 1 of δ values not quoted*		(1)
	Mass : M_r is 108		
	Loss of OH at m/e 91 / or $C_7H_7^+$		(1)
	Structure (to include functional groups)		(1)
			(1)
			Max 7
(c)	Any reasonable peak e.g. 15 = CH_3^+, 17 = OH^+, 109 = M+1		(1)
	Use of written communication Correct use of scientific logic and terminology		(1)
			Total : 11 max