

**Subject: Methods of Analysis and Detection**  
**Code: 2815/04**

**Session: January**

**Year: 2002**

**Final Mark Scheme**

<i>MAXIMUM MARK</i>	<b>45</b>
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- 1 (a) (i)  $R_f = \frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent front}}$  (1)
- (ii) Paper/thin-layer (1)
- (b) Water (as paper fibres) and solvent (1)
- (c) (i) Chromatogram is run in one solvent, (1) dried rotated 90° (1) and run in second solvent (1) (3)
- (ii) 6 (1)
- (d) (i) Adsorption (1)
- (ii) Variety of adsorbents can be used  
Better / faster separation  
Components can be extracted  
Smaller samples can be used (1)
- (e) (i) Theobromine (1)
- (ii) Caffeine peak area  $\frac{31 \times 6}{2}$  Theobromine peak area  $\frac{46 \times 4}{2}$   
= 93 = 92 (1)
- (Marked consequentially)  
 $\frac{92}{185} = 49.7 \pm 1\%$  (1)
- (iii) Dyes are not usually volatile (1)
- [Total · 14]

2. (a) (i) Electrons are promoted to higher energy levels in the atoms  
When they drop back, energy is emitted (1)
- (ii) Each series represents electrons dropping back to a particular  
energy level (1)
- (iii) Arrival of electrons from infinity to a given energy level (1)
- (b) 
$$\Delta E = \frac{hcL}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8 \times 6.02 \times 10^{23}}{485 \times 10^{-8}}$$

$$= 247 \text{kJ mol}^{-1} \quad (1)$$
- (c) Series of standards run in spectrometer (1)
- Calibration graph produced (1)
- Sample run and concentration read off (1)
- Sample diluted if necessary and new solution re-run (1)
- Any 3 of the above

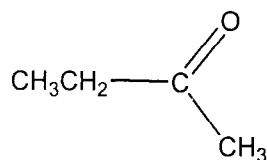
[3]

[Total : 9]

3. (a) No of carbons =  $\frac{(M+1) \times 100}{M \times 1.1} = \frac{120}{52 \times 1.1}$  (1)  
 = 2 (1)  
 [2]
- (b) (i) 1700 - C=O (1) 3100 - OH (or NH) (1) [2]
- (ii) Some evidence of logic required .
- $M_r = 60$  of which 24 = 2 carbons  
 From ir 2 oxygens are present  
 Molecular formula is  $C_2H_4O_2$
- Also allow mass spect Data e.g  $CH_3^+$  at m/e 15 (1)
- $$\begin{array}{c} O \\ | \\ CH_3C \\ | \\ OH \end{array}$$
 (1)
- [2]
- (c) (i) Q contains a halogen atom (Cl or Br) (1)
- (ii) Q contains chlorine (1)  
 [2]
- (d) Spectrum is too complex (1)  
 Molecules form very large number of fragments (1)  
 Lack of volatility (1)  
 [Any 2]
- (e) R is HCN (1 0078 + 12 0000 + 14 0030) (1)  
 S is CO (12 0000 + 15.9949) (1)  
 [2]
- [Total 12]

- 4 (a) Compound  $C_5H_{12}$  is saturated (containing s bonds) (1)
- Compound  $C_4H_8O$  will contain lone pair electrons (1)
- $C_5H_{12}$  contains no chromophores, hence will show no major absorptions in u v (or converse) (1)
- [3]
- (b) Infra red spectrum shows strong  $C=O$  peak at  $1720\text{ cm}^{-1}$  (1)
- N m r spectrum shows 3 proton environments (1)
- Total number of protons = 8 (1)
- There are 3 identical protons with no adjacent protons (2.0 $\delta$ ) (1)
- There is a  $-CH_2CH_3$  group (1.0 $\delta$  and 2.4 $\delta$ ) (1)
- Description of splitting pattern (1)

This suggests T is



(1)

[Any 6]

Quality of language

(1)

[7]

[Total · 10]