

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Mark Schemes

Q1.

(a) Gas chromatography explanation

Different retention times / dipeptides appear at different times.

1

Different balance between solubility in the moving phase / gas carrier **and** retention by the stationary phase / column **OR** different relative affinity for mobile and stationary phases.

1

Mass spectrometry explanation

Same m/z values.

1

(Both) dipeptides / **J** and **K** have same molecular formula / M_r .

1

(b) ser-ala

1

ala-lys

1

ser-ala-lys

This order only.

1

[7]

Q2.

(a) Y 1

(b) X 1

(c) Jump in trend of ionisation energies after removal of fifth electron
Fits with an element with 5 outer electrons ($4s^2 3d^3$) like V 1

(d) Explanation: Two different colours of solution are observed 1

Because each colour is due to vanadium in a different oxidation state 1

(e) **Stage 1:** mole calculations in either order

$$\text{Moles of vanadium} = 50.0 \times 0.800 / 1000 = 4.00 \times 10^{-2}$$

Extended response

Maximum of 5 marks for answers which do not show a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

1

$$\text{Moles of SO}_2 = pV / RT = (98\,000 \times 506 \times 10^{-6}) / (8.31 \times 293)$$

$$= 2.04 \times 10^{-2}$$

1

Stage 2: moles of electrons added to NH_4VO_3

When SO_2 (sulfur(IV) oxide) acts as a reducing agent, it is oxidised to sulfate(VI) ions so this is a two electron change

1

$$\text{Moles of electrons released when SO}_2 \text{ is oxidised} = 2.04 \times 10^{-2} \times 2$$

$$= 4.08 \times 10^{-2}$$

1

Stage 3: conclusion

But in NH_4VO_3 vanadium is in oxidation state 5

1

4.00×10^{-2} mol vanadium has gained 4.08×10^{-2} mol of electrons
therefore 1 mol vanadium has gained $4.08 \times 10^{-2} / 4.00 \times 10^{-2} = 1$ mol
of electrons to the nearest integer, so new oxidation state is $5 - 1 = 4$

1

[11]