Quiz (Contribution of Analytical Chemistry)

Section A: Multiple-choice

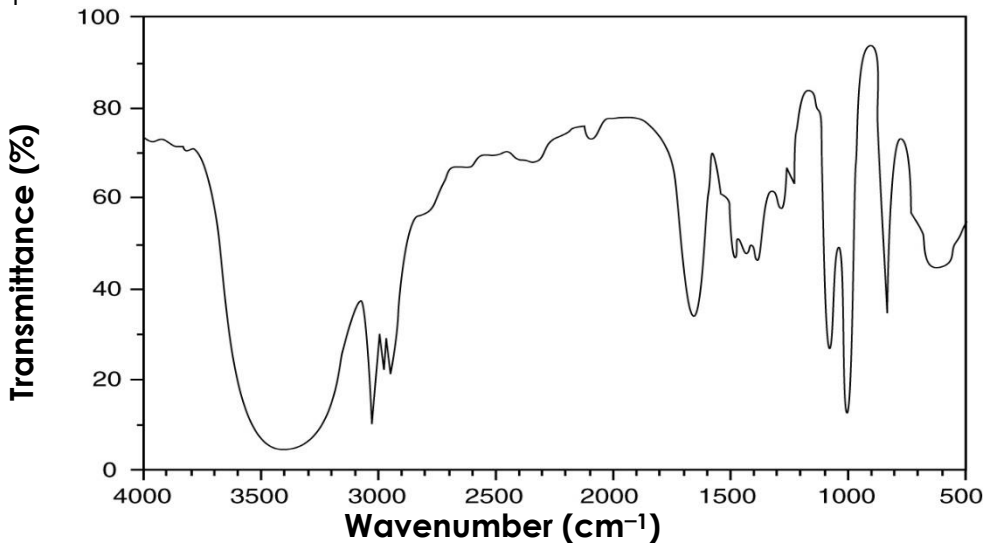
1. Hydrolysis of proteins gives a mixture of amino acids. What is the preliminary test for these amino acids?
   A. Colorimetry
   B. Infrared spectroscopy
   C. Mass spectrometry
   D. Thin-layer chromatography

2. Some white wine contains sulphur dioxide. Which of the following methods should be used to find the amount of sulphur dioxide in a wine sample?
   A. Infrared spectroscopy
   B. Mass spectrometry
   C. Volumetric analysis
   D. Thin-layer chromatography

3. Images of fingerprint can be seen clearly through
   A. gas chromatography-mass spectrometry.
   B. infrared spectroscopy.
   C. iodine sublimation.
   D. thin-layer chromatography.

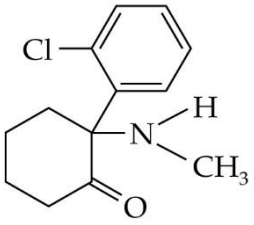
4. Which of the following methods is commonly used to measure the dioxin level in air?
   A. Column chromatography
   B. Gas chromatography-mass spectrometry
   C. Infrared spectroscopy
   D. Magnetic resonance imaging

5. The IR spectrum of the breath of a drunken driver is shown below:



   Which of the following absorbance peaks corresponds to the hydroxyl group?
   A. 1000 cm^{-1}
   B. 1600 cm^{-1}
   C. 3000 cm^{-1}
   D. 3400 cm^{-1}

Questions 6 to 8 refer to ketamine, which has the following structure:



6. Which of the following reagents does NOT react with ketamine?
   (1) Acidified potassium dichromate solution
   (2) Tollens' reagent
   (3) 2,4-dinitrophenylhydrazine

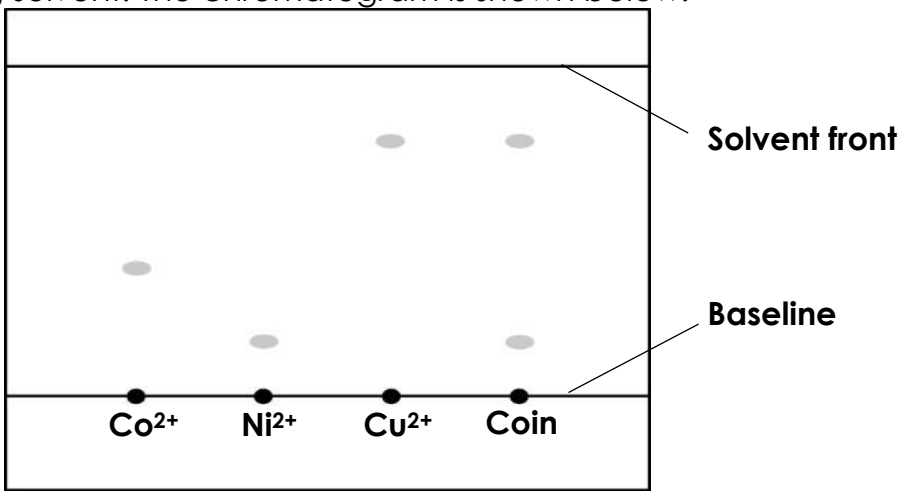
   A. (1) and (2) only
   B. (1) and (3) only
   C. (2) and (3) only
   D. (1), (2) and (3)

7. Which of the following absorption peaks is NOT expected to be observed in the IR spectrum of ketamine?
   A. An absorption peak at 3350 – 3500 cm^{-1}
   B. An absorption peak at 3230 – 3670 cm^{-1}
   C. An absorption peak at 2840 – 3095 cm^{-1}
   D. An absorption peak at 1680 – 1800 cm^{-1}

8. Which of the following methods is commonly used to identify ketamine in a urine sample?
   A. Breathalyser
   B. Gas chromatography-mass spectrometry
   C. Infrared spectroscopy
   D. Solvent extraction

Section B: Structured questions

A student dissolved a 5.0 g HK10¢ coin completely in 10 cm^3 of 8 M HNO_3. Paper chromatography was carried out, using a propanone-water mixture as the developing solvent. The chromatogram is shown below:



(a) Suggest a safety precaution for the experiment. Explain briefly.

(b) With reference to the chromatogram, what are the metals present in a HK10¢ coin?

(c) After performing paper chromatography, the student performed volumetric analysis to determine the percentage by mass of copper in the coin. The table below summarized the procedure:

Step 1	Remove all the unreacted nitric acid from the reaction mixture.
Step 2	Dilute the coin solution to 250.0 cm^3.
Step 3	Pipette 10.0 cm^3 of the dilute solution into a conical flask.
Step 4	Add excess potassium iodide to the solution to liberate iodine.
Step 5	Titrate the resultant solution with 0.1 M sodium thiosulphate solution.

In step 5, 22.65 cm^3 of 0.1 M sodium thiosulphate was required for complete reaction. The reactions involved are

$$2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2 + I_2$$
$$I_2 + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I^-$$

(i) Suggest an indicator used in this titration.
(ii) Calculate the percentage by mass of copper in the HK10¢ coin.
(Relative atomic mass: Cu = 63.5)

Suggested Answer

Section A

1.	D	5.	D
2.	C	6.	A
3.	C	7.	B
4.	B	8.	B

Section B

(a) As concentrated nitric acid is corrosive,
the experiment should be performed in a fume cupboard.

(b) Cu^{2+} and Ni^{2+}

(c) (i) Starch solution

(ii) Number of moles of $S_2O_3^{2-}$ = 0.1 x 0.02265 = 2.27×10^{-3}

From the two equations, mole ratio of Cu^{2+}: $S_2O_3^{2-}$ = 1:1.
$\therefore$ number of moles of Cu^{2+} in 10.0 cm^3 of solution = 2.27×10^{-3}

Number of moles of Cu^{2+} in 250.0 cm^3 of solution
= 2.27×10^{-3} x 250.0 / 10.0
= 0.0568

Mass of Cu = 0.0568 mol × 63.5 g mol^{-1} = 3.61 g

Percentage by mass of Cu in the HK10¢ coin
= (3.61 / 5.0) x 100%
= 72.2%