Analytical chemistry year 12

Name _____

1) Which technique is most useful in identifying the levels of mercury in the blood of a patient affected by food contamination?

a) HPLC

b) Flame test

c) ^{13}C NMR

d) Atomic absorption spectroscopy

1 mark

2) Give a reason for your answer to question 1) above.

1 mark

3) A mixture of the following substances are to be separated using gas-liquid chromatography(GLC) with a non-polar stationary phase and nitrogen gas as the mobile phase.

CH_3OH, $CH_3\ CH_2\ CH_2CH_2OH$, $C_{56}H_{90}O_{30}N_{21}S_{12}$, CHOOH

a) Which component of the mixture is not suitable for separation using GLC?

1 mark

b) Explain your answer to question a) above.

2 mark

c) Place the three molecules that will be separated by GLC in order of longest to shortest retention time.

Shortest R_t _____, _____, _____ longest R_t

2 marks

d) Give a clear explanation to c) above.

2 marks

4) A wine from Raz Cellars is analysed for its alcohol content. A 20.0 mL sample of the wine is placed in a 250 mL volumetric flask and distilled water added to the mark. A 25.0 mL aliquot is taken from the volumetric flask and titrated against 0.100 M $K_2Cr_2O_7$. The titration is repeated 5 times and the titres obtained are shown in the table below.

Titre	Volume (mL)
1	19.98
2	20.03
3	18.99
4	19.95
5	20.33

a) Calculate the average titre?

2 marks

b) Calculate the amount, in mol, of $Cr_2O_7^{2-}$ used in the average titre in a) above.

2 marks

c) The equation for the reaction between ethanol and $Cr_2O_7^{2-}$ is a redox reaction involving the oxidation of CH_3CH_2OH to CH_3COOH and the reduction of $Cr_2O_7^{2-}$ to Cr^{3+} .

i) Give the half equation for the oxidation of CH_3CH_2OH to CH_3COOH

2 marks

ii) Give the half equation for the reduction of $Cr_2O_7^{2-}$ to Cr^{3+}

2 marks

iii) Give the overall equation.

2 marks

d) Calculate the amount, in grams, of ethanol, in the 25.0 mL aliquot of diluted wine.

2 marks

e) Calculate the amount, in grams, of ethanol in the 20.0 mL original sample of wine.

2 marks

f) If the density of ethanol is 0.789 g/mL what volume of ethanol was present in the 20.0 mL sample of wine?

2 marks

g) What is the percentage by volume (%v/v) of ethanol in the wine expressed in the appropriate number of significant figures?

2 marks

h) Errors due to rinsing of equipment readily occur in volumetric analysis. What will be the outcome on the final value of the % v/v of ethanol in each of the following scenarios given in the table below. Circle the appropriate response.

Error	Outcome on the final %v/v of ethanol in the wine.
Water was left in the 25.0 mL pipette.	Greater / no change / less
Water was left in the 250 mL volumetric flask.	Greater / no change / less
The burette was washed with water and not left to dry.	Greater / no change / less

3 marks

5) Below is a list of analytical techniques.

^{1}H NMR, ^{13}C NMR, Mass spectroscopy, Atomic absorption spectroscopy, UV-visible spectroscopy, IR spectroscopy, Emission spectroscopy, Flame test, High pressure liquid chromatography, GLC.

a) Which techniques involve the excitation of electrons to higher energy levels?
b) Which techniques involve the excitation of nucleons to higher energy levels?
c) Which technique involves the absorption of electromagnetic radiation to change the behaviour of bonds within a molecule?
d) Which technique involves the destruction of the sample under investigation?
e) Which techniques can be used to obtain the concentration of a metal atom in a solution?
f) Name all the techniques that distinguish between fragments of different mass.
g) Which technique would you use to separate and identify an organic compound, with a high molecular mass, in blood plasma?
h) Name all the techniques that can be used to identify a compound and its concentration by first producing a calibration curve.
i) Which techniques involve the measurement of energy due to electrons returning from a higher energy state?
j) Name two techniques which can be used together to separate, identify and accurately measure concentrations of compounds in a mixture of low molecular mass hydrocarbons??

10 marks

6) An impure sample of iron(II)sulphate, weighing 2.45 grams was treated to produce a precipitate of Fe_2O_3. If the mass of the dried precipitate was 0.610 calculate the percentage of iron in the sample given to appropriate number of significant figures?

4 marks

7) A water way was contaminated with barium chloride. A 100.00 mL sample of the contaminated water was reacted with excess sodium sulphate to produce the white precipitate barium sulphate ($BaSO_4$). After the reaction the precipitate was filtered and repeatedly washed. Periodically the filtrate is analysed by reacting it with silver nitrate until no more white precipitate (AgCl) formed. At this point the barium sulphate was dried and weighed. A mass of 1.13 g of $BaSO_4$ was recorded.

a) Why was it necessary to test the filtrate with silver nitrate?

1 marks

b) Calculate the concentration of barium in the water in ppm. Give the answer to the right number of significant figures.

3 marks

c) i) What would happen to the concentration of barium calculated if the filtrate were not tested with silver nitrate.

1 mark

ii) Write the ionic equation for the reaction taking place to produce AgCl.?

1 mark