VCE CHEMISTRY 2009

YEAR 12 TRIAL EXAM UNIT 3

Time allowed: 90 minutes
Total marks: 83

20 Multiple Choice Questions
7 Short Answer Questions

An Answer Sheet is provided for Section A.
Answer all questions in Section B in the space provided.

To download the Chemistry Data Book please visit the VCAA website:
http://www.vcaa.vic.edu.au/vce/studies/chemistry/chem1_sample_2008.pdf *Page 20*

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Student Name....……..…….....

VCE Chemistry 2009 Year 12 Trial Exam Unit 3

Multiple Choice (Section A) Answer Sheet

Use a pencil to circle the letter corresponding to the correct or best alternative answer.

If you make a mistake erase your answer and select the correct one. Marks will **not** be deducted for incorrect answers.

Question 1	A	B	C	D	*Question 2*	A	B	C	D
Question 3	A	B	C	D	*Question 4*	A	B	C	D
Question 5	A	B	C	D	*Question 6*	A	B	C	D
Question 7	A	B	C	D	*Question 8*	A	B	C	D
Question 9	A	B	C	D	*Question 10*	A	B	C	D
Question 11	A	B	C	D	*Question 12*	A	B	C	D
Question 13	A	B	C	D	*Question 14*	A	B	C	D
Question 15	A	B	C	D	*Question 16*	A	B	C	D
Question 17	A	B	C	D	*Question 18*	A	B	C	D
Question 19	A	B	C	D	*Question 20*	A	B	C	D

VCE Chemistry 2009 Year 12 Trial Exam Unit 3

Multiple Choice Section

Section A

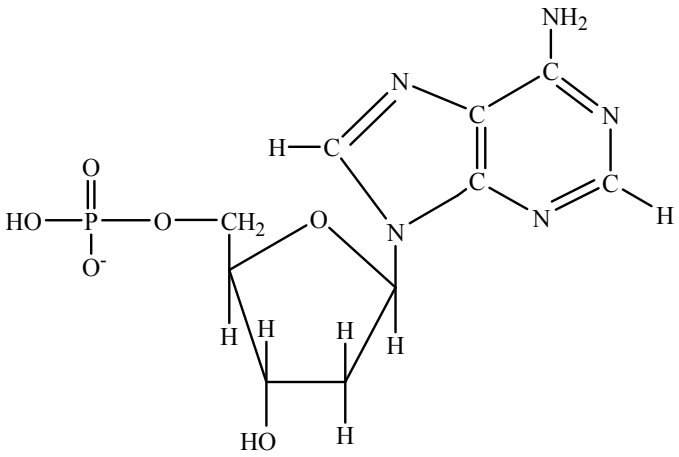
Section A consists of 20 multiple-choice questions.
Section A is worth approximately 25 per cent of the marks available.
*Choose the response that is **correct** or **best answers** the question.*
Indicate your choice on the answer sheet provided.

Question 1
A standard 0.103 M sodium carbonate solution was prepared in a volumetric flask. 25.00 mL aliquots were measured into a conical flask and titrated against a dilute solution of approximately 0.2 M hydrochloric acid. Which of the following indicators is most suitable for use in this titration?
A. Methyl red.
B. Phenol red.
C. Phenolphthalein.
D. Bromthymol blue.

Question 2
An aqueous solution of potassium dichromate has a clear orange colour. The concentration of such a solution is determined using UV-Visible spectroscopy.
An aqueous solution of potassium dichromate would be expected to
A. absorb orange light and hence allow orange light to pass through the solution.
B. absorb blue light and hence allow orange light to pass through the solution.
C. absorb orange light and hence allow blue light to pass through the solution.
D. absorb blue light and hence allow blue light to pass through the solution.

Question 3
The low resolution ^{1}H NMR spectrum of a compound shows that it has two peaks in the area ratio 9 : 1.
The spectrum could be that of
A ethanol.
B propan-2-ol.
C. methylpropan-2-ol.
D. methyl methanoate.

Questions 4 and 5 refer to the molecular structure shown below.



Question 4

This molecular structure is best described as representing

A. a nitrogen base.
B. DNA.
C. RNA.
D. a nucleotide.

Question 5

This molecular structure may be found as part of a naturally occurring larger molecular structure. Within that larger molecular structure it would be expected to form

A. one disulfide link.
B. two hydrogen bonds.
C. three hydrogen bonds.
D. three covalent bonds.

Question 6

Analysis of the IR, ^{1}H NMR and ^{13}C spectra of an organic compound shows

- an absorption band centred close to 3400 cm^{-1}
- a ^{1}H chemical shift close to 11 ppm
- ^{13}C chemical shifts close to 55 ppm and 170 ppm

According to these data the compound could be

A. ethanamine.
B. propanoic acid.
C. ethyl ethanoate.
D. valine.

Question 7
Two gas containers of equal volume are both at the same temperature and each contain only one substance.
Container X contains 16 g of oxygen gas.
Container Y contains 24 g of ozone gas.
Compared with container X, the pressure and number of atoms in container Y would be

A. pressure – **the same** number of atoms – **lower.**
B. pressure – **greater** number of atoms – **the same.**
C. pressure – **the same** number of atoms – **greater.**
D. pressure – **greater** number of atoms – **greater.**

Question 8
Consider the unbalanced overall redox equation for the reaction between chlorine dioxide and iodide ions in acidified solution

$$ClO_2(aq) + H^+(aq) + I^- \rightarrow I_2(aq) + Cl^-(aq) + H_2O(l)$$

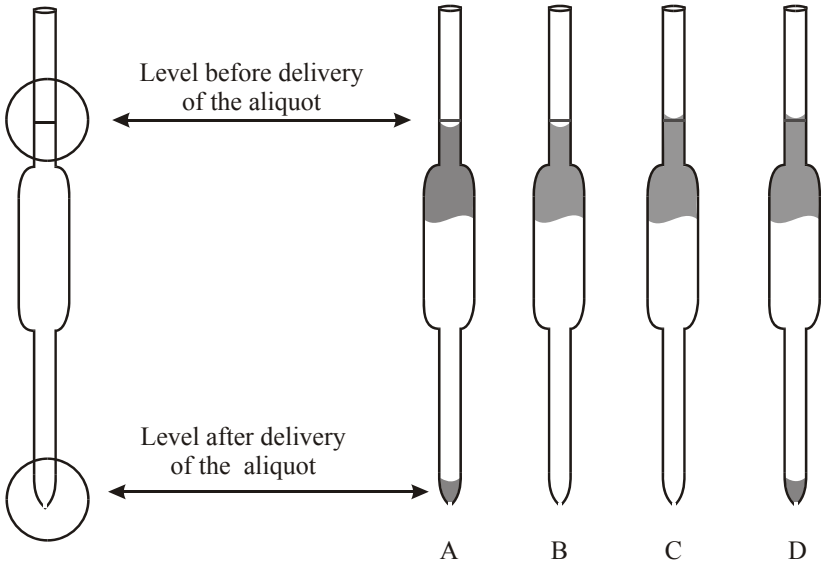
When this equation is balanced

A. the coefficient of I^- is 2 and it is the oxidant.
B. the coefficient of I^- is 10 and it is the reductant.
C. the coefficient of I^- is 2 and it is the reductant.
D. the coefficient of I^- is 10 and it is the oxidant.

Question 9
Which of the analytical techniques listed below is least likely to be used in deducing the molecular structure of an organic compound?

A. Mass spectrometry.
B. Nuclear magnetic resonance spectroscopy.
C. Infrared spectroscopy.
D. Atomic absorption spectroscopy.

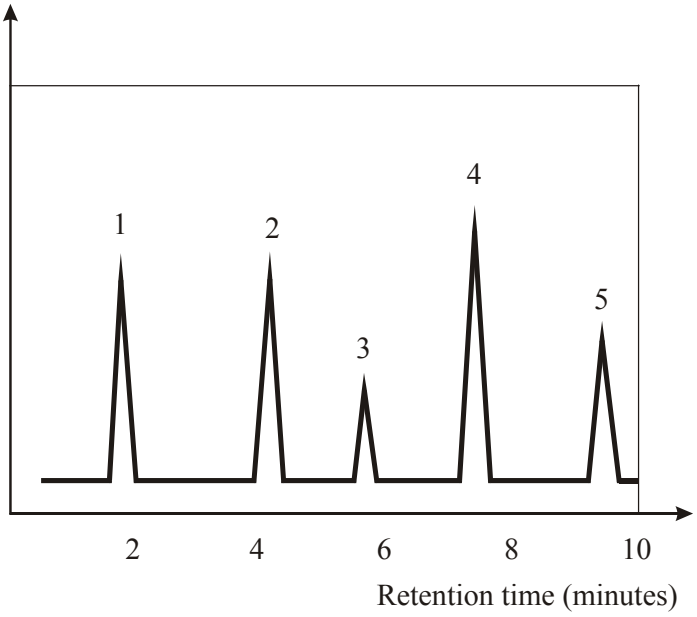
Question 10
A pipette is an important piece of laboratory equipment in volumetric analysis. In a particular analysis, a 25.0 mL aliquot of the solution being analysed is required. Which of the following diagrams correctly shows the levels of the solution in the pipette before and after delivery of the aliquot?



Question 11
Which of the following pieces of equipment must always be used in an accurate gravimetric analysis?
A. Electronic balance.
B. Filter funnel.
C. Volumetric flask.
D. Burette.

Question 12
'Rubber' is used in numerous applications, ranging from simple 'elastic' bands to tyres for motor vehicles and aircraft. SBR, a synthetic rubber, is a copolymer of styrene, C_8H_8, and butadiene, C_4H_6, combined by an addition reaction in a ratio that produces a product with an empirical formula of $C_{10}H_{13}$.
In what mole ratio are styrene and butadiene combined to produce SBR?
A. 1 mol C_8H_8 : 1 mol C_4H_6
B. 1 mol C_8H_8 : 3 mol C_4H_6
C. 3 mol C_8H_8 : 1 mol C_4H_6
D. 10 mol C_8H_8 : 13 mol C_4H_6

Question 13
A mixture of alkanols, each containing a single hydroxyl functional group on the end carbon and part on an homologous series, was separated using gas chromatography. The smallest alkanol in the mixture had a molar mass of 74 g mol^{-1}. A chromatograph produced during the separation is simulated below.



An accurate interpretation of this chromatogram would be that
A. alkanol 5. is the most abundant in the mixture.
B. alkanol 3. could be 1-heptanol.
C. alkanol 1. is most strongly adsorbed to the stationary phase.
D. alkanol 4. could be 3,4-dimethylpentan-1-ol.

Question 14

Stages in the creation of a DNA fingerprint include:

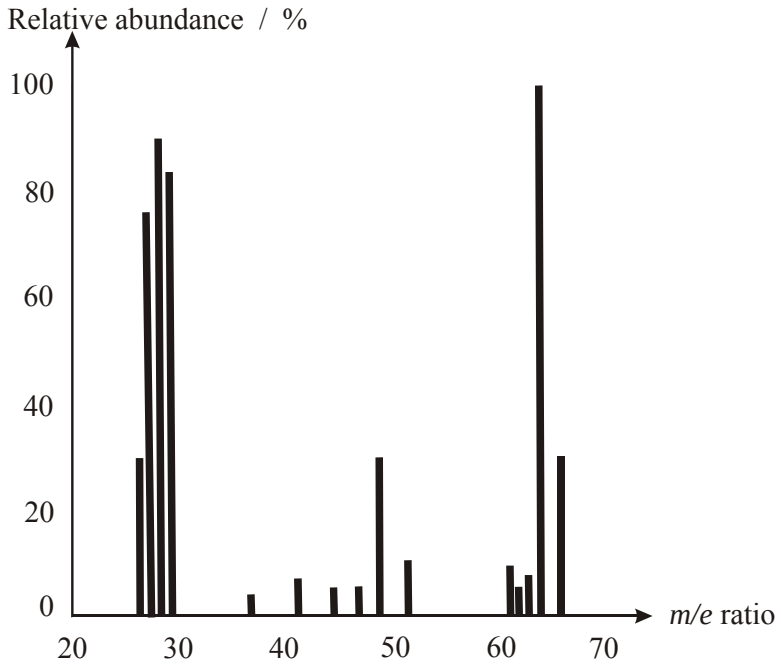
1. Obtain DNA sample.
2. Amplify the DNA sample.
3. Cut up the DNA to produce fragments.
4. Separate the DNA fragments.

Which of the following processes in not involved in these stages?

A. Polymerase chain reaction.
B. Gas chromatography.
C. Gel electrophoresis.
D. Use of restriction enzymes.

Question 15

The mass spectrum represented below is that of a product of a substitution reaction between ethane and chlorine.



The peaks at *m/e* ratios 64 and 66 respectively would be due to the species

A. $CH_3{}^{35}Cl^+$ and $CH_3{}^{35}Cl_2{}^+$
B. $CH_3CH_2{}^{35}Cl$ and $CH_2{}^{35}ClCH_2{}^{37}Cl$
C. $CH_3CH_2{}^{35}Cl^+$ and $CH_3CH_2{}^{37}Cl^+$
D. $C_2H_5{}^{35}Cl^+$ and $C_2H_3{}^{37}Cl^+$

Question 16
The following statements, with one key word omitted were part of an article entitled 'Two minds on one track in cancer riddle discovery' which appeared on page 9 of The Sunday Age on December 28, 2008.

'The two young women were not working together .... though both findings involved an _____ called telemorase, which plays a role in tumour development and is present in most cancers.
'The suppression of telemorase helps reduce the size of tumours and the treatment has no known effect on healthy cells.
Professor Lie said 'telemorase' was not associated with benign tumours. It is a marker for malignant tumours'
The word omitted in the statements was
A. enzyme
B. antibiotic
C. amino acid
D. disease

Question 17
Pure sulfuric acid, H_2SO_4, contains unionised H_2SO_4 molecules and is a strong oxidising agent. Which of the following substances is least likely to be produced when concentrated sulfuric acid is the oxidant in a chemical reaction?
A. H_2S
B. S
C. SO_2
D. SO_3

Question 18
In an aqueous solution at pH 2, lysine would be expected to form a species with a charge of
A. -1
B. 0
C. +1
D. +2

Question 19
What IR absorption band present in the spectra of the nucleic acids guanine, cytosine and thymine would not be present in the IR spectrum of adenine?
A. 3350-3500 cm^{-1}
B. 1670-1750 cm^{-1}
C. 1610-1680 cm^{-1}
D. 2850-3300 cm^{-1}

Question 20
The mass, in grams, of one molecule of 2-aminopropane is closest to
A. 59.0
B. 9.97×10^{-23}
C. 9.80×10^{-23}
D. 3.55×10^{25}

End of Section A

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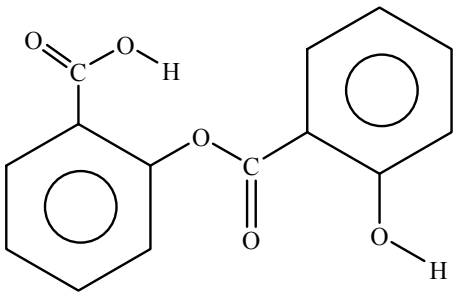
Short Answer Questions

Section B

Section B consists of 7 short answer questions.
This section is worth approximately 75 per cent of the total marks available.
The marks allotted are shown at the end of each part of each question.
Questions should be answered in the spaces provided.

Question 1
The molecular structure of Salsalate, a drug with analgesic and anti-inflammatory properties, is shown below.



a. Identify, by circling and naming, all the functional groups present in Salsalate molecules.

(3 marks)

b. Salsalate molecules are formed by an esterification reaction. Give the molecular structure of the reactant molecules involved in this reaction.

(2 marks)

c. Give the molecular formula of Salsalate molecules.

(1 mark)

d. The mass spectrum of Salsalate shows a significant peak at an *m*/*e* ratio 257. Give the formula of the fragment causing this peak.

(1 mark)

e. If a mass spectrum of Salsalate showed a very small peak at an *m*/*e* ratio of 259, suggest a possible cause of this peak.

(1 mark)

Total 8 marks

Question 2

An organic reaction pathway is represented below.

$$C_2H_4 \rightarrow X \rightarrow Y : X + Y \rightarrow C_4H_8O_2$$

a. Draw structures showing all bonds of the molecules represented by X and Y.

(4 marks)

b. The infrared spectra of all the compounds in the reaction pathway show a number of absorptions. What changes occur in a molecule when it absorbs infrared radiation?

(1 mark)

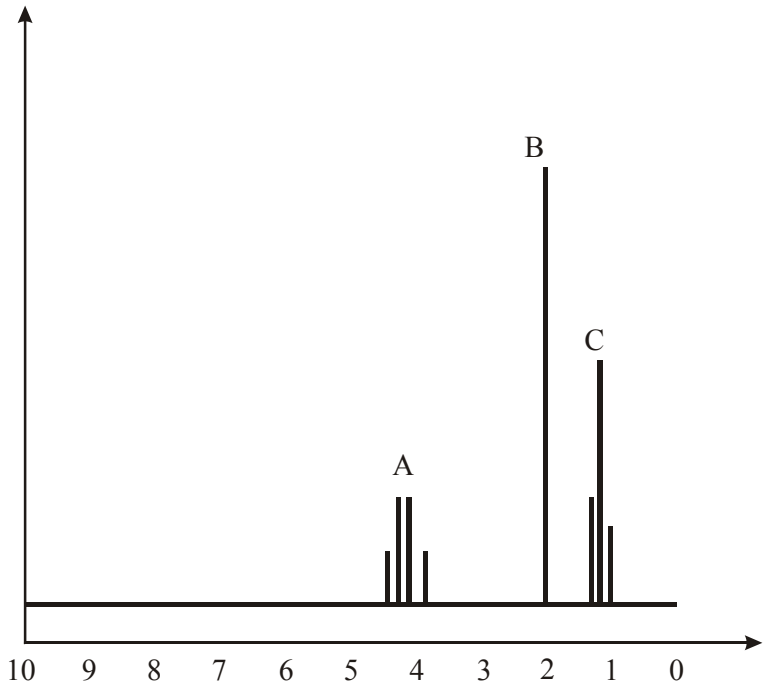
c. Identify an absorption band which would be expected to be present in the IR spectrum of only one of the compounds in the pathway. Explain your choice.

(2 marks)

d. Explain why an IR spectrum of X shows a broad absorption band centred around 3400 cm^{-1} whilst an IR spectrum of Y shows a broad absorption band centred around 2900 cm^{-1}.

(2 marks)

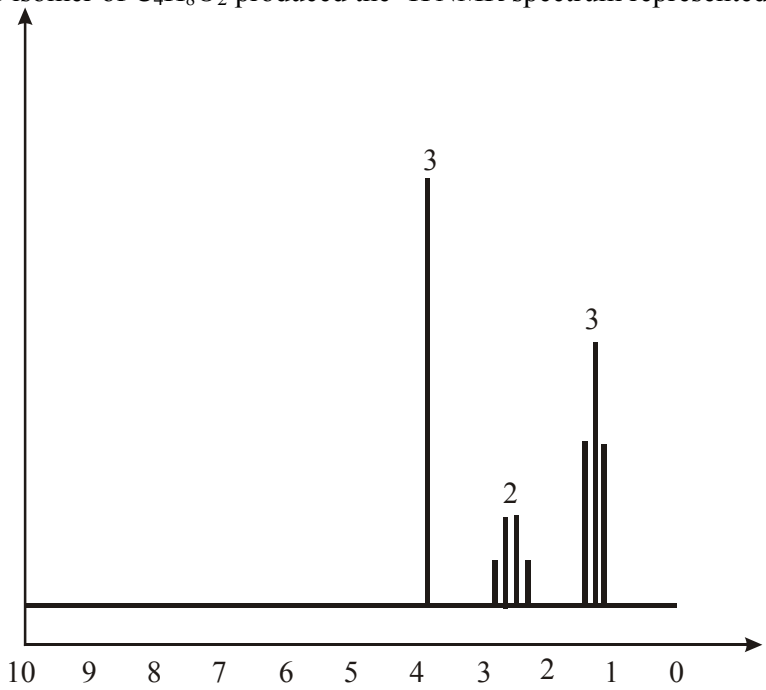
e. The ^1H NMR spectrum of $C_4H_8O_2$ is represented below.



Draw the structural formula of $C_4H_8O_2$ and identify the H atoms responsible for peaks A, B and C on the spectrum.

(3 marks)

f. Another isomer of $C_4H_8O_2$ produced the ^1H NMR spectrum represented below.



Give the name and semi-structural formula of this compound.

(2 marks)

Total 14 marks

Question 3

A key component of the tertiary structure of many proteins is disulfide links.

a. Give the name of an amino acid, which, when part of a protein chain, may be involved in disulfide links.

(1 mark)

b. Draw the structure of a dipeptide formed between the amino acid identified in (a) and a different amino acid containing sulfur. Circle the functional group which is characteristic of a dipeptide.

(2 marks)

c. Describe the functional group changes that occur during the formation of a dipeptide.

(1 mark)

d. In terms of bonding what is common to both a peptide link and a disulfide link?

(1 mark)

e. How is the secondary structure of a protein maintained?

(2 marks)

f. The amino acid tryptophan is an essential amino acid that is used in the body to produce the B-group vitamin niacin.

i. What is an 'essential' amino acid?

(1 mark)

ii. What is the molecular formula of tryptophan?

(1 mark)

g. Aspects of the structure of a protein may be determined using chromatography. The first step in this process is to gently heat the protein in a dilute solution of hydrochloric acid. What is the purpose of this step?

(1 mark)

Total 10 marks

Question 4
The iodine number of a fatty acid is defined as the number of grams of iodine, I_2, that reacts with 100 g of the fatty acid in an addition reaction.

a. i. What is the iodine number of linolenic acid?

(3 marks)

ii. Why does arachidic acid have an iodine number of zero?

(1 mark)

b. Biodiesel is manufactured from vegetable oils in a process called 'transesterification'. This involves the reaction of the oil with an alcohol in the presence of a catalyst. It is, in effect, a two step process. Firstly the oil molecules are broken down into their fatty acids and one 'other product'. The fatty acids then react with the alcohol to produce biodiesel.

i. Give the name and molecular formula of the 'other product' of transesterification.

(1 mark)

ii. Write a balanced equation for the production of the biodiesel methyl palmitoleate from its fatty acid.

(2 marks)

c. Give the chemical formula of the main biofuel produced by fermentation.

(1 mark)

d. What is the main concern with the large scale production of biofuels?

(1 mark)

e. Suggest a reason why there was less focus on the production of biofuels following the economic downturn that started in second half of 2008.

(1 mark)

Total 10 marks

Question 5

A particular brand of fertiliser contains ammonium sulfate, $(NH_4)_2SO_4$, as its only source of nitrogen.

The nitrogen content of the fertiliser was determined using the following method.

A 2.75 g sample of the fertiliser was weighed in a weighing bottle and then added to 100 mL of 0.108 M sodium hydroxide, NaOH(aq), which was then heated and boiled gently. This converted all the ammonium ions into ammonia. The equation for this reaction is

$$NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(g) + H_2O(l).$$

After all the ammonia had been boiled off, the solution was cooled and then titrated with 0.105 M hydrochloric acid, HCl(aq). A titre of 14.1 mL was required to neutralise the excess sodium hydroxide, according to the equation

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l).$$

a. Calculate the amount of NaOH, in mole, remaining unreacted after the conversion of NH_4^+ to NH_3.

(1 mark)

b. Calculate the amount of NaOH, in mole, required to convert all the NH_4^+ to NH_3.

(1 mark)

c. Determine the percentage, by mass, of nitrogen in the fertiliser.

(3 marks)

d. Errors that might have occurred during this practical procedure are listed below. For each error, indicate the likely effect of the error on the calculated percentage of nitrogen by placing a tick in the appropriate box.

Error	Calculated % N too high	No effect on calculated % N	Calculated % N too low
A small amount of the cooled solution is split prior to the titration.			
The burette is rinsed with water immediately before adding the acid, prior to the titration.			
Traces of fertiliser remain in the weighing bottle after transfer to the 0.108 M NaOH.			

(3 marks)

Total 8 marks

Question 6

A sample of magnesium oxide is uniformly contaminated with barium oxide. An analysis to determine the composition of this sample uses the fact that whilst both substances react with sulfuric acid to produce metal sulfates, barium sulfate is insoluble but magnesium sulfate is soluble.

A 0.952 g sample was added to 250 mL of 1 M sulfuric acid, which was an excess, and reaction allowed to go to completion. The precipitate formed was collected by filtration, dried and weighed. The mass of precipitate collected was 0.237 g. The filtrate was also collected and made up to 500 mL with deionised water.

a. Write balanced equations for the reaction of the metal oxides with sulfuric acid.

(2 marks)

b. Calculate the concentration, in mol L^{-1}, of Mg^{2+} ions in the 500 mL of solution produced from the filtrate.

(4 marks)

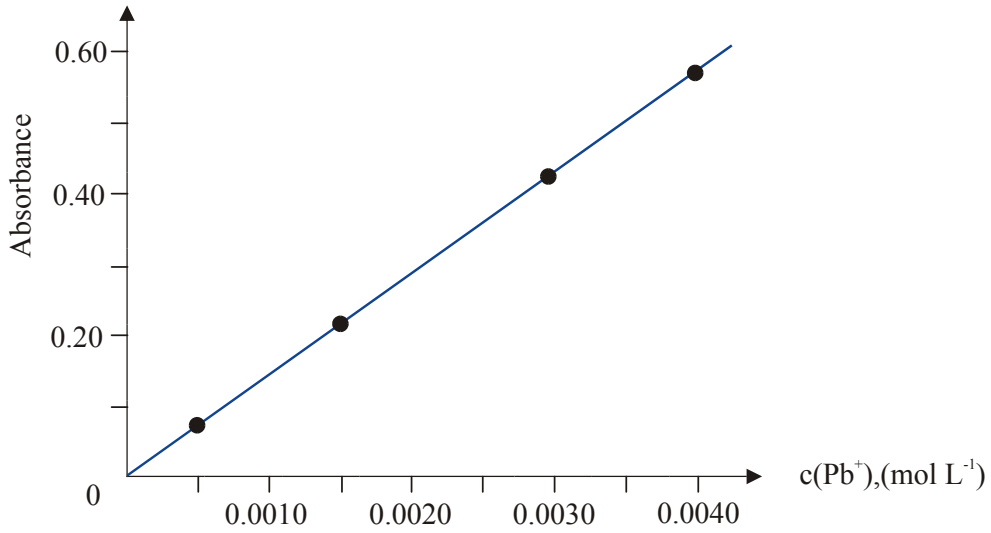
c. How would **not** washing the precipitate with deionised water in this procedure affect the accuracy of the answer to (b.)?

(2 marks)

Total 8 marks

Question 7

To determine if the level of lead in bore water was safe for drinking, a spectroscopic technique was used to measure the concentration of lead. The absorbances of four standard solutions of $Pb^{2+}(aq)$ were measured and the calibration curve given below was constructed.



A 50 mL sample of bore water was diluted to 100 mL and when a small sample of the diluted solution was added to the spectrometer an absorbance of 0.50 was recorded.

a. What analytical instrument was used for the analysis?

(1 mark)

b. What change occurred to the lead atoms during the energy absorption?

(1 mark)

c. Determine the concentration of lead, in mol L^{-1}, in the bore water.

(2 marks)

d. Determine mass of lead, in mg, present in one litre of the bore water.

(1 mark)

Total 5 marks

End of Section B

End of Trial Exam