SUZANNE CORY
High School

Unit 2 AOS 2
Chemistry 2020
Test 2: Analytical Chemistry ANSWERS

Section	Number of Questions	Number of Marks
A. Multiple Choice	**10**	**10**
B. Short Answer	**3**	**24**

Reading time: 5 minutes
Writing time: 50 minutes

Name : ANSWERS Teacher : 11CHEMCAD

Question Booklet

Materials
You should have pens, pencils, a ruler, an eraser, a scientific calculator
You will be supplied with a Data Book.

Instructions
Ensure that you write your name and your teacher's name clearly on the booklet.
Answer all questions in section A on the multiple-choice answer sheet provided - no answers written in this booklet will be accepted.
Answer all questions in section B in the space provided in this question and answer booklet.
No marks will be deducted for incorrect answers

Multiple Choice Answer Sheet

Please mark all answers to section A on the sheet below by shading the corresponding box.

Only responses marked on this sheet will be given credit.

1	**A**	B	C	D
2	A	**B**	C	D
3	A	**B**	C	D
4	**A**	B	C	D
5	A	B	C	**D**
6	A	B	**C**	D
7	A	B	**C**	D
8	A	B	C	**D**
9	A	**B**	C	D
10	**A**	B	C	D

Section A: Multiple Choice Questions (10 marks)

1. The presence of carbon dioxide in water:
   A. Causes it to become more acidic
   B. Causes it to become more basic
   C. Does not change the acidity of water
   D. Causes carbon monoxide poisoning

2. The presence of acid rain has several undesirable effects. Which of the following is not one?
   A. Death of many species of aquatic flora and fauna
   B. Increase of greenhouse gases
   C. Corrosion of metals and limestone buildings
   D. Leaching of minerals from soil which reduces plant growth

3. Metals that have a high density and are toxic to living organisms are called
   A. Organometallic compounds
   B. Heavy metal
   C. Hard water
   D. Metalloids

4. The electrical conductivity of a sample can be used to:
   A. Measure the concentration of ions in the sample
   B. Determine the types of ions in the sample
   C. Measure the turbidity of the sample
   D. Measure the pH of the sample

5. The volume of liquid delivered by a burette is called:
   A. An aliquot
   B. A pipette
   C. A standard
   D. A titre

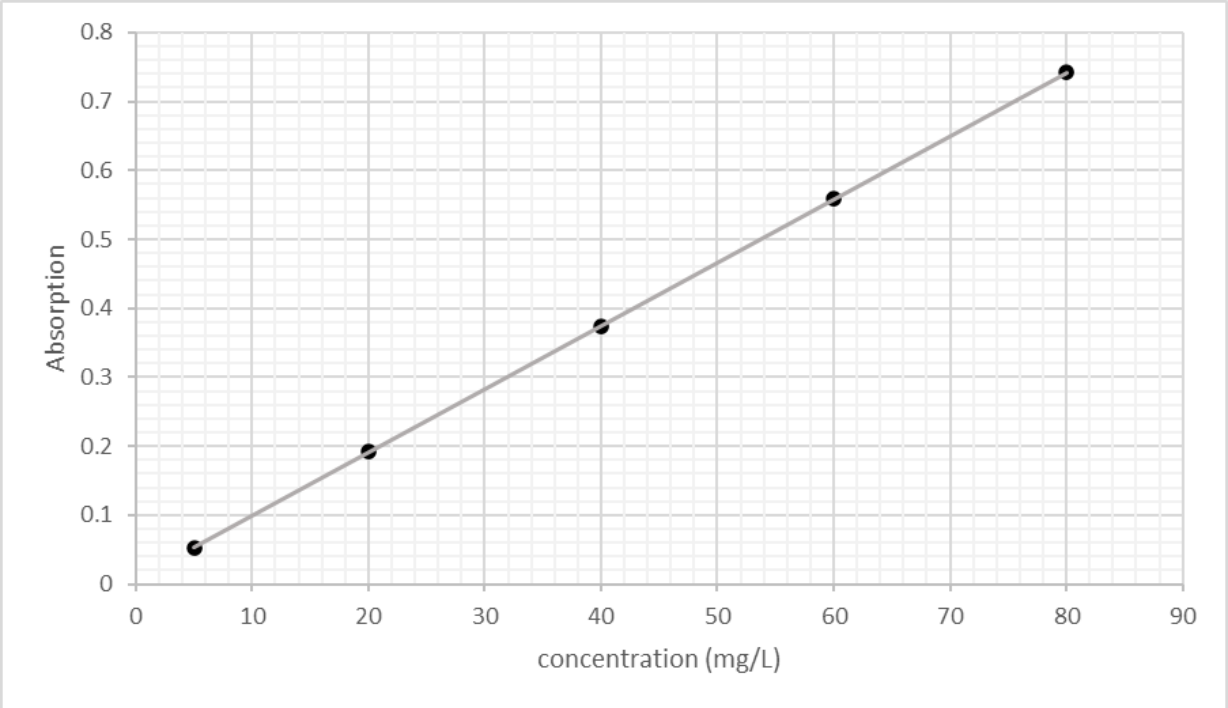
6. Which of the following laboratory equipment has a largest uncertainty?
   A. A 50mL burette
   B. A 20mL pipette
   C. A 100mL graduated beaker
   D. A 250mL volumetric flask

7. Colorimetry and UV-visible spectroscopy is used to work out the concentration of salts in solution based on the absorption of light. Which of the following is true?
   A. Colorimetry is more precise than UV-visible spectroscopy.
   B. Solutions of lower concentrations absorb more light.
   C. The light that the solution absorbs is the complementary colour of the solution.
   D. The solution absorbs light that is the same colour as it.

8. Atomic absorption spectroscopy (AAS) is mainly used to detect the presence of
   A. Organic compounds
   B. Noble gases
   C. Halogens
   D. Metals

9. Which of the following is not true about high performance liquid chromatography (HPLC)?
   A. Samples with stronger desorption to the stationary phase will more readily dissolve into the mobile phase.
   B. The retention time of a compound is used for quantitative analysis.
   C. The peak area or peak height of a compound is used in a calibration curve to determine the concentration of unknown samples.
   D. Samples with stronger adsorption to the stationary phase will have a larger retention time.

10. Below is the calibration curve for a solution of a red compound that was analysed using UV-Visible spectroscopy.



Concentration (mg/L)	Absorption
5	0.0529
20	0.1914
40	0.3743
60	0.5586
80	0.7429
sample	0.3000

What is the concentration of the red compound?

   A. $32\ mg\ L^{-1}$
   B. $0.3000\ mg\ L^{-1}$
   C. $0.3000\ mg\ mL^{-1}$
   D. $32\ mg\ mL^{-1}$

Section B: Short Answer (24 marks)

Question 1 (7 marks)

Cory Jones wanted to determine the amount of lead content inside a 250g piece of brass pipe. To do so, he cut off 50.00g of brass piping and dissolves it in a solution of nitric acid, HNO_3 and sulfuric acid, H_2SO_4. A white precipitate of lead sulphate, $PbSO_4$, is formed. Cory then filters the solution and dries the precipitate in an oven.

a. Write the chemical equation for the reaction of lead, Pb, with sulfuric acid, H_2SO_4. (Include states) 2 marks

$Pb(s) + H_2SO_4(aq) \rightarrow PbSO_4(s) + H_2(g)$ $1A$ *Equation* $1A$ *States*

b. If 3.59g of precipitate was found, determine the mass of lead in the original piece of brass pipe. 3 marks

$m(PbSO_4) = 3.59g$

$n(PbSO_4) = \frac{m}{M_r} = \frac{3.59}{271.3} = 0.013232584 \ldots mol$ $1M$

$n(PbSO_4) = n(Pb) = 0.013232584\, mol$ $(mole\ ratio)$ $1M$

$m(Pb) = nM_r = 0.013232584 \times 207.2 = 2.74179g = 2.74g$ $1A$

c. What is the percentage by mass of lead in the brass pipe? 1 mark

$\%mass = \frac{2.74179}{50.00} \times 100 = 5.48\%$ $1A$ *conseq*

d. Lead is found to be poorly soluble in water. Would this cause an overestimation or underestimation of the percentage mass of lead in the brass pipe? Justify your answer. 1 mark

Underestimation – since lead is poorly soluble, it means that some lead will stay dissolved in the solution. Therefore, the precipitate will not contain all the lead in the brass pipe and will cause an underestimation of the percentage mass of lead in the brass pipe. **Justification required.** $1A$

Question 2 (5 marks)

19.46g of solid pure sodium hydroxide is completely dissolved in 150.0 mL of water.

a. Calculate the moles of sodium hydroxide. 1 mark

$n(NaOH) = \frac{m}{M_r} = \frac{19.46}{40} = 0.4865\ mol$ 1A

b. Calculate the concentration of the solution in molarity. 1 mark

$c(NaOH) = \frac{n}{V} = \frac{0.4865}{0.150} = 3.243M$ 1A conseq

c. In another reaction, 2.643g of zinc metal is dissolved in 20.0mL of 3.00M sodium hydroxide solution according to the following equation:

$$Zn(s) + 2NaOH(aq) + 2H_2O(l) \rightarrow Na_2Zn(OH)_4(aq) + H_2(g)$$

Which reactant is in excess and by how many moles? 3 marks

$n(Zn) = \frac{m}{M_r} = \frac{2.643}{65.4} = 0.04041\ mol$

$n(NaOH) = cV = 3.00 \times 0.020 = 0.060\ mol$ 1M

Zn reacts with NaOH in a 1:2 ratio.

$0.08082 mol\ NaOH$ requires $0.04041\ mol\ Zn$, but we only have $0.060\ mol$ of $NaOH$

Thus, Zn is in excess. 1A

$0.06 mol\ NaOH$ requires $0.03 mol\ Zn$.

Thus, there is $0.04041 - 0.03 = 0.0104\ mol\ Zn$ in excess 1A conseq

Question 3 (12 marks)

Suzanne Jones is a student who likes doing titrations. For her experiment, 25.0 mL aliquots of hydrochloric acid, HCl, solution were titrated with a calcium hydroxide solution , $Ca(OH)_2$.
The balanced equation for the reaction between calcium hydroxide and hydrochloric acid is

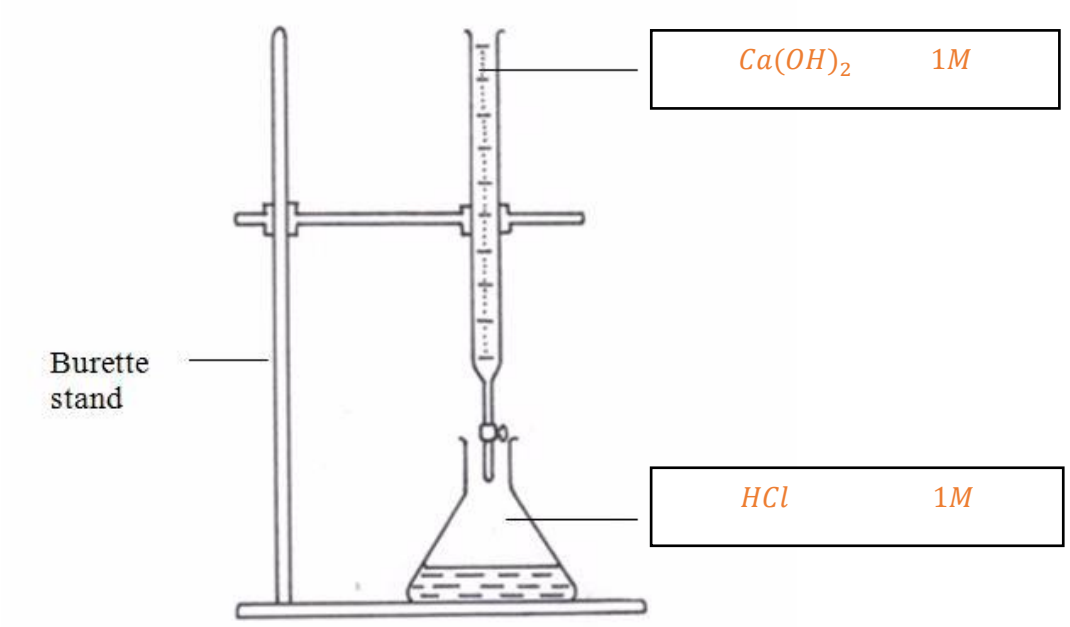
$$Ca(OH)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$$

a. Suzanne Jones wants to make a standard solution of 1.00M $Ca(OH)_2$. If she had 250.0 mL of water, determine the mass of solid calcium hydroxide needed. 2 marks

$n(Ca(OH)_2) = cV = 1.00 \times 0.250 = 0.250\ mol$ $1M$

$m(Ca(OH)_2) = nM_r = 0.250 \times 74.1 = 18.525g = 18.5g$ $1A$

b. Suzanne's experiment is set up like the following diagram. Fill in the blanks with the solutions that should be found in their respective parts of the set up. 2 marks



c. Suzanne begins doing her titrations and records her results below.

Trial number	**1**	**2**	**3**	**4**	**5**
Initial reading (mL)	0.22	20.98	8.12	10.54	6.86
Final reading (mL)	20.88	41.42	28.6	30.84	27.38
Titre (mL)	20.66	20.44	20.48	20.30	20.52

i. Complete the table above. $1A$ 3 $correct,$ $2A$ 5 $correct$ 2 marks

ii. Determine the three concordant results and hence, find the average titre. 2 marks

Concordant results are $20.44\ mL, 20.48\ mL, 20.52\ mL$ $1A$

Average titre $= \frac{20.44 + 20.48 + 20.52}{3} = 20.48\ mL$ $1A$

d. Determine the concentration of the hydrochloric acid. 3 marks

$V(Ca(OH)_2) = 0.02048\ L$

$n(Ca(OH)_2) = cV = 1.00 \times 0.02048 = 0.0248\ mol$ $1M$

$n(Ca(OH)_2) : n(HCl) = 1:2$

$n(HCl) = 2 \times n(Ca(OH)_2) = 2 \times 0.0248 = 0.0496\ mol$ $1M$

$c(HCl) = \frac{n}{V} = \frac{0.0496}{0.025} = 1.98M$ $1A$

e. In her preparation of the titration, Suzanne is careful when rinsing every piece of glassware for volumetric analysis. Choose one piece of glassware (burette, pipette, or flasks) and explain how rinsing it with the incorrect solution can change the results? 1 mark

Burette/Pipette – Rinsing it with deionised water will dilute the titrant/analyte. This will increase the amount of titre that will react with the analyte

Flasks – Rinsing with titrant will reduce the amount of titre as there will be less analyte to react with the titrant.

Flasks – Rinsing with analyte will increase the amount of titre as there will be more analyte to react with the titrant

$1M$ $choose + explain$