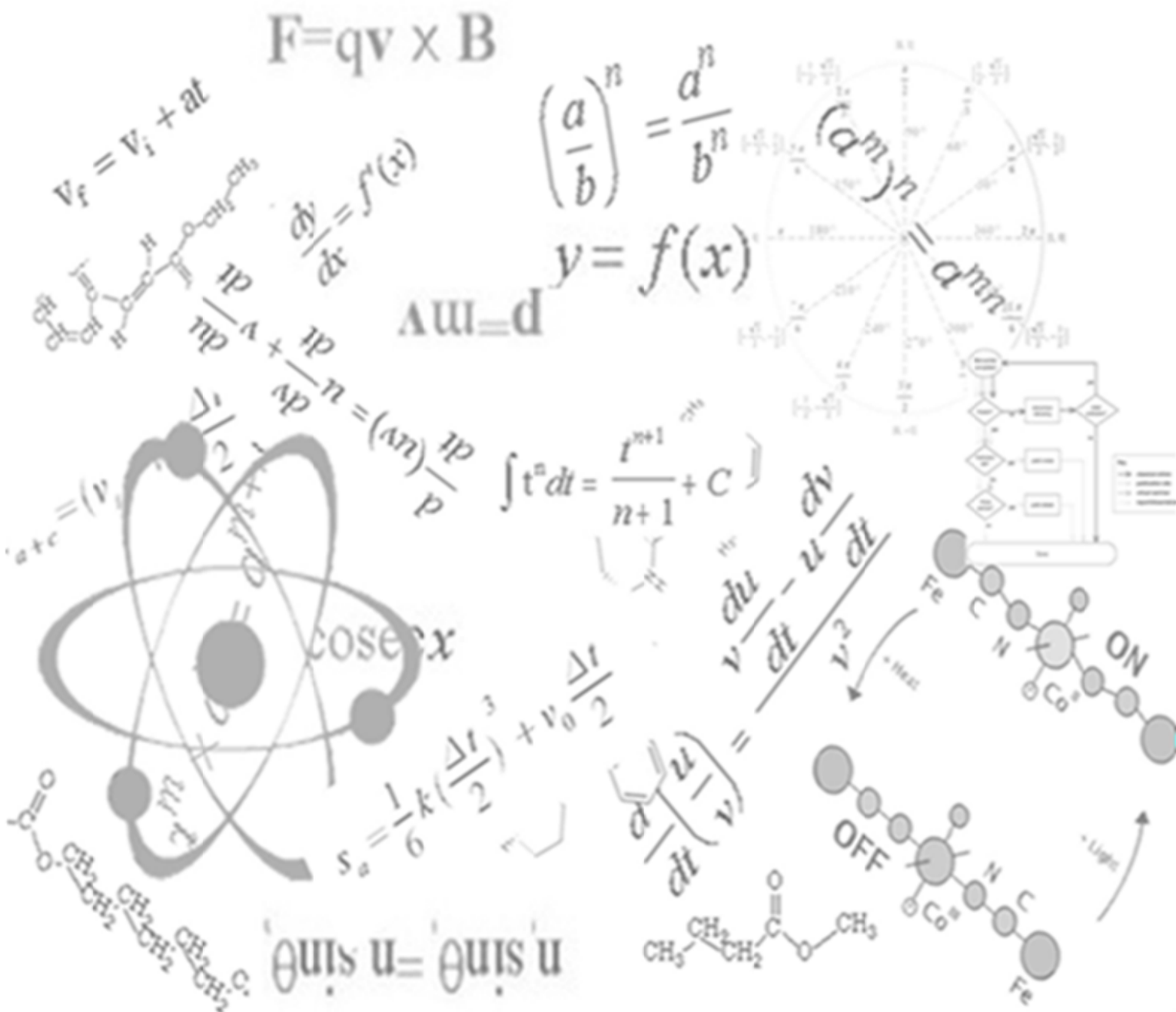


where students come first!



Year 12- Chemistry

The Acidic Environment



Acidic environment exam 3 – Questions

1. (5 marks)

- (a) A student made up 0.01 mol L^{-1} solutions of four acids – A, B, C and D. She measured the pH of the acids and found them to be 4.5, 6.5, 2.1 and 2.7 respectively.
- (i) Arrange the acids in order of increasing strength, from weakest to strongest 1 mark
- (ii) Are any of those acids completely ionized. Explain your answer 2 marks
- (b) HClO_4 , perchloric acid, is a strong acid where as the related HClO_2 , chlorous acid is a weak acid. Write ionization reactions for these acids that reflect the strength of the acid. 2 marks

2. (5 marks)

Caustic soda (sodium hydroxide) can be used to strip paint off furniture.

A 3.0 g container of caustic soda was dissolved in water and the volume of the solution was made up to 3.0 L.

The sodium hydroxide solution was then titrated with 0.026 mol L^{-1} hydrochloric acid solution.

- (a) Calculate the concentration of the sodium hydroxide solution in mol L^{-1} . Show your working. 1 mark
- (b) Determine the pH of the hydrochloric acid solution. 1 mark
- (c) Evaluate the use of sodium hydroxide as a *primary standard*. 3 marks

3. (2 marks)

A series of ten-fold dilutions was carried out on a solution of $0.01 \text{ mol L}^{-1} \text{ HNO}_3$.

- (a) What is the minimum concentration of $\text{H}^+(\text{aq})$ that can be obtained by successive dilutions of the HNO_3 ?
- (b) What is the pH of the solution in (a)?

4. (3 marks)

An ester used in banana flavouring is butyl ethanoate. A student wanted to prepare this ester in the school laboratory.

- (a) Write a balanced structural equation for the production of butyl ethanoate. 1 mark
- (b) For the preparation of this ester, a few drops of concentrated sulfuric acid were added to the reactants and the mixture refluxed for many hours. Justify the steps in the students procedure. 2 marks

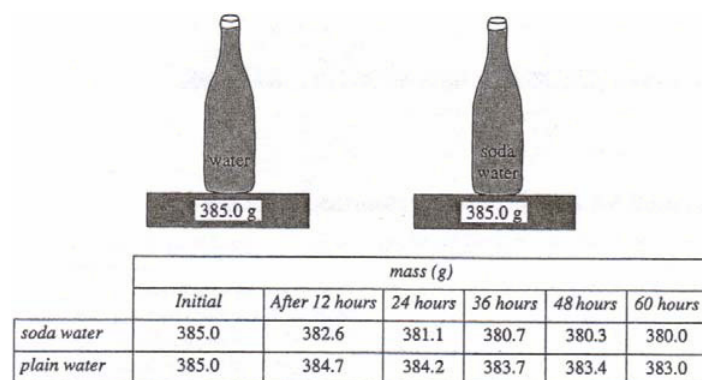
5. (3 marks)

Certain salts dissolve in water to lower its pH.

- (a) Identify such a salt 1 marks
- (b) With the help of an equation, explain how the pH is lowered. 2 marks

6. (6 marks)

As part of your practical work you decarbonated a beverage. A student decarbonated a sample of soda water by opening the bottle it was in and leaving it for a period of time, weighing it at regular intervals. She also used a non-carbonated sample of water as a control, recording its mass at the same intervals.



- (a) Graph the information shown for each water sample on the same graph. 2 marks
- (b) Interpret the trends shown in the graph. 2 marks
- (c) Use the graph to determine the volume of CO₂ gas produced at 25°C and 100 kPa. Show your working. 2 marks

7. (4 marks)

Use Le Chatelier's Principle to relate the increase in burning fossil fuels to a possible increase in the acidity of the oceans.

8. (4 marks)

A volumetric analysis required that a student accurately prepare a 0.1 mol/L solution of pure anhydrous sodium carbonate. Detail the steps required to make the standard solution, including any glassware used.

9. (7 marks)

A 500mL bottle of concentrated sulfuric acid (18 mol/L) was dropped in a laboratory accident. Solid sodium hydrogen carbonate (NaHCO₃) was used to neutralise the spilled acid.

- (a) Justify the choice of the solid sodium hydrogen carbonate to clean up the spill. Include relevant equation(s). 4 marks
- (b) Calculate the minimum mass of sodium hydrogen carbonate needed to neutralise the spilled acid completely. 3 marks

10. (5 marks)

A titration was carried out using 0.246 mol/L HCl to standardise 25.0 mL aliquots of a solution of the weak base, sodium carbonate. An appropriate indicator was chosen to show the end point of the neutralisation. The results gained are shown in the table below.

Run	1	2	3	4	5
Initial burette volume (mL)	0.5	23.6	0.7	23.5	0.2
Final burette volume (mL)	23.5	45.8	23.0	46.2	22.4

(a) Calculate the concentration of the sodium carbonate solution. Justify the steps in your calculation. 3 marks

(b) The student had a choice of indicators:

- Methyl orange; changes from red to orange from pH 3.0 to 4.5.
- Phenolphthalein; changes from colorless to pink from pH 8.3 to 10.0.

Select the indicator that should be used for this titration, giving a reason for your choice. 2 marks

11. (4 marks)

Discuss factors that must be considered when using neutralisation reactions to safely minimise damage in chemical spills.