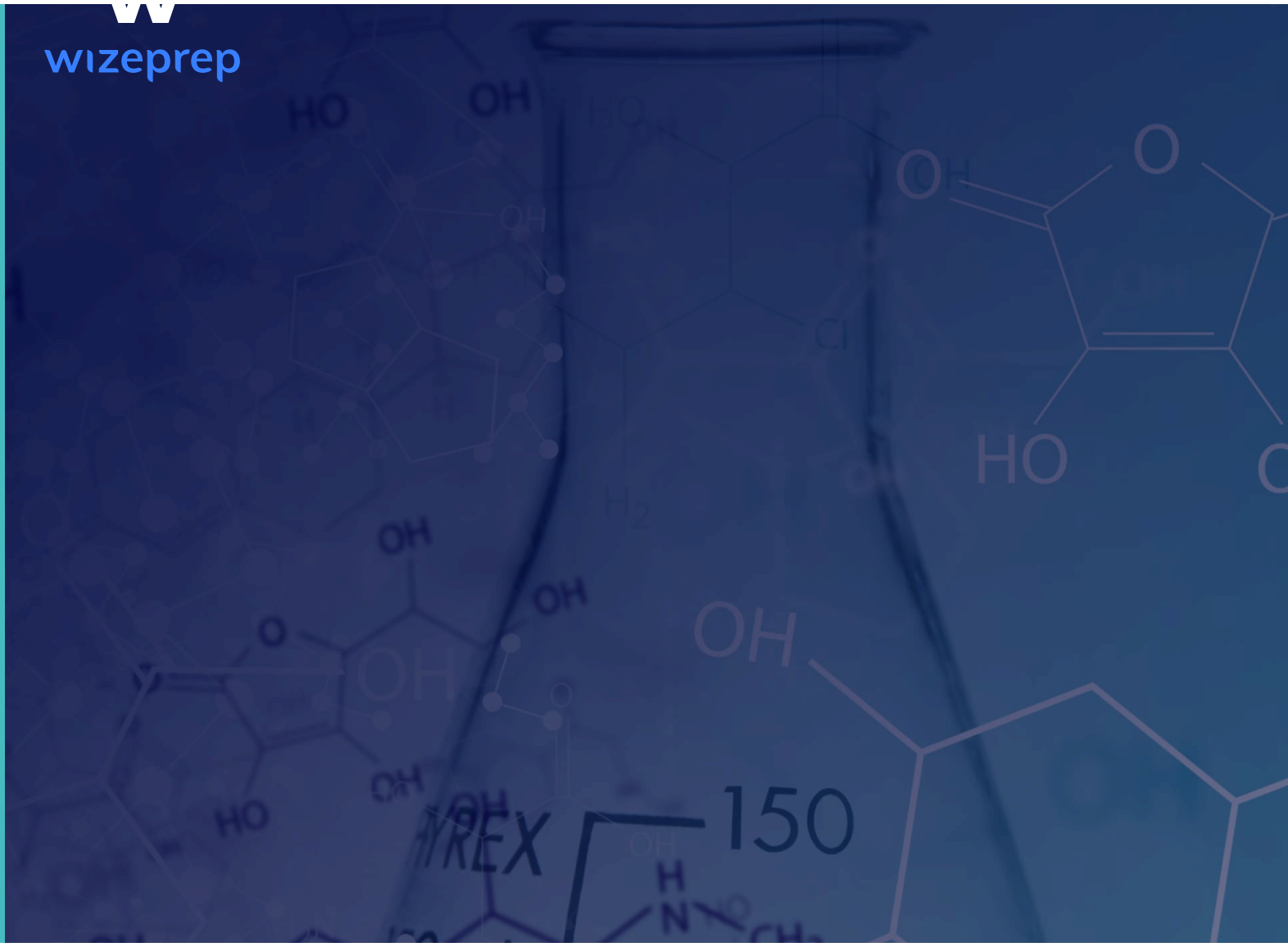
wizeprep



Ontario High School

Grade 11 Chemistry

Summer 2024, Chapter 8 Notes

Welcome to Wizeprep

These notes were created on Jun 6th, 2024

We're always updating our content. Check back for more.

👋 Welcome to Your Course Notes

I'm Dana, your Wizeprep chemistry tutor. I put these notes and the corresponding online course together especially for Grade 11 Chemistry at Ontario High School. It's formulated to tell you everything you need to know, in a quick and easy format so you can get better grades, spend less time studying, and more time living.

Dana 4.4/5 ⭐
MSc

Find Your Course Online

These course notes correspond to an online course full of video lectures, practice problems, instructor Q&A and more. Access it with this QR code or at wizeprep.com/in-course-experience/Sch3U-High-School

98%

Of Wizeprep Students Get Better Grades

> *After discovering Wizeprep at the beginning of my second semester, my grades have gone up significantly. I feel so much more confident when taking my exams.*

Emily, Undergraduate Student

Your Wizeprep Resources

Get Better Grades

98% of students who study with Wizeprep reported higher grades

Really Understand Concepts

Our instructors know how to make complex topics feel simple

Cut Your Study Time in Half

Quick, curated lessons allow you to focus your study time where it matters

Find in These Course Notes

Relevant Theory

All the theory and expert knowledge you need to fully understand your course.

Practice Questions

Tons of practice problems, similar to those expected on your exam.

Exam Tips

Unique exam writing tips proven to help you score higher.

Find Online

Bite-Sized Video Lessons

Each section corresponds to a minutes-long video explanation by your expert instructors.

Solutions to Problems

See the solutions to the practice problems as well as a step-by-step breakdown of the answers.

24/7 Instructor Q&A

Need help clarifying a concept? You have direct access to your instructor.

Not subscribed yet?

Get started for free on Wizeprep.com

Table of Contents

8. Acids and Bases

8.1 Acid Base Definitions

8.1.1

Acids and Bases Definitions

- **Arrhenius definition:** compounds identified as producing H^+ or OH^- ions in solution
  - Acids produce H^+ ions:

$$HNO_3(aq) \rightarrow H^+(aq) + NO_3^-(aq)$$

  - Bases produce OH^- ions:

$$LiOH(aq) \rightarrow Li^+(aq) + OH^-(aq)$$

- **Modified Arrhenius definition:** compounds identified as acids or bases based on their reaction with water
  - Acids react with water to produce H_3O^+ ions

$$HNO_3(aq) + H_2O(\ell) \rightarrow H_3O^+(aq) + NO_3^-(aq)$$

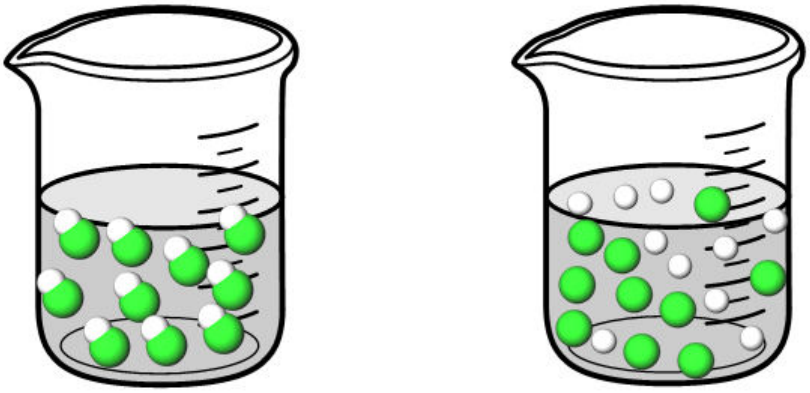
  - Bases react with water to produce OH^- ions

$$NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

Acid and Base Strength

- Strong acids ionize completely:

$$HNO_3(aq) \rightarrow H^+(aq) + NO_3^-(aq)$$



- Weak acids partially ionize to give H^+:

$$HF(aq) \rightleftharpoons F^-(aq) + H^+(aq)$$

- Strong bases dissociate completely in water:

$$LiOH(s) \rightarrow Li^+(aq) + OH^-(aq)$$

- Weak bases react with water to give OH^-, but the reaction is not complete

$$NH_3(aq) + H_2O(\ell) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

Watch the video tutorial for this lesson (04:14)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=74844&activity_type=CourseLesson

8.1.2

Properties of Acids and Bases

Acids

- Taste Sour
- No particular texture
- Turns blue litmus paper red
- pH < 7

Bases

- Taste Bitter
- Feel slippery
- Turns red litmus paper blue
- pH >7

Watch the video tutorial for this lesson (01:40)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=75608&activity_type=CourseLesson

8.1.3

Naming Acids and Bases

Naming Acids without Oxygen

- A **binary acid** is an acid that consists of hydrogen and one other element.
- To name a binary acid, start with the **prefix *hydro-*,** followed by the **base name of the anion** and **the ending *-ic*** then the word **acid**

  Example: HCl is _____

Naming Acids with Oxygen

- Acids that are made out of hydrogen, oxygen and a third element are known as **oxyacids.** The third element is usually a nonmetal.
- If the anion has the ***-ite*** ending, the name of the acid is the root of the anion followed by the suffix ***-ous***.
  Example: HNO_2 is _____
- If the anion has the ***-ate*** ending, the name of the acid is the root of the anion followed by the suffix ***-ic***.
  Example: HNO_3 is _____

Naming Bases

- Most common bases are ionic hydroxides. Use the naming convention for ionic compounds with polyatomic ionds

  Example: NaOH is _____

Watch the video tutorial for this lesson (03:17)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=75470&activity_type=CourseLesson

8.1.4

Practice: Acids and Bases Definitions and Properties

Match the following terms and definitions

A. Feels slippery

B. Completely dissociates in solution

C. Partially ionize in solution

D. Taste sour

( ) Weak acid

( ) Strong base

( ) Property of an acid

( ) Property of a base

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113046&activity_type=QuizQuestion

8.1.5

Practice: Identifying Arrhenius Acids and Bases

Part 1

Which of the following compounds is a base according to the Arrhenius theory? Select all that apply.

- [ ] KOH
- [ ] HClO
- [ ] $Ba(OH)_2$
- [ ] H_3PO_4

Practice: Identifying Arrhenius Acids and Bases

Part 2

Which of the following compounds is an acid according to the Arrhenius theory? Select all that apply.

- [ ] NaOH
- [ ] $Ca(OH)_2$
- [ ] H_3PO_3
- [ ] HF

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=112601&activity_type=QuizQuestion

8.1.6

Which one of the following statements about strong acids is true?

- All strong acids have H atoms bonded to electronegative oxygen atoms.
- Strong acids are 100% ionized in water.
- Strong acids are very concentrated acids.
- Strong acids produce solutions with a higher pH than weak acids.

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113903&activity_type=QuizQuestion

8.1.7

Example: Identifying Strong Acids and Bases

Group the following molecules as strong acids, strong bases, or neither: HBr, NaCl, H_2SO_4, $Mg(OH)_2$, KOH, H_3PO_4

Solution available online

Watch the video tutorial for this lesson (01:41)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=78354&activity_type=CourseLesson

8.2 Titrations

8.2.1

Introduction to Titrations

- **Titrations** always involve an acid reacting with a base. We perform titrations to determine the unknown concentration of an acid or a base.
- Titrations are **neutralization reactions** between a **titrant** and **analyte**.

Titrant

- Solution in the burette
- We know its concentration and it is usually a strong acid or base
- We control the amount of the titrant we add to the flask

Analyte

- Solution in the volumetric flask
- We don't know its concentration
- We do know its volume

Equivalence Point and End-Point

- Once the number of moles of titrant equals the number of moles of analyte, the reaction is complete and we have reached the **equivalence point**
- We follow the change in pH of the analyte as titrant is added to it:
    a. Using a pH meter
        - A sudden change in pH helps us determine when we have reached the equivalence point.
    a. Using an indicator
        - **Indicators** help to show a pH change by changing the color inside the flask
- We refer to the point at which the sudden change in pH occurs or when the color of the indicator changes, as the **end point** of the titration.

Watch the video tutorial for this lesson (04:08)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=75202&activity_type=CourseLesson

8.2.2

Indicators

- An **indicator** is a weak acid or base added in a very small quantity to the analyte of a titration before the experiment begins.
- We observe the colour changes in an indicator over a small pH range.
- To pick an indicator for your acid-base titration, select an indicator whose colour changes around the pH at the equivalence point

Name	Acid Colour	pH Range of Colour Change	Base Colour
Alizarin yellow	Yellow	$10.1 - 12.0$	Red
Phenolphthalein	Colorless	$8.2 - 10.0$	Pink
Bromothymol blue	Yellow	$6.0 - 7.6$	Blue
Methyl orange	Red	$3.2 - 4.4$	Yellow
Bromocresol green	Yellow	$3.8 - 5.4$	Blue

Watch the video tutorial for this lesson (02:01)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=77249&activity_type=CourseLesson

8.2.3

Example: Titrations

What volume of 0.030 mol/L HI (aq) is required to neutralize 15mL of 0.010 mol/L $Ba(OH)_2$ (aq)?

$$Ba(OH)_2(aq) + 2HI(aq) \rightarrow BaI_2(aq) + 2H_2O(\ell)$$

Solution available online

Watch the video tutorial for this lesson (02:05)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=78066&activity_type=CourseLesson

8.2.4

Practice: Titrations Terms and Definitions

Match the following terms and definitions.

A. the procedure used to determine the concentration of a solution

B. the standardized solution of known concentration

C. the point at which indicator colour changes permanently

D. the calibrated tube that is used measure titrant

E. the theoretical point at which neutralization is complete

F. solution whose concentration is unknown

( ) titrant

( ) end point

( ) equivalence point

( ) burette

( ) titration

( ) analyte

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113810&activity_type=QuizQuestion

8.2.5

Practice: Indicators

Methyl orange indicator is added to a solution with a pH of 6.4. In this solution the colour of the indicator is predicted to be:

Name	Acid Colour	pH Range of Colour Change	Base Colour
Alizarin yellow	Yellow	$10.1 - 12.0$	Red
Phenolphthalein	Colorless	$8.2 - 10.0$	Pink
Bromothymol blue	Yellow	$6.0 - 7.6$	Blue
Methyl orange	Red	$3.2 - 4.4$	Yellow
Bromocresol green	Yellow	$3.8 - 5.4$	Blue

- colourless
- red
- orange
- yellow

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113811&activity_type=QuizQuestion

8.2.6

25mL of a solution of 0.5mol/L KOH is required to neutralize 15mL of sulphuric acid. What is the concentration of the acid?

$$2KOH\,(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(\ell)$$

- 0.26mol/L
- 0.42mol/L
- 0.96mol/L
- 1.1mol/L

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113045&activity_type=QuizQuestion

8.3 pH and pOH Calculations

8.3.1

pH and pOH Calculations

- In pure water, at 25°C the following chemical reaction takes place:

$$2H_2O \rightleftharpoons H_3O^+ + OH^-$$

- We can classify aqueous solutions based on the concentration of the hydronium ions:
  - neutral solutions: $[H_3O^+(aq)] = 1 \times 10^{-7} mol/L$
  - acidic solutions: $[H_3O^+(aq)] > 1 \times 10^{-7} mol/L$
  - basic solutions: $[H_3O^+(aq)] < 1 \times 10^{-7} mol/L$

- From here we can define pH, or the "power of hydrogen":

$$pH = -\log [H_3O^+ (aq)] \text{ and } [H_3O^+ (aq)] = 10^{-pH}$$

- We can also define pOH:

$$pOH = -\log [OH^- (aq)] \text{ and } [OH^-(aq)] = 10^{-pOH}$$

Watch the video tutorial for this lesson (02:38)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=75654&activity_type=CourseLesson

8.3.2

Example: Calculating pH

If 0.2mol of HCl are dissolved in 1.8L of water, what is the pH?

Solution available online

Watch the video tutorial for this lesson (01:27)

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=77596&activity_type=CourseLesson

8.3.3

Practice: Calculating pH

Calculate the pH of a 2.75×10^{-3} mol/L aqueous HNO_3 solution. Give your answer to two decimal places.

Answer

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=112603&activity_type=QuizQuestion

8.3.4

Practice: Understanding pH

A solution with a pH of 1 has ____ the hydronium ion concentration compared to a solution with a pH of 4.

- 3 times
- 300 times
- 1000 times
- 3000 times

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113908&activity_type=QuizQuestion

8.3.5

Practice: Solutions and pH

Calculate the pH of a solution prepared by adding 25.00mL of 0.100mol/L HCl with 75.00mL of $2.50x10^{-2}$mol/L HBr. Give your answer rounded to two decimal points.

Answer

View Solutions on Wizeprep.com

Solutions to these questions, as well as step-by-step breakdowns of the answers at:

https://www.wizeprep.com/in-course-experience/Sch3U-High-School?activity_id=113909&activity_type=QuizQuestion

Thanks for Studying With Us
Good Luck!

Find this, and much, much more on Wizeprep.com

Bite-Sized Video Lessons

Each section corresponds to a minutes-long video explanation by your expert instructors.

Solutions to Problems

See the solutions to the practice problems as well as a step-by-step breakdown of the answers.

24/7 Instructor Q&A

Need help clarifying a concept? You have direct access to your instructor.

Also on Wizeprep.com

Crash Courses

A live review of all testable concepts, exam-like practice problems, tips & tricks, and Q&A. Led by an instructor who is an expert on your course.

✓ Live Online Session ✓ Booklet ✓ Solutions ✓ Recording

Weekly Tutorials

A weekly, live review of lecture topics led by an instructor who knows your course inside and out.

✓ Live Online Session ✓ Booklet ✓ Solutions ✓ Recording

First week free!

Mock Exam Walkthroughs

A realistic practice exam based on past exams from your course. An instructor experienced with your course will walk through the solutions.

✓ Live Online Session ✓ Booklet ✓ Solutions ✓ Recording

Wizeprep MCAT

Biology | Chemistry | Org Chem | Biochem | Physics | CARS | Psych

Two Plans

ELITE 515 LIVE

Flexible live schedules, face-time with our MCAT instructors.

515+ performance guarantee

SELF-PACED

Watch 144 hours of expert MCAT instruction whenever you have time.

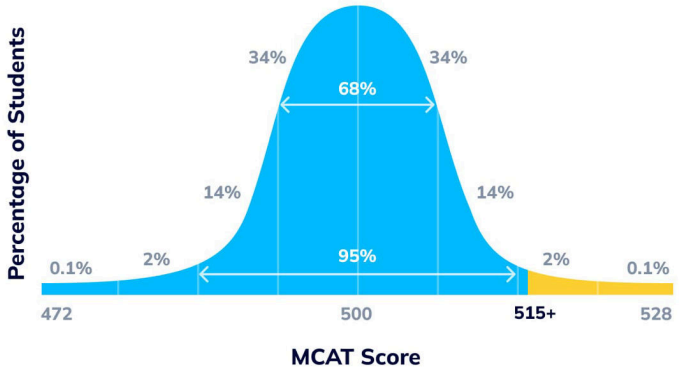
Both Plans Include...

- 144 hrs of expert instruction
- 15 full-length practice exams
- 100+ practice passages
- 405+ passage-based questions
- All AAMC materials
- Personalized study plan
- 6 top-quality textbooks
- Unlimited Q&A with MCAT experts

515+ GUARANTEED

Performance Guarantee

The Elite 515 program promises you a score of at least 515 on the MCAT or money back. A 515 puts you within the top 2% of scores!



Find Free MCAT Resources on Wizeprep.com/MCAT

Free Live Events

Learn about the med school application process and more.

Free Diagnostic Exam

Predict your MCAT score and assesses strengths and weaknesses.

Free Trial

Don't just take our word for it. Try out the first few lessons yourself.

Other Courses at Ontario High School

Grade 12 Chemistry
Resource for SCH4U

Grade 12 Calculus & Vectors
Resource for MCV4U

Grade 12 Biology
Resource for SBI4U

Grade 10 Principles of Mathematics
Resource for MPM2D

Grade 12 Data Management
Resource for MDM4U

Grade 12 Advanced Functions
Resource for MHF4U

Grade 11 Functions
Resource for MCR3U

Grade 12 Physics
Resource for SPH4U

Grade 11 Biology
Resource for SBI3U

Grade 9 Math (De-streamed)
Resource for MTH1W