

# **PiXL Independence:**

## **Chemistry – Student Booklet**

### **KS5**

#### **Acids and Bases**

#### **Contents:**

- I. Level 1- Multiple Choice Quiz – 20 credits
- II. Level 2 - 5 questions, 5 sentences, 5 words – 10 credits each
- III. Level 3 - Science in The News – 100 credits
- IV. Level 4 - Scientific Poster – 100 credits
- V. Level 5 - Video summaries – 50 credits each

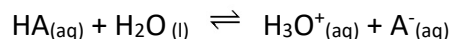
**PiXL Independence – Level 1**  
**Multiple Choice Questions**  
**A Level Chemistry – Acids and Bases**

**INSTRUCTIONS**

Score: /20

- Read the question carefully.
  - Circle the correct letter.
  - Answer all questions.
1. Which of the following statements about Brønsted-Lowry acids is FALSE?
    - a. They are proton donors.
    - b. They release hydrogen atoms.
    - c. They are proton acceptors.
    - d. They form hydroxonium ions ( $\text{H}_3\text{O}^+$ ) when mixed with water.
  
  2. Which of the following best describes a Brønsted-Lowry base?
    - a. They donate protons.
    - b. They accept protons.
    - c. They release hydrogen ions ( $\text{H}^+$ ).
    - d. They neutralise alkalis.
  
  3. Nitrous acid,  $\text{HNO}_3$  is an example of a weak acid. Which of the following is the correct balanced equation for the equilibrium that occurs when phosphoric acid dissolves in water?
    - a.  $\text{HNO}_3 \longrightarrow \text{H}^+ + \text{NO}_3^-$
    - b.  $\text{HNO}_3 \longrightarrow \text{H}^+ + \text{NO}_3$
    - c.  $\text{HNO}_3 \rightleftharpoons \text{H}^+ + \text{NO}_3^-$
    - d.  $\text{HNO}_3 \rightleftharpoons \text{H}^+ + \text{NO}_3$
  
  4. The following definition applies to which of the terms below?  
'These dissociate almost completely in water releasing nearly all of the hydrogen ions ( $\text{H}^+$ ).'
    - a. Strong base.
    - b. Weak acid.
    - c. Weak base.
    - d. Strong acid.
  
  5. The following definition applies to which of the terms below?  
'These substances dissociate only very slightly in water so only a small number of  $\text{H}^+$  ions are formed. An equilibrium is established which lies over to the left.'
    - a. Strong base.
    - b. Weak acid.
    - c. Weak base.
    - d. Strong acid.
  
  6. Which of the following terms best fits this definition: 'These substances are proton acceptors which ionise almost completely in water?'
    - a. Strong base.
    - b. Weak acid.
    - c. Weak base.
    - d. Strong acid.

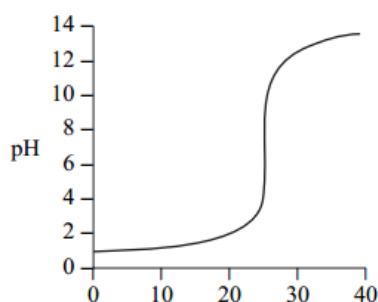
7. Look at the following equation:



Which substance is acting as a Bronsted-Lowry base?

- HA
  - H<sub>2</sub>O
  - H<sub>3</sub>O<sup>+</sup>
  - A<sup>-</sup>
8. What are the units for K<sub>w</sub>?
- mol<sup>2</sup> dm<sup>-6</sup>
  - mol dm<sup>3</sup>
  - mol dm<sup>-3</sup>
  - None of the above.
9. What is the value for K<sub>w</sub> at 298K?
- 10.0 x 10<sup>-14</sup>
  - 10.0 x 10<sup>14</sup>
  - 1.00 x 10<sup>14</sup>
  - 1.00 x 10<sup>-14</sup>
10. Hydrochloric acid is a strong acid. Calculate the pH of a 0.025 mol dm<sup>-3</sup> hydrochloric acid solution.
- 1.6
  - 1.7
  - 0.6
  - 0.7
11. Which of the following equations enables us to calculate the hydrogen ion concentration of an acid from the pH?
- log<sub>10</sub>[H<sup>+</sup>]
  - 10<sup>pH</sup>
  - 10<sup>-pH</sup>
  - 10<sup>pH</sup>
12. Which of the following is NOT a strong acid?
- HCl
  - CH<sub>3</sub>COOH
  - H<sub>2</sub>SO<sub>4</sub>
  - HNO<sub>3</sub>
13. Which of the following is a weak base?
- Ca(OH)<sub>2</sub>
  - NH<sub>3</sub>
  - CH<sub>3</sub>COOH
  - NaOH

14. Calculate the pH of  $0.5 \text{ mol dm}^{-3}$  KOH at 298K, using  $K_w$ .
- 12.7
  - 12
  - 13.7
  - 13
15. Which of the following equations can be used to help find the hydrogen ion concentration of a weak acid?
- $K_a = \frac{[\text{H}^+]^2}{[\text{HA}]^2}$
  - $K_a = \frac{[\text{H}^+]^2}{[\text{HA}]}$
  - $K_w = [\text{H}^+][\text{OH}^-]$
  - $K_w = [\text{H}^+]^2$
16. What are the units for  $K_a$ ?
- $\text{mol}^{-2} \text{ dm}^6$
  - $\text{mol dm}^3$
  - no units
  - $\text{mol}^{-2} \text{ dm}^6$
17. Look at the following pH graph for an acid-base titration:



What titration does the graph show?

- Strong acid and strong base.
  - Weak acid and strong base.
  - Weak acid and weak base.
18. Which of the following is correct?
- $\text{p}K_a = \log_{10}K_a$
  - $-\text{p}K_a = \log_{10}K_a$
  - $\text{p}K_a = -\log_{10}K_a$
  - $\text{p}K_a = \log_{10} - K_a$
19. Which of the following best describes a buffer?
- Have a neutral pH of 7.
  - Is made using a strong base and one of its salts.
  - Resists changes in pH when a small amount of acid or base is added.
  - Solution which stops the pH from changing completely.

20. Calculate the pH of a buffer solution which contains  $0.1 \text{ mol dm}^{-3}$  propanoic acid and  $0.05 \text{ mol dm}^{-3}$  sodium propanoate.  $K_a$  of propanoic acid is  $1.26 \times 10^{-5} \text{ mol dm}^{-3}$ .
- a. 4.60
  - b. 4.70
  - c. 5.70
  - d. 3.70

**PiXL Independence – Level 2**  
**5 questions, 5 sentences, 5 words**  
**A Level Chemistry – Acids and Bases**

**INSTRUCTIONS**

- For each statement, use either the suggested website or your own text book to write a 5-point summary. In examinations, answers frequently require more than 1 key word for the mark, so aim to include a few key words.
- It is important to stick to 5 sentences. It is the process of selecting the most relevant information and summarizing it that will help you remember it.
- Write concisely and do not elaborate unnecessarily, it is harder to remember and revise facts from a big long paragraph.
- Finally, identify 5 key words that you may have difficulty remembering and include a brief definition. You might like to include a clip art style picture to help you remember it.

**Example:**

<b>QUESTION:</b>	Explain the terms Brønsted-Lowry acid and Brønsted -Lowry base.			
<b>Sources:</b>	Website – <a href="https://www.khanacademy.org/science/chemistry/acids-and-bases-topic/acids-and-bases/a/bronsted-lowry-acid-base-theory">https://www.khanacademy.org/science/chemistry/acids-and-bases-topic/acids-and-bases/a/bronsted-lowry-acid-base-theory</a> Website - <a href="http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html">http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html</a>			
	<ol style="list-style-type: none"> <li>1. An acid is a proton donor, it releases H<sup>+</sup> ions.</li> <li>2. A base is a proton acceptor, it accepts H<sup>+</sup> ions.</li> <li>3. <math>\text{HA}_{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{H}_3\text{O}^+_{(aq)} + \text{A}^-_{(aq)}</math></li> <li>4. <math>\text{B}_{(aq)} + \text{H}_2\text{O}_{(l)} \rightleftharpoons \text{BH}^+_{(aq)} + \text{OH}^-_{(aq)}</math></li> <li>5. Water is amphoteric, it can act as both a Brønsted-Lowry acid and Brønsted-Lowry base.</li> </ol>			
<b>Acid = proton donor</b>	<b>Base = proton acceptor</b>	$\text{H}_3\text{O}^+_{(aq)} + \text{A}^-_{(aq)}$	$\text{BH}^+_{(aq)} + \text{OH}^-_{(aq)}$	<b>Water is amphoteric</b>

**QUESTION 1:** Define  $K_w$  and give its value at 298K.

**Sources:**

Website – <https://www.chemguide.co.uk/physical/acidbaseeqia/kw.html>

Website – <https://www.khanacademy.org/science/chemistry/acids-and-bases-topic/acids-and-bases/a/water-autoionization-and-kw>

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**QUESTION 2:** Explain how to use  $K_w$  to find the pH of a strong base.

**Sources:** YouTube – <https://www.youtube.com/watch?v=IMSjhTZnUFQ>  
Website – <https://www.chemguide.co.uk/physical/acidbaseeqia/kw.html>

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**QUESTION 3:**

Explain how to use  $K_a$  to find the pH of a weak acid.

**Sources:**

Website – <https://www.youtube.com/watch?v=T679W7VjFAw>

Website –

<https://www.khanacademy.org/science/chemistry/acids-and-bases-topic/copy-of-acid-base-equilibria/v/weak-acid-equilibrium>

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**QUESTION 4:** Explain how to find the pH of a strong acid.

**Sources:**

Website – <https://www.thoughtco.com/calculating-ph-of-a-strong-acid-problem-609587>

Website - <http://www.chemguide.co.uk/physical/acidbaseeqia/acids.html>

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**QUESTION 5:** Explain how a buffer is made and how it helps to resist changes in pH.

**Sources:**

Website – <http://www.chemguide.co.uk/physical/acidbaseeqia/buffers.html>

Website - <http://chemcollective.org/activities/tutorials/buffers/buffers3>

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# PiXL Independence – Level 3

## Science in the News

### A Level Chemistry – Acids and Bases

#### Fake news

Sensationalised news stories have been around for some time, but with the mass growth of social media, the problem seems to have grown in recent years.

Therefore, the ability to identify real information, track it back to the source article and make your own judgement is a very important skill. This activity will help you develop that skill.

#### Skin care – it's all about the pH

**News article** – <https://www.pinkvilla.com/lifestyle/people/three-popular-skin-fads-are-ruining-your-skin-389322>

**News article** – [PH Effects on Skin \(healthfully.com\)](http://www.healthfully.com)

**News article** – <http://www.elle.com/beauty/makeup-skin-care/tips/a2461/how-to-get-balanced-skin-539785/>

**Journal article** – <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4171909/>

#### Task

You need to produce a 1-page essay on the impact of pH balanced washes on the 'healthiness' of skin.

Essay section	Activity
<b>Introduction</b>	What does the term 'pH' mean? What is the pH of skin? What is the pH of most soaps?
<b>Describe</b>	Describe factors which affect the 'healthiness' of the skin.
<b>Evaluate</b>	Evaluate the claim that washing with pH balanced soaps helps protect the skin.
<b>Conclude &amp; Reflect</b>	Is washing with pH balanced products the most effective way to protect the skin? Are there other factors which have a more negative impact on skin?

# PiXL Independence – Level 4

## Scientific Posters

### A Level Chemistry – Acids and Bases

**Scientific Posters** - Scientists communicate research findings in three main ways. Primarily, they write journal articles much like an experiment write up. These are very concise, appraise the current literature on the problem and present findings. Scientists then share findings at conferences through talks and scientific posters. During a science degree, you would practice all three of these skills.

Scientific posters are a fine balance between being graphically interesting and attracting attention and sharing just the right amount of text to convey a detailed scientific message. They are more detailed than a talk and less detailed than a paper.

Use this information to help structure your poster – <https://www.wikihow.com/Make-a-Scientific-Poster>

More detailed guidance is available at: <https://guides.nyu.edu/posters>

#### Creating your poster

It is easiest to create a poster in PowerPoint; however, you need to add custom text boxes rather than using the standard templates.



Posters need to be eye catching, but readable from a distance. If you use PowerPoint, start with a 4:3 slide (for easier printing, it can then be printed on A3) and use a 14-16 pt font.

The first box could be larger to draw people in. You can use a background image, but pick a simple one that is of high quality. Select 'text box fill' and select 'change the transparency' to maintain the contrast and partially show the picture.

You can experiment with different layouts and you should include images. Avoid a chaotic layout, posters are read from top left column downwards.

Remember to include the authors and references.

Finally, look at the examples given on the University of Texas website which also offers an evaluation of each <https://ugs.utexas.edu/our/poster/samples>

## Buffer solutions



### Background

Buffer solutions resist changes in pH when small amounts of acid or base are added, or when diluted. They are made from weak acids or bases and one of their salts. When the concentration of either  $H^+$  or  $OH^-$  ions changes, the position of equilibrium moves to counteract the change. This change is explained by the Le Chatelier Principle.

**Source article:** <http://www.chemguide.co.uk/physical/equilibria/lechatelier.html>

**Source article:** <http://www.chemguide.co.uk/physical/acidbaseeqia/buffers.html>

**Animation:** <https://www.youtube.com/watch?v=ZLKEjXbCU30>

**Use other sources as necessary.**

### Task

Produce a scientific poster explaining how buffers work in terms of ions, equilibrium, acids and bases.

You should link this to your understanding of chemical equilibria, Le Chatelier and reversible reactions.

<b>Recall</b>	Define the terms dynamic equilibrium and buffer.
<b>Describe</b>	Describe how an acidic buffer and a basic buffer are made; give an example for each.
<b>Explain</b>	How buffers help to resist changes in pH.
<b>Discuss</b>	How do you calculate the pH of a buffer solution?

# PiXL Independence – Level 5

## Video summaries

### A Level Chemistry – Acids and Bases

#### Cornell Notes

At A level and University, you will make large amounts of notes, but those notes are only of use if you record them in a sensible way. One system for recording notes is known as the Cornell notes system. This method encourages you to select relevant information, rather than trying to write a transcript of everything said. More importantly, it forces you to spend a few minutes reviewing what you have written, which has been scientifically proven to aid learning and memory retention.

The ideal is to write everything on one page, but some students may prefer to type and others will to handwrite their notes. Whichever option you use, remember the aim is to summarise and condense the content with a focus on the objectives that you are trying to learn and understand.

#### There are three main sections to the Cornell notes

- 1 **Cue/ Objectives** – This can be done before or after the lecture. You may have been provided with the objectives or you may need to decide what they were or you may want to make the link to your learning if this is an additional task or lecture you are viewing, such as this video.
- 2 **Notes** – In this space you record concisely, simply the things you are LESS likely remember - **The NEW knowledge**.
- 3 **Summary** – The most important step that is carried out after the lecture or video. This helps to reinforce learning.

#### Background

The following series of videos link to your learning.

#### Source article:

**Video 1 – Acid base titration example.**

**Khan Academy:** [https://www.youtube.com/watch?v=XjFNmflv9\\_Q](https://www.youtube.com/watch?v=XjFNmflv9_Q)

**Video 2 – How to prepare a standard solution.**

**RSC:** – <https://www.youtube.com/watch?v=iPYyRNjXkgY>

**Task:**

**You need to produce a set of Cornell notes for each of the videos given above.  
Use the following objective to guide your note taking, this links to your learning.**

1. Explain how to carry out the calculations associated with acid-base titrations.
2. Explain how to prepare a standard solution.

**Objectives**

What are the main learning outcomes that have been shared with you?  
This will help guide you to taking the RIGHT notes during the video.

Title  
Date

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Sketch down note and key words  
Do not write in full sentences whilst you listen, put quick sketches, single words, mind maps, short hand etc.  
To help train you for university, try not to pause the video because you could not pause a live lecture (However, a lecture may give more natural pauses for you to catch up).

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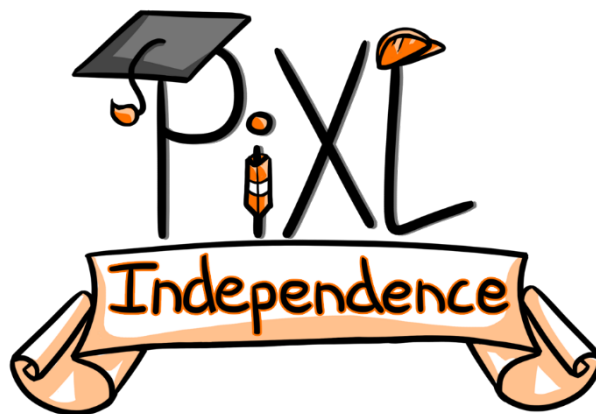
**Summary (after the video)**

What are your main points of learning from this video.  
This is your chance to make sense of your notes.  
Make clear connections to the things you need to know



	<b>Title</b> <b>Date</b>
<b>Objectives</b>	
<b>Summary</b>	

	<b>Title</b> <b>Date</b>
<b>Objectives</b>	
<b>Summary</b>	



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