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Activity Report
Properties of Acids and Bases
Experiment Number:
#1

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Introduction

Have you ever been introduced to the intriguing world of "acids" and "bases"? These seemingly simple words encapsulate profound concepts that impact our daily lives in fascinating ways. Despite their universality, the captivating realm of acids and bases continues to be a subject of exploration and investigation.

The present undertaking revolves around the beautiful chemistry of acids and bases. Conducted within the halls of Sentinel School in West Vancouver, this experiment employs locally sourced samples as its subject matter. Executed entirely by students, this endeavour is devoid of any vested stance. I am embarking on analyzing 20 distinct solutions, utilizing an array of 7 indicators. There exists no predetermined bias to champion here; the intent behind this venture rests solely on the pillars of knowledge expansion and direct observation of indicator responses.

In pursuit of illuminating insights, the experiment entails a meticulous analysis of diverse solutions through a comprehensive spectrum of indicators, aimed at delineating their pH values with enhanced precision. A granular approach awaits the students as they engage with a well-organized plate for solution evaluation. The iterative process involves sequential application, rinsing, and subsequent repetition with an assortment of solutions and corresponding indicators. Amid this orchestrated activity, the observation of distinct colour transformations within solutions will provide pivotal insights into their inherent pH levels.

Results

pH Indicators and Tested Solutions

pH	Magnesium	Red Litmus	Blue Litmus	Phenolphth	Bromothym	Bromothym	Methyl	pH Range

Indicators	Ribbon	Paper	Paper	alein	ol Blue	ol Green	Orange	
1M HCl	Bubbles	Red	Red	Colorless	Yellow	Yellow	Red	0-4
1M NaOH	None	Blue	Blue	Pink	Blue	Blue	Orange	9-14
Aspirin	None	Red	Red	Colorless	Yellow	Yellow	Red	0-4
Vinegar	None	Red	Red	Colorless	Yellow	Yellow	Red	0-4
Pipe Cleaning	None	Blue	Blue	Pink	Blue	Blue	Orange	9-14
Bleach	None	Colorless	Colorless	Colorless	Yellow	Blue	Orange	12
Oven Cleaning	None	Blue	Blue	Pink	Blue	Blue	Orange	9-14
Lemon Juice	None	Red	Red	Colorless	Yellow	Yellow	Orange	0-4

Ammonia	None	Blue	Blue	Pink	Blue	Blue	Orange	9-14
Milk of Magnesia	None	Red	Blue	Pink	Blue	Blue	Orange	9-14
Soap	None	Red	Blue	Colorless	Yellow	Blue	Orange	4-7
0.2 M KCl	None	Red	Blue	Colorless	Blue	Blue	Orange	7-9
Table Salt	None	Red	Blue	Colorless	Blue	Blue	Orange	7-9
Tears	None	Red	Blue	Colorless	Blue	Blue	Orange	7-9
Gastric Juice	None	Red	Red	Colorless	Yellow	Yellow	Red	0-4
Sweat	None	Red	Blue	Colorless	Yellow	Blue	Orange	4-7
Saliva	None	Red	Blue	Pink	Blue	Blue	Orange	9-14

Blood	None	Red	Blue	Colorless	Green	Blue	Orange	7-9
Urine	Bubbles	Red	Blue	Colorless	Yellow	Blue	Orange	4-7
Unknown Solutionn	None	Red	Blue	Colorless	Blue	Blue	Orange	7-9

Discussion

The exploration of outcomes has illuminated a realm of intrigue and curiosity. Among the manifold substances evaluated, a perplexing anomaly emerged in relation to the red and blue litmus papers. This unusual phenomenon prompts speculation concerning potential litmus paper discrepancies, given that the behaviour of other indicators aligns with expectations. Instances wherein the red litmus paper retains its original colour and the blue variant remains steadfastly blue have surfaced, challenging comprehension. Although enigmatic, acknowledging these atypical occurrences stands imperative within the scientific discourse.

In the aftermath of extensive experimentation, I have drawn discernible patterns from the data, delineating three distinctive pH clusters. The primary cluster spans pH levels from 0 to 4, encompassing entities such as 1M HCl, aspirin, vinegar, lemon juice, and gastric juice. Progressing onward, a secondary cluster emerges, spanning pH levels from 4 to 7, housing the likes of soap, sweat, and urine. A tertiary cluster, marked by pH values between 7 and 9, encompasses entities such as 0.2 M KCl, table salt, tears, the unknown solution, and blood. Significantly, the majority of solutions gravitate within the expansive pH range of 9 to 14, including oven-cleaning agents, ammonia solutions, milk of magnesia, 1M NaOH, pipe-cleaning agents, bleach, and saliva.

Furthermore, among the gamut of solutions tested, only two entities showcased neutrality. Despite both 0.2 M KCl and table salt finding themselves within the pH ambit of 7 to 9, nuances distinguish their behaviour. The red litmus paper retained its original hue, while the blue variant held steadfast, implying peculiarities. Notably, bromothymol blue exhibited a dual spectrum of blue and green at pH 7. This remarkable revelation intertwines with the fundamental nature of these two solutions, as salts. "Salt" in table salt's nomenclature alludes to this quality, whilst the derivation of KCl through HCl and KOH amalgamation underscores their neutral nature. The absence of H or OH, omnipresent in acids and bases, further substantiates the neutrality of KCl.

Moreover, the discourse extends to the domain of indicators. The prowess of specific indicators in detecting highly alkaline or acidic solutions stands out conspicuously. Among these, phenolphthalein takes precedence in pinpointing the most basic solution. Its colour transition aligns with the highest pH readings across indicators. Noteworthy is bromothymol blue, triggering a colour shift at a pH of 7, distinctly different from phenolphthalein's threshold of 9. This dichotomy highlights the nuances in indicator behaviour. Additionally, probing the solution's composition uncovers intriguing revelations. Basic solutions, replete with OH, find representation in NaOH, containing solely OH and Na constituents. Magnesium ribbon, representing an alkaline-earth metal, simplifies the discrimination between acids and bases. The fervent reactivity of magnesium, coupled with its liberation of H gas upon acid interaction, renders it a reliable acid identifier.

Furthermore, the discourse extends to the interaction of indicators with solutions characterized by varying pH levels. An acidic solution at pH 3 induces effervescent bubbles upon the magnesium ribbon, while red litmus papers vividly turn red. Conversely, phenolphthalein retains its colorlessness, bromothymol blue and bromothymol green transition to yellow, and methyl orange accentuates the solution with a red hue. Shifting the focus to a basic solution at pH 10, the magnesium ribbon remains inert, red litmus papers embrace a vivid blue, phenolphthalein takes on a pink tinge, and bromothymol blue, as well as bromothymol green, adopts a serene blue colour. Methyl orange, in this context, reveals its versatility by casting a bright yellow hue.

Upon drawing these multifaceted conclusions, an intriguing contemplation unfurls—an exploration of possibilities within a hypothetical scenario. Contemplating the examination of factory wastewater for its inherent pH nature, the prospect arises—can we deduce its acidic, basic, or neutral essence employing a trifecta of indicators? Amid deliberation, embracing methyl red, bromothymol blue, and phenolphthalein emerges as an informed choice. Bromothymol blue stands as an initial indicator offering a rudimentary assessment of acidity or alkalinity. Methyl red, attuned to acidic realms (pH 0-6), and phenolphthalein, responsive to basic conditions (pH 8-14), harmoniously delineates the spectrum. Should both indicators hold their original hues—methyl red appearing yellow and phenolphthalein maintaining colorlessness—a pH equilibrium of 6-8, indicative of neutrality, is conceivable.

Conclusion

In summation, our odyssey emboldens our understanding of acids and bases, unravelling novel facets of their behaviour. The tapestry woven from diverse indicators unveils a mesmerizing symphony of colours, enabling us to glean insights into the underlying pH of various solutions. With the tapestry of understanding unfurled, we bear witness to the dichotomy between acidic and basic solutions, a testament to the profound impact of these fundamental chemical concepts.

The journey also stokes contemplation about alternative methodologies, beckoning us to explore uncharted territories. The aspiration to unearth more efficient methods, ones that offer heightened specificity and efficacy, beckons us toward novel scientific frontiers. Indeed, the prospect of manipulating the solution-to-indicator ratio, a facet left unexplored within the present expedition, raises intriguing possibilities. Such nuanced investigations could potentially illuminate previously hidden nuances, enriching our scientific understanding.

As our experiment concludes, it seeds not only insight but curiosity. The pondering of future thought experiments entices, igniting intellectual fervour to determine the viability of employing a trifecta of indicators to ascertain the pH of the wastewater. Imagining a scenario involving the effluent emanating from a factory's drainage pipe, the question looms: Can this complex brew be distilled to the binary of acidic, basic, or neutral using a mere trio of indicators? Engaging with indicators like methyl red, bromothymol blue, and phenolphthalein, we speculate about the possibility of decoding pH characteristics, delineating the intricate interplay of chemical constituents within this aqueous tapestry.

The implications extend far beyond the confines of our experiment, poised to shape and inform future inquiries into the fascinating realm of chemical reactions and their telltale indicators.

Bibliography

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