## Exercise-3A

**What do you understand by an alkali? Give two examples of:**
**(a) Strong alkalis (b) Weak alkalis**
**Solution:**

An alkali is a basic hydroxide which when dissolved in water produces hydroxyl ions ($OH^-$) as the only negatively charged ions.
Examples of:
(a) Strong alkalis - Sodium hydroxide NaOH, Potassium hydroxide KOH
(b) Weak alkalis - Calcium hydroxide $Ca(OH)_2$, Ammonium hydroxide $NH_4OH$

**2. What is the difference between:**
**(a) an alkali and a base,**
**(b) the chemical nature of an aqueous solution of HCl and an aqueous solution of $NH_3$.**
**Solution:**

(a)

| Alkali | Base |
|---|---|
| 1. All alkalis are soluble in water. | 1. Bases may or may not be soluble in water. |
| 2. All alkalis are bases. | 2. Not all bases are alkalis. |

(b) The chemical nature of an aqueous solution of HCl and an aqueous solution of $NH_3$
The aqueous solution of HCl is acidic in nature and it can turn blue litmus to red.
The aqueous solution of $NH_3$ is basic in nature and it can turn red litmus to blue.

**3. Name the ions furnished by:**
**(a) bases in solution, (b) an acid.**
**Solution:**

(a) Bases produce hydroxyl ion ($OH^-$) in solutions
(b) Acids produce hydrogen ion ($H^+$) in solutions

**4. Give one example in each case:**
**(a) A basic oxide which is soluble in water,**
**(b) A hydroxide which is highly soluble in water,**
**(c) A basic oxide which is insoluble in water,**
**(d) A hydroxide which is insoluble in water,**
**(e) A weak mineral acid,**
**(f) A base which is not an alkali,**
**(g) An oxide which is a base,**
**(h) A hydrogen containing compound which is not an acid,**
**(i) A base which does not contain a metal ion.**
**Solution:**

(a) Barium oxide, BaO
(b) Sodium hydroxide, NaOH
(c) Manganese oxide, MnO
(d) Copper hydroxide, $Cu(OH)_2$
(e) Carbonic acid, $H_2CO_3$
(f) Ferric hydroxide, $Fe(OH)_3$
(g) Copper oxide, CuO
(h) Ammonia, $NH_3$
(i) Ammonium hydroxide, $NH_4OH$

**5. You have been provided with three test tubes. One of them contains distilled water and the other two have an acidic solution and a basic solution respectively. If you are given red litmus paper, how will you identify the contents of each test tube?**
**Solution:**

We know that, bases turn red litmus to blue colour.
So, when a drop from each of the test tubes is put on the red litmus paper the one which turns blue can be easily identified as base. Then, the remaining test tubes contains either distilled water or acid. Now, the find out exactly the contents of these test tubes - a drop of basic solution is mixed with a drop of each of the remaining two solutions separately and then the nature of the drops of the mixtures is checked. If the color of red litmus turns blue, then the second solution is neutral and if there is no change in color, then the second solution is acidic.
By the concept of neutralization, we know that acidic and basic solutions neutralize each other. Thus, we can distinguish between the three types of solutions and identify the contents of each test tube.

**6. HCl, $HNO_3$, $C_2H_5OH$, $C_6H_{12}O_6$ all contain H atoms but only HCl and $HNO_3$ show acidic character. Why?**
**Solution:**

Since, HCl and $HNO_3$ ionize in aqueous solution and produce hydrogen ions these show acidic character. Whereas ethanol and glucose do not ionize in aqueous solution.

**7. (a) Dry HCl gas does not change the colour of dry litmus paper. Why?**
**(b) Is $PbO_2$ a base or not? Comment.**
**(c) Do basic solutions also have $H^+_{(aq)}$? Explain why they are basic by taking an example?**
**Solution:**

(a) As dry HCl gas does not contain any hydrogen ions in it when compared to its aqueous solution, it does not show acidic behaviour. Thus, dry HCl gas does not change the colour of dry litmus paper.

(b) Lead oxide reacts with hydrochloric acid to produce lead chloride and water hence it's a metallic oxide, but it is excluded from the class of bases as chlorine is also produced.
$PbO_2 + 4HCl \rightarrow PbCl_2 + Cl_2 + 2H_2O$
Hence, lead oxide is not a base.

(c) Yes, basic solutions also have $H^+$ ions, but the concentration of $OH^-$ ions is more than the $H^+$ ions

which makes the solution basic in nature.
First we have to understand that formation of hydrogen ion and hydroxyl ion are complementary to each other if one is produced the other one is produced.
Example: An aqueous solution of NaOH ionizes to produce higher concentration of hydroxyl ion than hydrogen ion and that's why NaOH is basic in nature.

**8. How would you obtain:**
**(a) A base from other base**
**(b) An alkali from a base**
**(c) Salt from another salt?**
**Solution:**

(a) A base can be obtained from another base by double decomposition. The aqueous solution of salts with base precipitates the respective metallic hydroxide.
$FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$

(b) An alkali from a base can be obtained

$$Na_2CO_3 + Ca(OH)_2 \xrightarrow{\Delta} 2NaOH + CaCO_3$$ **….. fig**

(c) Salt from another salt
$NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3$

**9. Write balanced equations to satisfy each statement.**
**(a) Acid + Active metal → Salt + Hydrogen**
**(b) Acid + base → Salt + Water**
**(c) Acid + Carbonate or bicarbonate → Salt + Water + carbon dioxide**
**(d) Acid + sulphite or bisulphite → salt + water + sulphur dioxide**
**(e) Acid + Sulphide → Salt + hydrogen sulphide**
**Solution:**

(a) $Mg + 2HCl \rightarrow MgCl_2 + H_2$
(b) $HCl + NaOH \rightarrow NaCl + H_2O$
(c) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
(d) $CaSO_3 + 2HCl \rightarrow CaCl_2 + H_2O + SO_2$
(e) $ZnS + 2HCl \rightarrow ZnCl_2 + H_2S$

**10. The skin has and needs natural oils. Why is it advisable to wear gloves while working with strong alkalis?**
**Solution:**

It's known that alkalis react with oil to form soap. Since, our skin contains oil so when we touch strong alkalis, a reaction takes place and soapy solution is formed. Thus, it's advisable to wear gloves.

**11. Complete the table:**

| Indicator | Neutral | Acidic | Alkaline |
|---|---|---|---|
| **Litmus** | **Purple** | | |
| **Phenolphthalein** | **Colourless** | | |

**Solution:**

| Indicator | Neutral | Acidic | Alkaline |
|---|---|---|---|
| Litmus | Purple | Blue to red | Red to blue |
| Phenolphthalein | Colourless | Colourless | Pink |

**12. What do you understand by pH value? Two solutions X and Y have pH values of 4 and 10, respectively. Which one of these two will give a pink colour with phenolphthalein indicator?**
**Solution:**

The strength of acids and alkalis is expressed in terms of hydrogen ion concentration which is represented as pH.
The solution with pH value 10 is basic in nature so, it will give pink colour with phenolphthalein indicator.

**13. You are supplied with five solutions: A, B, C, D and E with pH values as follows:**
**A = 1.8, B = 7, C = 8.5, D = 13 and E = 5**
**Classify these solutions as neutral, slightly or strongly acidic and slightly or strongly alkaline.**
**Which solution would be most likely to liberate hydrogen with:**
**(a) Magnesium powder**
**(b) Powered zinc metal. Give a word equation for each reaction.**
**Solution:**

A = Strongly acidic
B = neutral
C = Slightly alkaline
D = Strongly alkaline
E = Slightly acidic
(a) Solution A
Word equation: Solution A(acidic solution) + Mg → $H_2$ + Mg salt
(b) Solution A
Word equation: Solution A (acidic solution) + Zn → $H_2$ + Zn salt

**14. Distinguish between:**
**(a) A common acid-base indicator and a universal indicator**
**(b) The acidity of bases and basicity of acids**
**(c) Acid and alkali (other than indicators)**
**Solution:**

(a) A common acid-base indicator and a universal indicator:
An acid-base indicator like litmus gives information only whether a given substance is an acid or a base. The universal indicator gives a complete picture to how acidic or basic a substance is by giving

different colours for solutions of different pH values.

(b) The acidity of bases and basicity of acids:
The acidity of bases is defined as the number of hydroxyl ions which can be produced per molecule of the base in aqueous solution.
Basicity of acids is defined as the number of hydronium ions that can be produced by the ionization of one molecule of that acid in aqueous solution.

(c) Acid and alkali:
An acid is a substance which produces $H^+$ ions (higher concentration) when dissolved in water.
An alkali is a substance which gives $OH^-$ ions (higher concentration) in its aqueous solution.

**15. What should be added to**
**(a) Increase the pH value**
**(b) Decrease the pH value of a neutral solution?**
**Solution:**

(a) An alkali can be added.
(b) An acid can to be added to decrease the pH value of a neutral solution.

**16. How does tooth enamel get damaged? What should be done to prevent it?**
**Solution:**

Items like chocolates and sweets are degraded by bacteria present in our mouth. Tooth decay starts in humans start when the pH falls below 5.5. So, due to the lower pH values the tooth enamel which is the hardest substance in our body gets corroded. The saliva produced by salivary glands is slightly alkaline and this helps to increase the pH to some extent. But in order to prevent this one can brush their teeth with a toothpaste as it contains basic substance which is used to neutralize excess acid in the mouth.

**17. When you use universal indicator, you see that solutions of different acids produce different colours. Indeed, solution of the same acid with different concentrations will also give different colours. Why?**
**Solution:**

A universal indicator is a pH indicator made of a mixture of dyes and several compounds that shows many smooth colour changes over a wide range of pH, depending on the strength of the acid or base. By exhibiting several colours one can determine an approximate pH of a solution ranging from 1-14. That's also why solutions of the same acid with different concentrations give different colours.
The more acidic solutions turn universal indicator bright red. A less acidic solution will only turn it orange-yellow. Colour differences can be noticed in case of vinegar which is less acidic and battery acid which is more acidic.

**18. (a) A solution has a pH of 7. Explain how you would (i) increase its pH; (ii) decrease its pH**
**(b) If a solution changes the colour of litmus from red to blue, what can you say about its pH?**
**(c) What can you say about the pH of a solution that liberates carbon dioxide from sodium carbonate?**

**Solution:**

(a) (i) The pH of the solution can be increased by adding a basic solution or alkali.
(ii) The pH of the solution can be decreased by adding an acidic solution.
(b) Since, the solution changes red litmus to blue its nature is basic and the pH value will be more than 7.
(c) The pH of the solution will be less than 7.

**19. Solution P has a pH of 13, solution Q has a pH of 6 and solution R has a pH of 2. Which solution**
**(a) will liberate ammonia from ammonium sulphate on heating?**
**(b) is a strong acid?**
**(c) contains molecules as well as ions?**
**Solution:**

(a) Solution P
(b) Solution R
(c) Solution Q