



Yr3 Chemistry Remedial – Acids & Bases

Name : _____ () Class: _____ Date: _____

All calculations MUST be shown. No mark given if calculations are not shown. All mathematical answers must be in 3 significant figures.

1. Which of the substances listed below fits the description in the boxes provided. Each substance can be used only ONCE.

Aqueous ammonia
hydrogen chloride

calcium hydroxide
sodium oxide

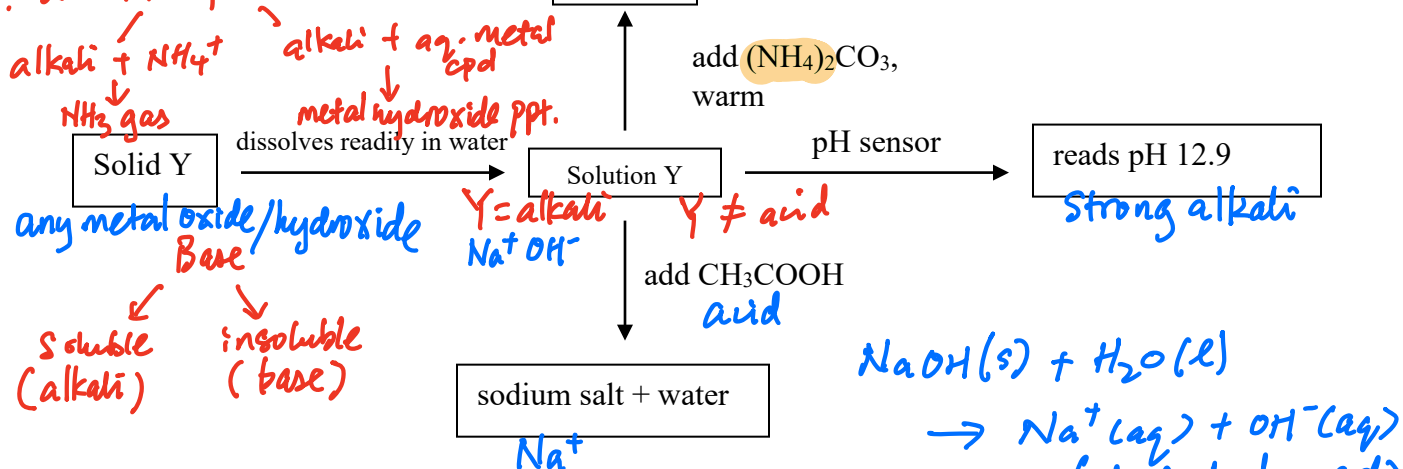
carbonic acid
universal indicator

Substance	Description
a. ammonia	has a pH of about 11 <i>weak base</i>
b. carbonic acid	has a pH of about 5 <i>weakly acid.</i>
c. hydrogen chloride	dissociates almost complete in water <i>HCl(g) - not acidic until water is added</i>
d. sodium oxide	produces OH ⁻ ions when dissolved in water
e. universal indicator	is used to test for acids and alkalis
f. calcium hydroxide	is used by farmers for the treatment of soil <i>(excess acidity)</i>

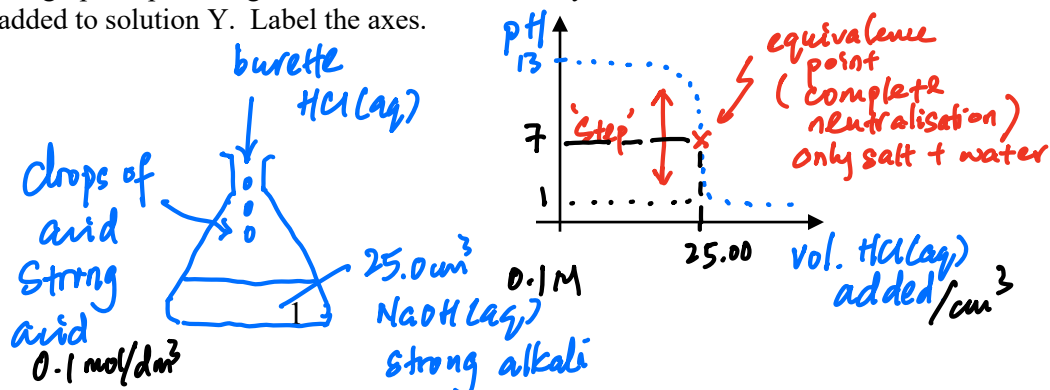


2. The chart below shows the chemical properties of a substance Y.

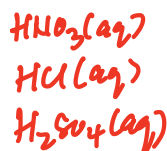
1. 3 Rxns of acid
2. 2 Rxns of alkali



- (a) Deduce the identity of substance Y : *NaOH*
(b) Suggest a test to show the presence of ammonia gas: *use moist red litmus paper (turned blue)*
(c) Sketch the graph of pH changes over time when dilute hydrochloric acid is slowly added to solution Y. Label the axes.



3. Dilute nitric acid was added to magnesium carbonate. Table of solubility.
 Mg^{2+} CO_3^{2-}
all CO_3^{2-} insoluble except $Gp I / NH_4^+$



- (a) Write the balanced equation (with state symbols).



- (b) 25.0 cm³ of 1.0 M of the acid was added to 0.840 g of magnesium carbonate.

- (i) Calculate the number of moles of the acid present.

$$\begin{aligned} \text{no. of moles acid} &= 0.025 \times 1.0 \\ &= 0.0250 \text{ mol} \end{aligned}$$

- (ii) Calculate the number of moles of magnesium carbonate present.

$$\begin{aligned} \text{no. of moles } MgCO_3 &= \frac{0.840}{24+12+48} = 0.0100 \text{ mol} \end{aligned}$$

do not use mole ratio yet!

- (iii) Calculate the volume (in dm³) of carbon dioxide gas given off, at room conditions.

$MgCO_3$ is limiting (all of 0.01 mol used up)



$$\text{no. of moles } CO_2 = 0.0100 \text{ mol}$$

$$\text{vol. } CO_2 = 0.0100 \times 24 = 0.240 \text{ dm}^3 \quad (\text{or } 240 \text{ cm}^3)$$

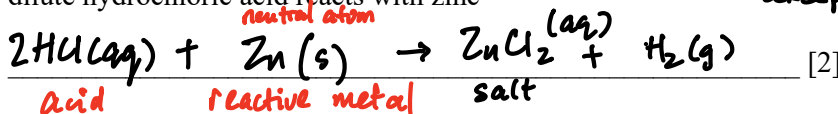
- (iv) Suggest a chemical test to test for the presence of carbon dioxide gas. Describe the observation you would see.

Bubble CO_2 gas into limewater, (aq. $Ca(OH)_2$ or $Ca(OH)_2$ solution)
 white ppt. formed.

[cannot describe as chalky solution!]

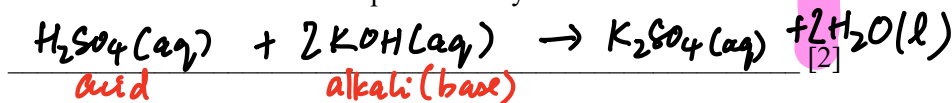
4. Write balanced equations (with state symbols) for these reactions:

- (a) dilute hydrochloric acid reacts with zinc

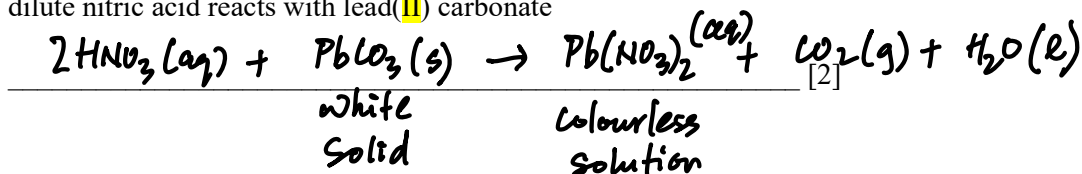


all chlorides are soluble except $PbCl_2, AgCl$
 white solid

- (b) dilute sulfuric acid reacts with potassium hydroxide



- (c) dilute nitric acid reacts with lead(II) carbonate



5 polyatomic ions : OH^- NO_3^- CO_3^{2-} SO_4^{2-}
 NH_4^+

The Periodic Table of Elements

I		II		Group										III	IV	V	VI	VII	0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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11 Na sodium 23	12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium 101	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	55 Cs caesium 133	56 Ba barium 137	57-71 lanthanoids actinoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
87 Fr francium -	88 Ra radium -	89-103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Copernicium -	114 Fl flerovium -	116 Lv livermorium -	118 Og oganeson -	120 Uu ununoctium -	122 Uut ununtrium -	124 Uuq ununquadium -	126 Uuh ununhexium -	128 Uus ununseptium -	130 Uub ununbium -	132 Uut ununtrium -	134 Uuq ununquadium -	136 Uuh ununhexium -	138 Uus ununseptium -	140 Uub ununbium -	142 Uut ununtrium -	144 Uuq ununquadium -	146 Uuh ununhexium -	148 Uus ununseptium -	150 Uub ununbium -	152 Uut ununtrium -	154 Uuq ununquadium -	156 Uuh ununhexium -	158 Uus ununseptium -	160 Uub ununbium -	162 Uut ununtrium -	164 Uuq ununquadium -	166 Uuh ununhexium -	168 Uus ununseptium -	170 Uub ununbium -	172 Uut ununtrium -	174 Uuq ununquadium -	176 Uuh ununhexium -	178 Uus ununseptium -	180 Uub ununbium -	182 Uut ununtrium -	184 Uuq ununquadium -	186 Uuh ununhexium -	188 Uus 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$$[H^+] = 0.2 \text{ mol dm}^{-3} \quad pH = -\log[H^+] = -\log(0.2) = 0.69$$

Yr3 Chemistry Remedial – Acids & Bases

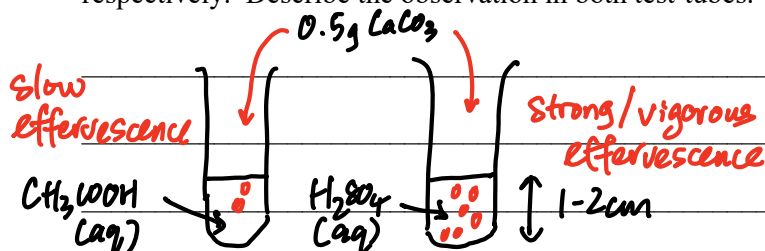
5. Dilute sulfuric acid is a strong acid, and ethanoic acid is a weak acid. H_2SO_4 - dibasic 0.1 mol/dm^3 CH_3COOH - monobasic 0.1 M $[H^+]$ in weak acid $= 0.1 \times 0.1\% = 0.0001 \text{ mol dm}^{-3}$ $pH = -\log(0.0001) = 4$

(a) Briefly describe the differences in acid strength, using ionization.

no HA left \leftarrow Strong acid dissolves and dissociate completely in water to form high concentration of H^+ ions.

many HA left \leftarrow Weak acid dissolves and dissociate partially in water to form low concentration of H^+ ions.

- (b) The same amount of calcium carbonate was added to 2 test-tubes, both containing equal volumes of 0.1M of sulfuric acid and 0.1M ethanoic acid respectively. Describe the observation in both test-tubes.



$NaOH(aq)$

$HCl(aq)$ observation? no effervescence / no visible rxn

6. (a) Oxides of elements may be classified as acidic, basic, amphoteric or neutral. Name one example of each in the boxes provided.

Nature of Oxide	Chemical Name (List A)	Solubility
a. Neutral	Carbon monoxide	Insoluble
b. Acidic	Carbon dioxide / sulfur dioxide	Sparingly soluble / soluble
c. Basic	Sodium oxide	Soluble
d. Amphoteric	Lead(II) oxide	insoluble

- (c) From the examples named in 6(a), suggest which of those substances (in List A) will react with the following reactants. Your substances can be used once, more than once, or not at all.

Reactant	Substance (from List A)
dilute hydrochloric acid	
sodium hydroxide	

7. Briefly explain the following observations:

- (a) When dilute sulfuric acid is neutralized by aqueous sodium hydroxide, the resulting mixture is a very good conductor of electricity.

- (b) A solution of hydrogen chloride in methylbenzene does not conduct electricity and does not react with magnesium.

- (c) A solution of hydrogen chloride in water conducts electricity and reacts rapidly with magnesium.

✓ *tough* 8. Ethanol is an organic compound with the formula, $\text{CH}_3\text{CH}_2\text{OH}$. This compound is soluble in water. It seems to suggest, with the presence of the $-\text{OH}$ group and the hydrogen atoms bonded to carbon atoms, and its good solubility, that it can be an acid or an alkali.

- (a) Other than using pH sensor or indicators, briefly describe how you can prove that a solution of ethanol is not an acid.

not acidic
alcohol (neutral) *no H^+ / no OH^- (not alkaline)*
add CaCO_3 (chalk) - if no effervescence
then alcohol is not acidic. *never use taste / touch to test!*

- (b) Other than using pH sensor or indicators, briefly describe how you can prove that a solution of ethanol is not an alkali.

add NH_4Cl (NH_4^+ salt) - no NH_3 gas produced
so moist red litmus paper did not turn blue!

--- End ---

Send answers to Telegram:

1. 3K - Joshi
2. 3D - Ethan Chin
3. 3G - Sudha

Answers

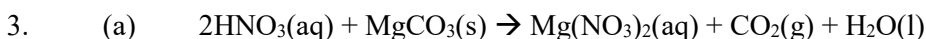
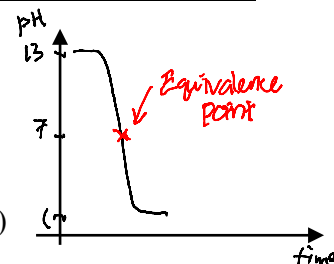
1.

Substance	Description
a. aqueous ammonia	has a pH of about 11
b. carbonic acid	has a pH of about 5
c. hydrogen chloride	dissociates almost complete in water
d. sodium oxide	produces OH ⁻ ions when dissolved in water
e. universal indicator	is used to test for acids and alkalis
f. calcium hydroxide	is used by farmers for the treatment of soil

2a Sodium Hydroxide

2b Use moist red litmus paper. Turned blue.

2c See graph on right. 1m for shape, 1m for pHs



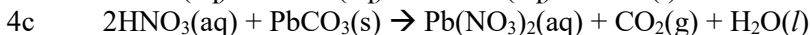
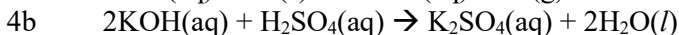
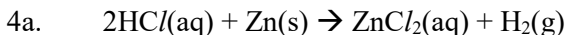
(d) (i) No. of moles acid present = $0.0250 \times 1.0 = 0.025 \text{ mol}$

(ii) No. of moles carbonate present = $0.84/84 = 0.0100 \text{ mol}$

(iii) Limiting reagent is magnesium carbonate.

Volume of carbon dioxide gas = $0.0100 \times 24.0 = 0.240 \text{ dm}^3$

(iv) Bubble CO₂ gas into limewater/calcium hydroxide solution. White ppt. will be formed in colourless solution.



5a Sulfuric acid, when dissolved in water, undergoes complete ionization to produce aqueous H⁺ ions. However, ethanoic acid, when dissolved in water, only undergoes partial ionization to produce low concentration of aqueous H⁺ ions.

5b Rapid, vigorous effervescence in test-tube containing the strong acid [1], slower effervescence in the other test-tube.

6a

Nature of Oxide	Chemical Name (List A)	Solubility
a. Neutral	Carbon monoxide	Insoluble
b. Acidic	Carbon dioxide	Partially soluble
c. Basic	Sodium oxide	Soluble
d. Amphoteric	Zinc oxide	Insoluble

6b

Reactant	Substance (from List A)
dilute hydrochloric acid	Sodium oxide, zinc oxide
sodium hydroxide	Carbon dioxide, zinc oxide

7a This neutralization reaction produces aqueous sodium sulfate and water. Since sodium sulfate is a soluble salt, it will dissolve to produce aqueous mobile ions, that can act as mobile charge carriers.

7b Hydrogen chloride will not ionize in methylbenzene, thus no aqueous H^+ ions are dissociated. With no aqueous hydrogen ions present, it does not react with magnesium as an acid.

7c Hydrogen chloride will ionize in water, producing aqueous hydrogen ions (mobile charge carriers) that will allow electricity to be conducted. The solution is acidic and it will react with magnesium.

8a Add calcium carbonate (or moderately reactive metal such as Mg). If no effervescence is observed, and no carbon dioxide gas evolved, the ethanol solution is then not acidic.

8b Add any ammonium salt and warm the mixture. If no effervescence observed (no ammonia gas evolved), the ethanol solution is not an alkali.