I'm not a robot

Chemistry practical guide

The electrodes may be carbon or steel, perhaps mounted in a wooden support, cork or rubber stopper so as to keep the electrodes a constant distance apart. Put a little iodine solution on each drop. (d) HEAT OF A COPPER DISPLACEMENT REACTION (i) Put 25 mL 0.2 M copper sulphate solution in a 100 mL polythene fitted with a 1-hole stopper and thermometer. Hold a thermometer with the bulb in the powder. Note whether carbon dioxide gas forms. Note any changes in the voltmeter reading. (f) Analytical Balance An analytical balance measures masses to within 0.0001 g. This process is done in three stages. Reading from an angle, rather than straight on, results in a parallax error. Note the maximum temperature reached. (g) Calorimetry Calorimetry is used to determine the heat released or absorbed in a chemical reaction. (iii) Use the equation: molarity of Z = moles of Z / volume in dm3 Remember: moles Z = mass Z / formula mass of Z Concentration can also be expressed directly in grams per litre (1dm3). Stand these 7 test tubes in a rack and leave for several days. Acid solutions have a pH value less than 7. 2 mL of 20-volume hydrogen peroxide will give enough oxygen almost to fill the burette. The electrodes can be labelled positive and negative. We can use the pH scale to express the degree of acidity. The magnesium ribbon darkens just before it begins to melt. Note that the thermometer used for calorimetry differs from the less accurate one in your glassware drawer. Test the 3 samples by: (a) burning ethene; (b) shaking with a few drops of dilute potassium permanganate solution made alkaline with sodium carbonate solution, the colour should disappear; (c) shaking with a little bromine water, the colour again disappears. Concentrated hydrochloric acid is used in the manufacture of many chemicals. The acid is poured into the burette. Put 20 mL hydrogen peroxide into a 100 mL bottle. Stir gently with a thermometer after the addition of each drop. This means that, in the process of dissolving in the water, the particles have absorbed energy. (a) Solids that conduct electricity The source of the DC supply can be dry cells in series giving 6 volts. Dry a selected seed crystal. At the boiling point the bubbles suddenly come out as a steady stream. No emphasis is laid on amount or quantity. Hold the apparatus in a beaker of water and heat gently with a Bunsen burner flame. After a while, look carefully for a white ring which will form where the ammonia gas and the hydrogen chloride gas meet after diffusing through the air towards each other. Tube 7: Wrap a piece of copper wire round a nail and put it in the test-tube exactly like tubes 5 and 6. Close the sliding glass doors. Place creased, small weighing paper on the balance pan. Put 10 mL of sodium thiosulphate solution into the 100 mL beaker and stir in 40 mL of water. Heat the test-tube and cotton wool and weigh it again. Evaporation may be increased by sitting the crystal growing jar on a tin with a 5 watt bulb mounted inside it. Use a rubber band to attach the capillary tube, sealed end down, to a thermometer. Reacts with oxygen gas to form water. Put 3 cm of sodium thiosulphate crystals in a test-tube. This works better than a funnel for the small, 10 mL burettes. Note any changes in the thermometer reading. Place the tip of the pipette in the solution and release your grip on the bulb to pull solution into the pipette. The decreasing intensity of the blue colour indicates that starch is being used up. (i) Test the conductivity of solids by making a good contact between the surface of the solid and the two electrodes. When the magnesium stops burning on raising the lid, remove the lid. Pour the contents of the tube into a filter paper in a funnel over an evaporating basin. Living yeast, which is a variety of fungus, produces enzymes which act as catalysts in the conversion: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ BREAKDOWN OF ETHANOL TO ETHENE (ETHYLENE) Absorb ethanol on to cotton wool or asbestos wool and push this to the bottom of a hard glass test-tube. Note whether they all give the same colour: Plant extracts can act as indicators to test whether a substance is acidic or basic. time. (ii) Use a clean test-tube and thermometer to repeat the experiment using stearic acid, mp 69o, or use any other substance, mp < 100oC. Solutions with a pH value of 7 are neither acidic nor basic, they are neutral. Zinc sulphate gives a spongy mass of zinc at the cathode, oxygen gas at the anode. When the water containing the reacting ions becomes hotter, then we have gained this heat and we can make it do work for us. Your burette should be conditioned and filled with titrant solution. Connect the cell to the DC supply and watch for bubbles of gas at both electrodes. Note any loss in mass. Put a plug of cotton wool in the top of the tube. Tags :- chemistry practical book sinhala medium, chemistry practical note, pdf sinhala During their study of Chemistry, students are expected to acquire experience of planning, implementation, use of apparatus and techniques, analysis and evaluation. The change in temperature is determined by measuring the initial temperature, T1, of the reactants, and the maximum temperature, T2, of the contents of the calorimeter during the exothermic reaction. Moist pH paper No change Red rose petals No change Specific test A glowing match or wooden spill will relight when placed in oxygen gas. (f) Cooking and carbon dioxide The purpose of baking powder or soda in cooking is to produce tiny bubbles of carbon dioxide. Identity of the liquid by measuring the boiling point. Chemical Properties Solubility in water Very soluble in water. Product of combustion Is one of the "greenhouse" gases present in the atmosphere. Tube 2: Put a few pieces of anhydrous calcium chloride or silica gel in the bottom of a dry test-tube, and also two nails. Boiling point of water We can identify a pure substance from its melting point or boiling point. insoluble in excess Green ppt. An alkaline solution turns red litmus blue. The water levels inside and outside the tube should be the same and the level should be marked on the tube. A teat pipette makes a satisfactory dropper. (d) ELECTROLYSIS OF WATER Pure water does not conduct electricity. MOLES DISSOLVED VOLUME (CM3) CONCENTRATION (M) 1 1000 1M 1 500 2M 1 250 4M 1 2000 0.5M You need to be able to calculate (i) The number of moles or mass of substance in an aqueous solution of given volume and concentration (ii) The concentration of an aqueous solution given the amount of substance and volume of water. insoluble in excess White ppt. Heat the ink with a Bunsen burner flame. The small globule of lead, which accumulates at the negative electrode, the cathode, can be seen after about 10 minutes of electrolysis. Heat of fusion and vaporization 10(a) Separate by sublimation Separate iodine from a mixture of crystals of iodine and sodium chloride. Take 5 g samples and try to dissolve each in 15 mL of water in a test-tube. Don't lean on the bench while weighing. For example, every particle of solid must be transferred from the weighing paper to the (clean) beaker. Identification of ions and gasses as specified in the curriculum. Heat the mixture in an evaporating dish with a funnel placed over it. The time for the cross to become invisible should be greater than for the last experiment. Then place the bulb on the flat end of the pipette. The guide provides common information to help you approach high school Chemistry practicals better and easier. The experiment can be continued further by stirring in a 0.25M solution of barium chloride when the solution will become "milky" due to the formation of barium sulphate. To test if the bottle is full, lower a lighted splint or taper into the top of the jar. Another accurate method is to stand a conical flask containing the marble chips and acid on a balance and record the loss in mass every half minute. Marks for deductions or conclusions can only be gained if the appropriate observations are recorded. For example a burette reading of exactly 24.7 cm3 should be recorded in a results table as 24.70cm3. The concentration of a solution is determined from the number of moles of solute dissolved in one litre (1dm3) of solution. (i) Put baking powder into water. 9.8g of H_2SO_4 can be expressed either as 0.1M or 9.8g/dm3 Molarity (M) = g/dm3 / formula mass Example 1: 5.95g of potassium bromide were dissolved in 400cm3 of water. Use the brush provided to clean spills in the weighing chamber. Note how many times you can change the indicator colour before the test-tube is full. For phenolphthalein, the endpoint is the first permanent pale pink. Use this, the concentration of the titrant, and the stoichiometry of the titration reaction to calculate the number of moles of reactant in your analyte solution. Approach the endpoint more slowly and watch the colour of your flask carefully. Fit a stopper with a delivery tube reaching half way down a collecting test-tube or an U-tube, in a beaker of water. Repeat the experiment using 30 mL, 20 mL and 10 mL of this sulphate mixed with 20 mL, 30 mL and 40 mL of distilled water. Candidates will normally be instructed to put the dependent variable, the quantity being measured e.g. temperature on the y- axis. 2.CARBON DIOXIDE Physical Properties Colour Colourless Odour Odourless Density compared to air (heavier or lighter) Heavier than air Chemical Properties Solubility in water Fairly soluble in water. Hold the crucible lid in a pair of tongs close to the crucible. When cold, the fat will solidify and it can be separated from the water. Tapping the paper with a spatula will knock particles into the beaker. Repeat the experiment with other fruit juices and vinegar. IDENTIFICATION OF PURE SUBSTANCES Melting points, mp, of naphthalene (i) Put a very small amount of naphthalene in a capillary tube sealed at one end. If greater accuracy is needed, use a pipette or volumetric flask. Note the formation of hydrogen and compare the different rates at which the bubbles are formed. Titration A titration is a method of analysis that will allow you to determine the precise endpoint of a reaction and therefore the precise quantity of reactant in the titration flask. Lead acetate deposits lead on the cathode and oxygen gas is produced at the anode. Indicators An indicator is a substance used in titrations, which has one colour in the presence of an excess of one reagent and a different colour in the presence of an excess of the other. Use these balances when you need this high degree of precision. Repeat this experiment with one or two other flower colours. Record mass of solid. (ii) Alternatively, add sulphuric acid from a syringe. This vapour will break down over the hot porous pot to produce ethene gas and water vapour. The temperature change is usually between 6oC and 7oC. Draw solution in above the mark on the neck of the pipette. The specific catalysts are not usually available in school laboratories. Find where the gas is by testing with a lighted splint. Before titrating, condition the burette with titrant solution and check that the burette is flowing freely. After the solid is completely dissolved, very carefully fill the flask to the 500 mL mark. Half fill a graduated cylinder with water. Sprinkle the surface of the water with a very fine light powder, e.g. talc powder. insoluble in excess Aluminium ion:Al^{3+} +$3OH^-$ $Al(OH)_3(s)$ in excess NaOH forms soluble $(Al(OH)_4^-)$ Zinc (Zn^{2+}) White ppt. Calculate the rise of temperature. The tip should be clean and dry before you take an initial volume reading. (f) REACTION OF MAGNESIUM WITH CARBON DIOXIDE Fill a gas jar with carbon dioxide as described in experiment 2.38. Problems of an investigatory nature, possibly including suitable organic compounds. The voltage falls to zero after a short time because copper deposited on the zinc and caused the reaction to stop. Leave the solutions to cool to room temperature. The polymer will melt and give off vapours, which are collected in the receiving tube. This can be done be carefully tipping the creased weighing paper to pour the solid into the beaker. The gas is not too soluble to be collected by water displacement, as shown above for the preparation of hydrogen. (b) Substances that neither gain nor lose mass when heated Weigh a test-tube containing 1 cm dry zinc oxide and a 1 cm plug of cotton wool at the mouth to prevent loss of any solid during heating. These nails are in contact with air and water and form the control experiment. Use the brush provided to clean any spills. Pour thin petroleum distillate oil into a burette. Titration involves the neutralisation of an acid with an alkali or a soluble carbonate. This is usually done by running out the acid to a point one unit away from the trial, the going drop-by-drop until an accurate end point is obtained. Boil this fat in water and the oil will separate on the surface. Place a piece of metal foil in each test-tube. Take 40 mL of thiosulphate solution and add 10 mL of distilled water. 11(b). Test the third test-tube of gas by holding a lighted taper or splint over the mouth as soon as you take out the stopper. Note whether you can get back the original colour by adding more limewater. Heat the steel wool to red hot in a Bunsen burner flame then inserts it quickly into a test-tube of oxygen. Since readings are all subject to experimental error, the line drawn may not necessarily pass through every point. Before you take any reading from the burette after filling it, first allow the solution to run out to fill the tap and jet of the burette, and then you begin taking your readings. Replace the stopper, invert the bottle and shake it gently. Examples of indicators include; Methyl orange Phenolphthalein Methyl red Bromothymol blue Indicator colour changes Indicator Colour change Acid to alkali PH Type of acid- base titration Methyl orange Red to yellow 3.5 Strong acid – strong or weak base Litmus Red to blue 6.0 Strong acid – strong or weak base Bromothymol blue Yellow to blue 7.0 Strong acid – strong or weak base Phenolphthalein Colourless to red 9.5 Strong base-strong or weak acid Candidates may be asked to carry out exercises involving: Simple quantitative experiments involving the measurement of volumes: Speeds of reaction. At 5-minute intervals, remove 2 or 3 drops by means of a dropper and put them on a clean white tile, taking care to keep them from running into each other. To fill a burette, close the stopcock at the bottom and use a funnel. (b) REACTIONS THAT TAKE IN HEAT ENERGY Put 10 mL of water in a test-tube. Heat the fat in an iron saucepan or dish and, when it is molten, slowly add the sodium hydroxide solution with continuous stirring. (b) Density of a liquid Weigh a small container, fill with liquid and weigh again. The electric current has split up crystalline lead bromide into bromine gas and lead metal. Note any colour change. Note any variations in light refraction and reflection below the sodium that indicates something dissolving in the water. Copper (Cu^{2+}) Light blue ppt. To make up a solution, first dissolve the solid material completely, in less water than required to fill the flask to the mark. The ethene is insoluble in water, unlike ethanol, and will collect in the test-tubes. Adding acid CO_2 and the colour of the resulting solution (e.g. blue $Cu^{2+}(aq)$, may also provide clues. Note whether the yeast forms a gas. Using a Top-loading Balance Check if the balance is turned on. Open the air hole. Put a cardboard cover over the top to prevent diffusion of the gas. (iii) Add a few drops of sodium bicarbonate solution to 1 mL of flower extract indicator in a test-tube. Solder a piece of stout copper wire to a 4 cm length of braided copper screening wire. Carefully add the substance to be weighed up to the desired mass. Fix a delivery tube to the bottle. Your TA can show you how to deliver a partial drop of solution, when near the endpoint. (c) WHAT COMBINES WITH IRON DURING RUSTING Moisten the inside of a test-tube with water, sprinkle into it a spatula measure of iron filings and rotate it horizontally so that the filings spread and adhere to the walls. Scrape and clean the electrodes between each test. The excess copper wire is cut off. By this means the colouring matter will be extracted into the solvent. Attempt to work out the questions from the first principles and not use the formula method, which has its own limitations. The solution should be delivered quickly until a couple of mL from the endpoint. It is one of the gases responsible for air pollution. This amount is again an excess so that all the copper sulphate will be used up in the reaction. Do not allow ink to froth up or splash into the delivery tube. It is suitable for Form 4, Form 3, Form 2, and Form 1. The reaction is a double displacement involving a strong base such as sodium hydroxide and fats. Moist pH paper Shows a strong acidic reaction Red rose petals Would bleach and lose their colour Specific test None Footnotes: One of the "family" of halogen gases (iodine and bromine are in the same family) Used in water purification. Carbon deposits on the glass. (ii) Hold a piece of cotton wool soaked in ammonium hydroxide at the mouth of a test-tube of hydrogen chloride. Quickly, remove the pipette bulb and put your index finger on the end of the pipette. Pour off the liquid into a test-tube and filter into an evaporating basin. If none appear, add a little more acid or sodium sulphate solution. Concentrations of 1M or less are suitable. Record the time of adding the saliva. Add 5 mL of the acid and note the time given by the second hand of a clock. Plot a graph for each experiment. Use a magnifying glass to measure temperature values precisely. The pp t. Amount of substance In quantitative analysis, it is important to measure the amounts or moles of reacting substances accurately. The scale runs from 1 to 14, and the following general rules apply. The balancing numbers give the numbers of moles present for each chemical involved in the reaction. The solution will gradually become colourless as the sulphur dioxide reacts with the permanganate. The pale pink fades in 10 to 20 minutes. Note the conditions for rusting and which metal, (zinc, copper or tin), is best at preventing rusting. (e) ELECTRICAL ENERGY FROM CHEMICAL REACTIONS – ELECTROCHEMICAL CELLS In the preceding experiment zinc metal became zinc ions and copper ions became copper metal due to transfer of electrons from zinc metal to the copper ion. insoluble in excess iron(II) ion: $Fe^{2+}(aq) + 2OH^-(aq)$ $Fe(OH)_2(s)$ dark green ppt. Test whether the receiver test-tube is full by holding a piece of red litmus paper at the opening. The sections on tabulating data, significant figures, uncertainties, graphing, and subject specific vocabulary are particularly ... The practical ... The purpose of this booklet is to guide A-level chemistry students through the questions that are likely to appear on NECTA Paper 3, the practical paper. GENERAL EXAMINATION REQUIREMENTS Apparatus List This list given below has been drawn up in order to give guidance to schools concerning the apparatus that is expected to be generally available per student for examination purposes. Clean magnesium ribbon and cut into 0.5 cm pieces. Drain off excess liquid. It is always advisable ton use even scales. For example, if a candidate records four different titres as listed below, the mean can be worked out. Pressure affects the boiling point Put water in a sidearm test-tube or in a round-bottom flask with a 2-hole stopper. Have 3 test-tubes ready to collect ethene. Support a thermometer with the bulb in the solution. Universal indicator not only indicates whether a substance is acidic or basic but also how acidic it is. This booklet has been produced to help students preparing for and taking practical Examinations. HEATING AND BURNING DIFFERENT SUBSTANCES Substances that gain mass when heated. Filtration. ENERGY FROM CHEMICAL REACTIONS The following group of reactions involve ions in aqueous solution. Record the final time when the black cross below the beaker is no longer visible. Sulphur is produced during the reaction making the solution cloudy. Add two spatulas of manganese dioxide and oxygen bubbles off for collection. The irregular shape of the sodium changes to a sphere. Some useful points for candidates to keep in mind when constructing graphs are listed below. Calculate its molarity. After the final dilution, remember to mix your solution thoroughly, by inverting the flask and shaking. When all the copper sulphate crystals have changed to white and the tube has cooled, hold the tube in your hand and pour the liquid back on to the white crystals. Add to this 1 mL of saliva and stir this into the starch solution. Weigh approximately 2 g of each grade, size, of marble chips and put the four grades separately into each of the four tubes. Note any change in the copper carbonate. Although the experiments you carried out were relatively simple you will have used your measurements and observations to make inferences ... The new Practical Handbook has been introduced with the aim of providing the teachers with necessary guidance for planning practical activities, engaging students effectively in the ... The practical guide is an extract from CHM 392 course material as such it covers practical aspect as contained in Physical Chemistry II (CHM 201), and Organic Chemistry II. Heat the crucible again strongly but still hold the crucible lid in a pair of tongs close to the crucible in case the magnesium starts to burn again. (ii) Prepare sulphur dioxide in a generator which allows dilute sulphuric or hydrochloric acid to drip slowly on to sodium sulphate. Use a wash bottle to rinse the tip of the burette and the sides of the flask. Read the volume, immerse the solid in the water and read the volume again. Draw the shape of the boundary between the forming crystals and the melt. Note: The presence of carbon dioxide can be confirmed by the fact that limewater becomes "milky" when the gas is Passed through it. (d) Solvent extraction of oil from nuts Put groundnuts (peanuts) or pieces of chopped coconut into a mortar. (b) CONCENTRATION AND RATE OF REACTION The reaction between sodium thiosulphate and hydrochloric acid can take a noticeable time. Sugar does not react with iodine, but sugar will reduce copper (II) in Fehling's solution to red copper (I) oxide, and this is also a sensitive test. Chemicals must never be tasted Gases and vapours should never be smelt unless the question instructs the candidates to do so and then only with great care. Marble chips or other carbonate rock treated with dilute acid provides a good source. Use a tray with area > 30 cm2 so as not to restrict the oil film. (iv) Investigate a candle flame and the flame of a spirit lamp in a similar way. Carefully add substance to the container or paper. (g) TITRATION OF ACIDS AND BASES Measure exactly 20 drops of a dilute acid such as vinegar and put these into a test-tube. Use a rubber band to attach the tube containing inflammable and capillary tube to the bulb of a thermometer. The predetermined quantity e.g. volume will be on the x-axis. The stream of bubbles at one side causes movement. The liquid does not return to the solid state unless a catalyst is used. (e) REDUCTION OF POTASSIUM PERMANGANATE WITH SULFUR DIOXIDE (i) Add 10 mL of 0.1M solution of potassium permanganate and 10 mL 3M solution of dilute sulphuric acid to 200 mL of water containing sulphur dioxide. Boil the water and read the temperature on the thermometer. Corks should fit at both ends. The acid is contained in a thistle funnel and a tap controls the flow on to sodium sulphite in a suitable flask. Lead (Pb^{2+}) White ppt. This booklet advices candidate on how he or she should interpret, explain, evaluate and communicate the results of the exercises clearly and logically using relevant chemical knowledge and understanding and using appropriate specialist vocabulary. The seed crystal should then grow. Don't forget to add the spin bar each time! Set up the calorimeter with the thermometer (0° to 50°C, graduated every 0.1°C) supported from a stand so that the bulb does not touch the bottom of the cup. Put one drop of lemon juice on to the spot then note any change of colour. Heat with a small flame to avoid boiling over. Footnotes: Makes up 20% of the gases in the air. Copper sulphate deposits copper at the cathode and oxygen gas is produced at the anode. Drop a 3 mm diameter piece of sodium into the kerosene. This is the stability indicator light, indicating that the weight is stable. Note the comparative activity of the metals. They are for general-purpose use, but not for quantitative analysis. Separate this soap from the liquid below, melt and pour into matchboxes where it will solidify again as small bars of soap. (c) Diffusion of liquids (i) Place a crystal of potassium dichromate, potassium dichromate (VI), or ammonium dichromate at the bottom of a beaker of water. The solubility of a salt is usually expressed as the number of grams able to dissolve in 100 g water at 20oC, e.g. ammonium chloride 37.2 g, barium chloride 35.7 g, calcium chloride 42.7 g, copper sulphate 20.7 g, lead nitrate 54.4 g, magnesium sulphate 25.2 g, potassium chloride 34.0 g, potassium iodide 144.0 g, sodium bicarbonate 9.6 g, sodium chloride 36.0 g, sodium hydroxide 109.0 g, sodium nitrate 87.5 g. The scales should be chosen so that the results are spread out as far apart as the size of the grid allows but not at the expense of using a sensible scale. This is a 2M solution Also prepare 500 mL of a 2M hydrochloric acid solution. Connect crocodile clips to the rods and complete the circuit with a torch bulb, to indicate when a current is flowing, and a 12-volt torch battery or cells wired in series. Let the water cool and read the temperature again when the steady stream of bubbles ceases. You can also fill a burette using a disposable transfer pipette. This ensures that the electrodes are in contact with the liquid and not the solidified melt. The ppt. Add a spoonful of yeast and leave to stand for 2 days. Show the values that can be averaged to obtain an acceptable value for use in calculations (only those values within 0.2 cm 3 should be averaged). Manganese (IV) oxide is usually used as a catalyst in this reaction. COMMON LABORATORY EXPERIMENTAL PROCEDURES BUNSEN BURNER (i) Close the air hole and turn the gas tap full on. Zinc forms rapidly on the cathode. Tube 5: Wrap a piece of zinc foil round part of a nail. Impurities affect the melting point of a substance Mix stearic acid with the naphthalene, thus making the naphthalene impure. Drill two holes in the rubber stopper with a 1 mm drill. (ii) You can also support the seed crystal at the end of a glass tube. Sodium thiosulphate may be bought as "hypo" which is used in photography. The oil spreads out. The volume of the acid required for each change is read off and recorded in a table similar to the one below. Connect zinc foil to the negative terminal. Note whether carbon dioxide gas collects in the upper part of the jar. Potassium sulphate is an alternative substance. On the bottle or packet of Universal indicator, a colour chart shows the colour and the pH value associated with this colour as follows: (a) Colour (b) pH (c) Acid/Base (a) Red (b) 1-3 (c) very acidic (a) Orange (b) 4-5 (c) weak acid (a) Yellow (b) 6 (c) very weak acid (a) Green (b) 7 (c) neutral (a) Blue (b) 8 (c) very weak base (a) Indigo (b) 9-10 (c) weak base (a) Violet (b) 11- 14 (c) very basic Use 2 drops of Universal Indicator to 10 mL of solution to be tested. Read the temperature, heat to boiling and read the temperature again. Note any change in the reading if the thermometer touches the bottom of the test-tube. It is composed of an open cylinder of glass approximately 8 cm high and 2.5 cm in diameter. Slowly raise the temperature of the water. Check the density of the carbon dioxide by pouring" the gas into another bottle either above or below the first bottle. This experiment is called the glowing splint test. Disconnect the delivery tube when you stop heating to avoid a suck back of water onto the hot porous pot. The volumes stamped on the sides are approximate and accurate to within about 5%. (v) Litmus, an extract of lichens, is another plant indicator. Since both reactants and products are colourless, an indicator is used to find the neutralisation point or end point i.e. the point at which the acid has been neutralised. The reactants lost energy to the solution. Collect test tubes of the gas and stopper them. Note any changes at the copper foil and the zinc foil. (ii) Make a sugar solution and half fill a jar with this solution. If the jars are left for about 5 minutes carbon dioxide will be carried into the upper jar by diffusion; in the same way air will be carried into the lower jar. Stir and then add 5 mL of acid as before. In your science or chemistry course at GCSE you have carried out practical work in the laboratory. Place four 100 X 16 mm test tubes in a stand. Needed by the majority of living organisms for respiration Is produced by green plants as a by-product of photosynthesis. is not soluble in excess of NH_3 or NaOH. (c) Hydrogen chloride Put rock salt, sodium chloride, into a 100 mL filtering flask. The Vaseline will melt and form an airtight layer, solidifying as the water-cools. Watch the crystals grow using a hand lens. (h) MAKE SOAP FROM FATS Soap can be made from many oils and fats. When the water stops boiling, turn on the water pump to reduce the pressure. The origin (0,0) need not necessarily be included on either scale if it is not relevant. Potassium bromide may have too high a melting point, 682oC, to melt easily. The tubes collect any gas given off and the properties of the gas should be tested. (iii) Test pure distilled water for conductivity. Moist pH paper Shows a weak acidic reaction (around pH6) Red rose petals No change Specific test Turns lime water "cloudy" Footnotes: Makes up 0.04% of the gases in the air. Connect the electrodes to a 6-volt or 12 volt DC supply. The quantity of zinc powder is in excess to ensure that all the copper sulphate is used up in the reaction, so some zinc will remain when the reaction stops. To make the carbon more visible, you can add drops of sulphuric acid to remove the magnesium oxide and any unburnt magnesium. If the lead acetate solution is cloudy, add a few drops of acetic acid. 12(a) RUSTING Take 7 test tubes and 11 clean nails. Bromine is readily seen coming off at the positive electrode, which is the anode. After 5 to 10 minutes there should be enough hydrogen and oxygen gas for testing. The pH of a solution can be measured in several ways. (b) Volumetric (measuring) Flasks Erlenmeyer flasks and beakers are used for mixing, transporting, and reacting, but not for accurate measurements. The colour is then observed and inferences made. Let it cool and note the temperature when the naphthalene solidifies Calculate the average of these two values. If two moles are dissolved in 1litre (1dm3), the resulting solution is 2M and so on. (Ammonia may also be detected with moist red litmus: it turns it blue.) Residue turns yellow when hot and then white again when cold Zinc oxide, which may have been formed by the decomposition of another zinc compound Residue which is red when hot and yellow when cold Led (II) oxide, which may have been formed by the decomposition of another lead compound TABLE 8: SOLUBLE AND INSOLUBLE SALTS Soluble Insoluble Bases The alkalis: sodium and potassium hydroxides; calcium hydroxide, which is slightly soluble; ammonia. Note the time when the cross is no longer visible through the sulphur in the solution. Boiling point of inflammable liquids (i) Use a different method of heating inflammable liquids, e.g. ethanol, bp 78.4oC and acetone, bp 56oC. (c) Graduated Cylinders Graduated cylinders are useful for measuring liquid volumes to within about 1%. (iii) Use an L-shape piece of nichrome wire with a shield to fit on the top to protect your hand. The bulb, which should be low power, indicates when the current is flowing. Find the hottest part of the flame. Tube 4: Half cover 2 nails with water containing a little common salt dissolved in it. Ammonia is the less dense gas and the white ring of ammonium chloride should form nearer to the hydrogen chloride end than from the ammonia end of the tube. Pause after every few seconds to observe the amount of undissolved salt left in each tube. hydrochloric acid (i) Litmus turns blue, (ii) white clouds with HCl fumes. Note whether carbon dioxide forms. The potassium permanganate solution diffuses evenly through the water. Gently release the seal made by your finger until the level of the solution meniscus exactly lines up with the mark on the pipette. Using a pair of tongs or tweezers, dip a piece of cotton wool into concentrated hydrochloric acid and another piece into concentrated ammonium hydroxide. Iron (III) (Fe^{3+}) Red-brown ppt insoluble in excess Red-brown ppt insoluble in excess iron(III) ion: $Fe^{3+}(aq) + 3OH^-(aq)$ $Fe(OH)_3(s)$ brown ppt.* The ppt. Hang the seed crystal 5 cm from the base of the container with a bent wire. (ii) Weigh a test-tube containing 1 cm copper carbonate and a 1 cm plug of cotton wool at the mouth to prevent loss of any solid during heating. Leave the crucible to cool. (b) Substances that lose mass when heated (i) Weigh a test-tube containing 1 cm potassium permanganate crystals and a 1 cm plug of cotton wool at the mouth to prevent loss of any solid during heating. For example using 1cm to represent 3 units might spread the readings better than using 1 cm to represent 4 units but the scale may be difficult to read. Add boiling chips to prevent bumping. Compare the two flames and note which has the hottest point. We must assume that the specific heat of this moderately weak solution is the same as that of water. In the middle of the test-tube pack small pieces of unglazed porcelain. (a) Obtain animal fat from a butcher. Neutral substances, such as pure water, have a pH of 7, Alkalis have a pH greater than 7, The more alkaline a solution, the higher the pH. Use a lighted taper to investigate where the hydrogen has gone. Touch the oil drop with the point of a glass rod and then touch the prepared water surface. Measure the approximate area over which it spreads. Use tongs to prevent this. Do not attempt to reach a particular mass exactly. Then allow to cool. Test the pH value of lemon juice, vinegar, sodium bicarbonate solution, washing soda, lime water, sodium hydroxide solution, tap water, distilled water. 5.HYDROGEN GAS Physical Properties Colour Colourless Odour Odourless Density compared to air (heavier or lighter) Lighter than air. Add magnesium powder, or ribbon, a little at a time until the blue colour disappears. For a 1 M solution, multiply the rise in temperature by 5 (5 X 0.2M = 1.0 M). insoluble in excess Light blue ppt. Clamp the calorimeter so that it rests on the stirrer. (ii) Oxygen is colourless and has no smell. The lime water test will show the presence of carbon dioxide in the upper jar. Adjust the layer of kerosene to be shallow enough to allow the top of the sodium to protrude above the surface. Aspirate the gas into a bottle containing water. (iii) Since the volume of water has been doubled by adding one solution to the other, the final solution contains 1 mole of OH^- (aq) ions which reacted with 1 mole of $H^+(aq)$ ions to form 1 mole of water molecules. If the water has a large enough surface area, we assumed that thin oil will spread out in a layer one molecule thick called a monomolecular layer and not form little "hills" of molecules. Something that burns in air will burn five times more ferociously in pure oxygen gas. Water will spray into the flask from the jet. Put 50 mL of water in the flask and add 2 mL of hydrogen peroxide solution. Since I/time, reciprocal of time, is the measure of the rate of the reaction, plot thiosulphate concentrations against I/time. When the solution is colourless, decant the solution from the red copper powder at the bottom of the beaker. They are acidic substances. Points should never be joined by a series of short straight lines. (ii) Glass can be a conductor. Construct a bubbler to fit on the top of the jar. (iv) Repeat the experiment with limewater and indicator followed by dilute hydrochloric acid. Clean and dry the electrodes between each test. (b) Oxygen (i) Prepare oxygen safely by decomposition of hydrogen peroxide solution. Use minimum amount of indicator possible (2 – 3 drops) and recognize the end point has been reached e.g. when the colour just changes. Make seed crystals by slow evaporation of 30 mL of saturated solution in a glass dish. Fill the larger jar very carefully by pouring water down the side until the water level is above the top of the small bottle. Prevent crystals growing on the sides of a crystallizing dish by rubbing Vaseline round the upper inside rim. Ask your TA to demonstrate these techniques for you, in the lab. 2.84 Electrical energy from the displacement of copper by zinc Put concentrated copper sulphate solution in a beaker. or very slight white ppt insoluble in excess $Ca^{2+}(aq) + 2OH^-(aq)$ $Ca(OH)_2(s)$ white ppt. The rinsing should be transferred to the second vessel along with the rest of the mixture or solution. (c) The next stage is to weigh out common salt, sodium chloride; about twice the weight of sodium hydroxide used in (b) is needed. (ii) Fill a flask with ammonia. Record the temperature of this solution. The glowing splint bursts into flame. You may need to lift up on the funnel slightly, to allow the solution to flow in freely. BREAKDOWN OF POLYMERS Usually the smallest molecules are gaseous or liquid at room temperature and the large molecules are solids. Subtract the initial volume to determine the amount of titrant delivered. The rate of reaction can be found by finding the time taken to reach a certain degree of cloudiness in the solution. As you release the liquid from a pipette into a conical flask, one should not blow out the last drop remaining in the jet. (iii) Shake a test-tube of the gas with water to obtain a solution of hydrogen chloride. Sometimes crystals will grow from several points simultaneously to make boundaries where they meet. Drops of a colourless liquid appear in the collecting tube. Leave in moist air or on a window ledge for a few days and note the effect of the rust on the longer arm of the lever. Connect a delivery tube as 2.97 From large molecules to small molecules A Perspex or polystyrene B receiving tube c cold water D a liquid collects. A liquid is obtained. (ii) Pour a 2 cm layer of kerosene on to the surface of water in a test-tube. Put the test-tube in an empty beaker. The sulphur dioxide produced can be collected in gas jars covered with cardboard discs, which have central holes for the delivery tube. Prepare the tubes as shown below: Tube 1: Put 2 clean nails in the test-tube and half cover them with distilled water. Put 10 mL of molar copper sulphate solution in a small beaker. (d) Ammonia (i) Put a mixture of calcium hydroxide and ammonium chloride into a test-tube to a depth of 4 cm. (e) Separate two immiscible liquids of different density Use a separating funnel or make a separating funnel with a piece of wide tubing fitted with a stopper, tube and rubber tube with a clip. Ignite the charcoal in the Bunsen burner flame and then insert it quickly into another test-tube of oxygen. Plot concentration of the thiosulphate solution against time taken for the reaction. Transfer the liquid to a measuring cylinder. Used to make ammonia which is needed in the manufacture of fertilizers and explosives. Check the quantity of the pipette as indicated on the bulb of the pipette and remember to record it in the appropriate place. Weigh a clean evaporating dish, w1. The tube should have been drawn out into a jet. Wait until a clear boundary appears between the two liquids and then run off the denser layer into a beaker below. Find the density by dividing the mass of the liquid by the volume. Any soluble silver salt + any soluble chloride silver chloride precipitate. Eye protection must always be worn. (i) Collect four test tubes of the gas and cork them. 6.NITROGEN Physical Properties Colour Colourless Odour Odourless Density compared to air (heavier or lighter) Same as air Chemical Properties Solubility in water Slightly soluble Burning Does not support combustion Moist pH paper No reaction Red rose petals No reaction Specific test None Footnotes: Makes up around 79% of the gases in the air. The sodium melts because the reaction gives off heat. Insert a thermometer through a hole in the stopper so that the bulb of the thermometer reaches, but does not touch, the bottom of the test-tube or flask. For example, sodium chloride may be prepared by the reaction of sodium hydroxide and hydrochloric acid, according to the following equation – NaOH (aq) + HCl (aq) NaCl (aq) + H_2O (l) The equation specifies what amounts of sodium hydroxide and hydrochloric acid will react together and what amounts of products are produced. HEALTH AND SAFETY Candidates must follow the health and Safety policy normally operates in their laboratories when carrying out the practical Examination. Fill a U-tube with lumps of calcium oxide mixed with cotton wool. To avoid using the name of a colour to indicate acidity, we use a scale of numbers from 0 to 14 called the pH scale. Air mixing with the gas helps it to burn more rapidly and efficiently. (v) Blow soap bubbles by holding the delivery tube of the apparatus in detergent or soap solution. Carefully add concentrated sulphuric acid down the thistle funnel. It reacts with water to form a weak acid called carbonic acid. Blue copper sulphate crystals + heat -> white, anhydrous copper sulphate + water. The colour of the bleached plant can easily be regenerated by placing the plant in a solution of hydrogen peroxide. (ii) The generator used in experiment 2.75B is a convenient piece of apparatus for giving a continuous supply of sulphur dioxide for bleaching Bowers and other plants. Perspex and polystyrene are solid polymers, which can be broken down to smaller molecules by heat. (b) Solubility and solvents (i) Fill two test-tubes one third full with (a) water and (b) methylated spirits. The lime water will turn milky indicating that the carbon dioxide has fallen into the lower jar because it is the heavier gas. See your lab manual for a discussion of how to determine accurately the change in temperature from your graph of temperature vs. Add some clear saturated solution and weigh again, w2. Note any colour change with dilute hydrochloric acid. The ratio of NaOH: HCl: NaCl: H_2O is 1: 1: 1: 1. Evaporate the solution to leave zinc sulphate crystals. GENERAL NOTES FOR QUALITATIVE AND QUANTITIVE ANALYSIS Indicators An indicator is a substance used in titrations, which has one colour in the presence of an excess of one reagent and a different colour in the presence of an excess of the other. (b) Diffusion rates of ammonia and hydrogen chloride gases The long glass tube should be horizontal. Never dry hydrogen gas with concentrated sulphuric acid! (i) Place a few pieces of granulated zinc or zinc foil from the casing of an old dry cell in a boiling tube; add 2 drops of copper sulphate solution. Collect the copper and dry it. Stir or shake both tubes equally and simultaneously. Record the mass. Tube 3: Boil water for several minutes to expel dissolved air and pour into the test-tube whilst hot. Boil water in an electric jug or on an electrical hot plate. Oil floats on the surface and does not dissolve in the water. 12.PREPARING, COLLECTING AND TESTING GASES (b) Hydrogen Be careful! A dangerous explosion may occur if you use any vessel bigger than a small test-tube when igniting the gas, particularly if it is mixed with air. Weigh a crucible plus lid, put the pieces of magnesium ribbon in the crucible and weigh again. Can escape through the atmosphere into space. Place this in a larger jar. Temperature/OC 0 10 20 30 40 50 60 Solubility(g/100g of water) 6.9 8.2 9.6 11.1 12.7 14.5 16.4 8(a) Solubility and particle size To show that small particles dissolve faster than the large particles, add 4 g of coarse able salt to one test-tube half filled with water, and 4 g of fine table salt to a second test-tube containing the same amount of water or use whole and crushed copper sulphate crystals. Support the glass tubing vertically so that the seed crystal at the end is immersed in the solution of the salt. Then add lemon juice and note any colour change. Turn the bottle the right way up, remove the stopper and add 0.5 g of zinc dust. Note the hottest place in the flame. (e) Carbon dioxide Many reactions can be used to produce carbon dioxide gas. If one mole of a solute is dissolved in water and the volume of the solution made up to 1litre (1dm3), this solution in known as a molar solution or 1M solution. When each balloon is in place, tip the acid into each test-tube at the same time and observe which balloon is the fastest and the slowest to be blown up. Collect any gas formed and test for hydrogen with the glowing splint test. You should check for air bubbles and leaks, before proceeding with the titration. The acid is run into the flask until the indicator just changes colour. One burette, 50 cm3 A measuring cylinder, 50 cm³ or 25 cm³ A filter funnel One pipette, 25cm3 Two conical flasks within the range 150cm3 0r 250cm3 A beaker, squat form with lip: 250 cm³ A thermometer, -10°C to + 110°C at 1 °C A polystyrene or other plastic beaker of approximate capacity 150 cm³ Clocks (or wall-clock) to measure to an accuracy of about 1s. To do this, put a glass tube into the beaker of water so that it touches the bottom, then to drop the crystal down the tube. The calcium oxide dries the ammonia gas. (iii) To a little water in a wide test-tube, add concentrated sulphuric acid, drop by drop, down the side of the tube. insoluble in excess No ppt. Doing a Titration Begin by preparing your burette, as described on the burette page. This will allow a larger current to flow. This is an approximate dimension of a single molecule of the oil. Don't pick up tare containers with bare hands since your fingerprints add mass. Indicator colour changes Indicator Colour change Acid to alkali PH Type of acid- base titration Methyl orange Red to yellow 3.5 Strong acid – strong or weak base Litmus Red to blue 6.0 Strong acid – strong or weak base Bromothymol blue Yellow to blue 7.0 Strong acid – strong or weak base Phenolphthalein Colourless to red 9.5 Strong base-strong or weak acid Candidates may be asked to carry out exercises involving: Simple quantitative experiments involving the measurement of volumes: Speeds of reaction. Commercial "baking powders" often contain a solid acid, which only reacts with the sodium bicarbonate when moist. Sulphate ion (SO_4^{2-}) To a solution of the suspected sulphate add dilute hydrochloric acid and a few drops of barium chloride or nitrate solution White precipitate of barium sulphate $Ba^{2+}(aq) + SO_4^{2-}(aq)$ $BaSO_4(s)$ any soluble barium salt + any soluble sulphate barium sulphate Sulphite ion SO_3^{2-} (i) Add dilute hydrochloric acid to the suspected sulphite, (ii) test any gas evolved with fresh potassium dichromate (VI) paper (i) Choking sulphur dioxide gas formed, (ii) the dichromate paper turns from orange to green (i) Sulphite salt + hydrochloric acid chloride salt + sulphur dioxide, (ii) the sulphur dioxide reduces the dichromate (VI) to chromium (III). Collect test tubes of ammonia and cork them. Tie a piece of clean cotton around it without touching the seed crystal with your hands because impurities easily affect the size and shape of the crystal. Finally, the paper should be rinsed into the beaker, to remove all traces of the solid. So we need a standard way of comparing the concentrations of solutions. Take care not to touch either the solid sodium hydroxide or the solution, because it is very caustic. Sodium metal is lighter than water but heavier than kerosene. Predict at which electrode each gas will appear. Add 2 drops of water. The reaction can be vigorous! Copper metal deposits and the blue colour gradually disappear as the magnesium displaces the copper ion. Used to make ammonia gas, which in turn is used to make explosives and fertilizers. The colour changes or the identity of any gases evolved may provide evidence as to the identity of the unknown. The cotton wool is to prevent blocking of the tube. On the other hand, when the water containing the ions becomes colder, it is the ions which have gained the energy and the water has lost an equivalent amount. If you think you might have reached the endpoint, you can record the volume reading and add another partial drop. Put the electrodes into a beaker of distilled water. Burning Does not support combustion. A small bottle of similar size with the bottom cut off would do just as well. Gently heat the test-tube containing the Perspex. These skills will be ... G.C.E A/L Chemistry - Practical HandBook Largest online Education web site in Sri Lanka provides Past papers, Model papers, School papers, Campus papers, Marking schemes, Notes, Career guide for school leavers and lot more ... High school Chemistry Practical Handbook. Put about 2 mL of the mixture in a test-tube. A burette-reading card with a black rectangle can help you to take a more accurate reading. A burette is used to deliver the second reactant to the flask and an indicator or pH Meter is used to detect the endpoint of the reaction. This is a relative uncertainty of 4 x 10-4 or 400 parts per million. Record the changes of the thermometer reading. Grind the nuts in the solvent as finely as possible. Use a wash bottle to rinse the sides of the flask and the tip of the burette; to be sure all titrant is mixed in the flask. Watch the growth from one centre. (ii) Test ethanol, or methylated spirits, acetone, carbon (IV) chloride, vinegar, sugar solution, copper (II) sulphate solution, sodium chloride solution, and other substances dissolved in water. Sodium chloride dissolves readily in water but not so readily in methylated spirits. Add 5 mL water and shake until all the salt has dissolved. In a previous experiment yeast was used to break down sugar into ethanol, which is an even smaller molecule. Leave to cool. This suggests that the polymer has been broken down by heat to smaller molecules. Put 2 cm of the inflammable liquid in a test-tube. What this means is that if the amount of any one of the components in the above reaction is known then the others may be worked out from the ratio above. Look for changes in the melting point. The alloy supports for the coiled filament in electric light bulbs have also been found suitable for electrodes. Then add the acid to the base quite rapidly and stir with a thermometer. The carbon electrodes are supported by a strip of wood with two holes bored 2 cm apart for the electrodes. When you have reached the endpoint, read the final volume in the burette and record it in your notebook. To get electrical energy these electrons must flow in an external conductor from the zinc to copper. Note the actual temperature of the solutions when cool. Different colours suggest that some substances are more acidic than others. Stir the mixture frequently. Read the bottom of the meniscus. Dissolve about 2 g of potassium nitrate in the water. 7.OXYGEN Physical Properties Colour Colourless Odour Odourless Density compared to air (heavier or lighter) Slightly heavier than air Chemical Properties Solubility in water Slightly soluble in water Burning Oxygen gas is needed for burning or combustion. Burettes are used primarily for titration, to deliver one reactant until the precise end point of the reaction is reached. Add water drop by drop. Turn the balance on by pressing the control bar. Always write the reading immediately you take them. These nails are in contact with air, water and salt. To test what is in the cooler inner cone hold a splint of wood in the flame so that it passes through the inner cone. We can find the volume of an insoluble irregular solid with a measuring cylinder. TEST FOR TEST METHOD OBSERVATIONS TEST CHEMISTRY Bromide ion Br^- Add dilute nitric acid and silver nitrate solution Cream precipitate of silver bromide, partially soluble in dilute ammonia (i) $Ag^+(aq) + Br^-(aq)$ $AgBr(s)$ any soluble silver salt + any soluble bromide silver bromide precipitate Iodide ion I^- (i) Add dilute nitric acid and silver nitrate solution, OR (ii) Add lead(II) nitrate solution (i) Yellow precipitate of silver iodide insoluble in dilute ammonia, (ii) a yellow precipitate forms (i) $Ag^+(aq) + I^-(aq)$ $AgI(s)$ any soluble silver salt + any soluble iodide silver iodide precipitate, (ii) Insoluble lead (II) iodide formed, $Pb^{2+}(aq) + 2I^-(aq)$ $PbI_2(s)$ Nitrate ion NO_3^- boil the suspected nitrate with sodium hydroxide solution and fine aluminium powder fumes of ammoniaproduced, which turns red litmus blue. The current flowing will depend on the extent and rate of the reaction. Copper (II) carbonate copper(II) oxide + carbon dioxide: $CuCO_3(s)$ $CuO(s) + CO_2(g)$ [green] [black] + [colourless gas, test with limewater, white precipitate] zinc carbonate zinc oxide + carbon dioxide $ZnCO_3(s)$ $ZnO(s) + CO_2(g)$ [White] [Yellow hot, white cold] +[colourless gas, test with limewater, white precipitate] Hydrogen ion H^+ or H_3O^+ (i) litmus or universal indicator or pH meter, (ii) add a little sodium hydrogen carbonate powder (i) litmus turns red, variety of colours with universal indicator. Conditioning two or three times will insure that a stray drop of water does not change the concentration of titrant. No marks can be awarded for an incorrect answer without working but a correct method followed by an incorrect answer will receive credit. Leave the tube in this position for a few days. Warm the flask gently to expand the gas and then hold the flask upside down with the tube in the water. After a minute, check for solution on the tip to see if your burette is leaking. If not, press the on/off button and wait until the display reads 0.0 g. The solution is placed in the glass cylinder. Pour enough 1 M sulphuric acid down the thistle funnel on to the zinc to cover the bottom of the funnel tube. Transferring a Solution or Mixture If you are transferring a solution or heterogeneous mixture to another vessel, rinse the container with solvent to be sure the transfer is quantitative. He worked in the laboratories of the Carlsberg breweries and was interested in checking the acidity of beer. The first step is to calculate the mass of one mole of the compound by summing up the relative atomic masses of the constituent atoms. If your sample is a solid, make sure it is completely dissolved. (v) Universal Indicator can be in the form of a solution or dried on filter paper. Chloride ion Cl^- Add dilute nitric acid and silver nitrate solution. This is a small explosion. Add baking powder in a test-tube with vinegar or lemon juice (acetic acid). The test should show that the amount of sugar is increasing. Baking powder, or sodium bicarbonate, $NHCO_3$, reacts with an acid such as lactic acid from sour milk to produce carbon dioxide. The two small tubes are then filled with the solution, and carefully inverted over the electrodes. Light the gas and hold a piece of wire in different parts of the flame, moving it from the bottom to the top. This reaction between sodium and the water is much slower than if the sodium had been dropped directly on to the water. Put about 10 mL of dilute starch solution into a test-tube. Do record the mass of your container, if you will need it later. Be sure your eye is at the level of meniscus, not above or below. E.g. 1 mole of calcium carbonate ($CaCO_3$) will have a mass of 40 + 12 + 48 = 100g 10g of $CaCO_3$ will contain 10/100 = 0.1moles concentration of a solution It is very useful to be know exactly how much of a dissolved substance is present in a solution of particular concentration or volume of a solution. The solvent evaporates leaving the oil extracted from the nuts. 3.CHLORINE GAS Physical Properties Colour Greenish-yellow Odour Pungent odour Poisonous Density compared to air (heavier or lighter) Heavier than air Chemical Properties Solubility in water Soluble in water. Once used in airships but replaced by helium which is not explosive. $Ag^+(aq) + Cl^-(aq)$ $AgCl(s)$. (It's crude, but very effective!) Key techniques for obtaining accurate results are starting with a dry calorimeter, measuring solution volumes precisely, and determining change in temperature accurately. GRAPHS Some exercises in practical chemistry will require candidates to treat their readings graphically. (i) Prepare sulphur dioxide by burning sulphur in air. Heat a 3 mm bore piece of glass tubing in a flame until the end softens sufficiently to squeeze with pliers to make a smaller hole. If cork is used, this must be made leak proof by covering the whole of the bottom surface round the electrodes and the glass edge with Faraday's wax or a similar soft wax. 1NaOH (aq) + 1HCl (aq) 1NaCl (aq) + $1H_2O$ (l) This equation states that 1 mol of sodium hydroxide and 1 mol of hydrochloric acid will react together to give of 1 mol sodium chloride and of 1 mol water. A catalyst may slow down a reaction as well as speed it up. 2.4 Titration Experiment Titrations can be used to find the concentration of an acid or alkali from the relative volumes used and the concentration of one of the two reactants. If little crystals grow on the surface of the seed crystal, then screw on the lid of the jar to make the little crystals dissolve. Do not use metals in powder form because the reaction may be too vigorous and even cause an explosion. It is accordingly important that an assessment of a student's knowledge and understanding of Chemistry should contain a component relating to practical work and experimental skills. (a) DISPLACEMENT OF COPPER FROM AQUEOUS SOLUTION OF COPPER IONS (i) A metal higher in the activity order can displace copper metal from a solution of copper ions. Note the solubility of hydrogen chloride. Warm the evaporating basin for 10 minutes. (a) Diffusion of heavy carbon dioxide gas upwards (i) Fill a jar with carbon dioxide and invert it over a similar jar full of air. Test the conductivity of the melt by dipping in the electrodes and waiting a few moments for the electrodes to reach the same temperature. The increase of temperature should be about 13oC. The iodine sublimes on to the cool sides of the funnel. the aluminium powder is a powerful reducing agent and converts the nitrate ion, NO_3^-, into ammonia gas, NH_3 Hydroxide ion ie an alkali OH^- (i) litmus or (ii) add ammonium salt (i) turns litmus blue, (ii) if strongly alkaline ammonia should be released. (d) Size of a molecule We select an oil molecule because it has a density less than the density of water. The equation for the reaction can be written as: $Na_2S_2O_3 (aq) + 2HCl(aq) \rightarrow H_2O (l) + SO_2 (g) + S(s)$ (c) TEMPERATURE AND RATE OF A REACTION Use the reaction in experiment 2.92 to investigate the effect of temperature. (ii) Repeat the experiment with the carbon dioxide in the lower jar and invert a jar of air on top of it. 8.SULPHUR DIOXIDE GAS Physical Properties Colour Colourless Odour Pungent odour Density compared to air (heavier or lighter) Heavier than air Chemical Properties Solubility in water Soluble. Immediately insert the bung with the delivery tube into the flask. dissolves in both excess sodium hydroxide and ammonia to give a clear colourless solution. The iron will rust and the water level will rise up inside the tube, finally becoming steady. Note whether vapour collects on the cooler parts, change of colour from blue to white, and any liquid collecting in the receiving tube. Note the temperature of the naphthalene when it melts. Tube 6: Wrap a piece of tin foil round part of the nail. To test whether unburned carbon gives the yellow colour to the flame, sprinkle powdered charcoal into the flame to see if this gives the same effect. The collecting test-tube must be cooled thoroughly with cold water, as the fumes are harmful. $Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$ (ii) Repeat the experiment by attempting to displace copper metal using powdered zinc and iron metal. Put a capillary tube, sealed at one end, into the inflammable liquid with the sealed end up and the open end down in the inflammable liquid. Note whether the blue colour restored and if any heat is given back. The salt can be recovered from the filtrate by warming the evaporation basin to drive off the water. Calculate the solubility of the sodium bicarbonate as g per 100 g water at room temperature. SEPARATION OF MIXTURES (b) Separate by distillation Put 10 mL ink in a flat bottom conical flask. Discard the first two or three test tubes of hydrogen, as they will contain displaced air. Investigate the effect of Universal Indicator on the solutions above. Be careful! This reaction produces hydrogen gas! Instead of collecting the gas in a balloon or plastic bag, a more accurate method would be to collect the gas in a burette inverted over water and compare the volume of gas given off in unit time for each grade of marble chips. (i) pH meter gives a value of more than 7, the higher the pH number the stronger the alkali, the higher the OH^- concentration, (ii) ammonia gas is evolved: $NH_4^+(aq) + OH^-(aq)$ $NH_3(g) + H_2O(l)$ TABLE 3: TESTS FOR CATIONS TEST FOR With aqueous sodium hydroxide Test with aqueous ammonia TEST CHEMISTRY Magnesium(Mg^{2+}) White ppt. Rules for the pH scale: Acid have a pH less than 7, The more acidic a solution, the lower the pH. When the glass tubing cools, drop seed crystals on its end until one catches in the smaller hole. with acidified barium chloride/nitrate because sulphites dissolve in acids. If the volume of the pipette is larger than the volume of the pipette bulb, you may need to remove the bulb from the pipette and squeeze it and replace it on the pipette a second time, to fill the pipette volume completely. (b) LIQUIDS THAT CONDUCT ELECTRICITY (i) First test liquids obtained by melting substances. The calorimeters shown here can determine the heat of a solution reaction at constant (atmospheric) pressure. (iv) Investigate whether hydrogen is lighter than air by "pouring" the gas into a test-tube held either above the first tube or below it. Calculate the increase in mass of the magnesium. (i) Top-loading Balance Use a top loading balance to weigh solid material when a precision of 0.1 g is adequate. Look for an inner cone of unburned gases. RATE OF REACTION (a) SIZE OF PARTICLES AND RATE OF REACTION Marble chips can be broken up with a hammer and graded into 3 or 4 sizes: (a) coarse powder; (b) pieces about half the size of a rice grain; (c) pieces as large as rice grains; and (d) the original lumps of marble chips. If the magnesium is taking oxygen from the carbon dioxide for burning then you would find carbon in the gas jar. Hold over a flame until the crystals melt. It will be seen that one fifth of the air volume has been used up, suggesting that oxygen has been used up in the rusting of iron. They appear to "melt". The marks will be awarded by comparing the candidate's results with the teacher's reports. To this mixture of acid and indicator, add a dilute base drop by drop, and count the drops. The lead bromide is melted in a 100 mL hard glass beaker, or in a crucible. Very gradually stir small crystals of common salt into the water. Every 4 seconds, raise the lid to allow more air to enter but do not allow any white magnesium oxide smoke to escape. This experiment could be used as an introduction to the processes of reduction and oxidation. Close the top of the tube with your finger and remove the tube gently, leaving the crystal in the beaker. Test the solution with an acid/base indicator. Test for unburned carbon particles in the flame. A significant proportion of marks for quantitative exercise will be awarded for accuracy. This is the Chemistry version of this practical handbook. Keep this crystal in place by dropping other crystals on it. Squeeze or grind one of the coloured flowers or leaves in a mortar with a mixture made of 2 mL acetone and 2 mL ethanol. (i) Only common alkaline gas and (ii) forms fine ammonium chloride crystals with HCl Chlorine gas Cl_2 [test (ii) on its own is no good, could be HCl] (i) blue litmus, (ii) drop silver nitrate on the end of a glass rod pungent green gas, (i) litmus turns red and then is bleached white, (ii) white precipitate (i) non-metal, is acid in aqueous solution and a powerful oxidising agent, (ii) forms chloride ion in water Nitrogen(IV) oxide (or nitrogen dioxide) NO_2 No simple relatively unambiguous test Reddish- brown gas Strong oxidising agent Water vapour H_2O (i) White anhydrous copper(II) sulphate, (ii) dry blue cobalt chloride paper (i) turns from white to blue, (ii) turns from blue to pink (i) Blue hydrated copper(II) crystals or solution formed, (ii) hydrated cobalt ion formed $[Co(H_2O)_6]^{2+}$ Hydrogen sulphide (i)Smell (ii)Burning splint (iii)Lead (II) ethanoate paper (i)'Bad eggs' (ii)Gas burns-sulphur deposits (iii)Turns brown-black TABLE 2: TEST FOR ANIONS TEST FOR TEST METHOD OBSERVATIONS TEST CHEMISTRY Carbonate ion CO_3^{2-} (or hydrogen carbonate HCO_3^-) add any dilute strong acid to the suspected carbonate – if colourless gas given off, test with limewater Fizzing – colourless gas – turns limewater milky cloudy carbonate/hydrogen carbonate + acid salt + water + carbon dioxide, then white precipitate with limewater. Heat the tube gently. Prepare the solution to be analysed by placing it in a clean Erlenmeyer flask or beaker. For this reason 2 or 3 mL of dilute sulphuric acid or dilute sodium sulphate solution is added to the water in the electrolysis cell. You will see the indicator change colour when the titrant hits the solution in the flask, but the colour change disappears upon stirring. Read the temperature of the water. Note any changes to the bulb as the salt dissolves. The electrodes are connected to a safe DC supply with a small bulb in series. 26.50cm3 26.25cm3 26.60cm3 26.65cm3 The candidate is expected to ignore the second titre and average the remaining three 26.50 + 26.60 + 26.65 = 26.583 this should be recorded as 26.60cm3 3 (to the nearest 0.05cm3) In general, a final should always be given to the same number of significant figures as is suggested in the exercise. Rinse the tip of the burette with water from a wash bottle and dry it carefully. Push tare button to zero the balance. Bring the water to the boil with a very small flame and read the thermometer. Before beginning a titration, you should always calculate the expected endpoint volume. (b) INCREASE IN MASS OF IRON DURING RUSTING Counterbalance a piece of iron on a knife-edge, using a brass weight or stone. Approximately 125 mm x 16 mm Boiling tubes, approximately 150 mm x 25 mm Stirring rod ACCURACY Unless a question instructs candidates differently they should assume that readings from equipment and apparatus ought to be made with the following precision: Burette readings should be to the nearest 0.05 cm3 Weighings should be made to 0.01 g or 0.001 g depending on the precision of the balance 0 to 1000C thermometers should be read to the nearest 0.50C and 0 to 500C thermometers to the nearest 0.20C Timers will normally be read to the nearest second. Estimate what fraction of oil was removed by the glass point by using the glass point to remove successive fractions from the drop until it has been used up. Hold the tube in the hand while crystallization occurs.

Aluminium(Al3+) White ppt. Add the 1 g of copper oxide. Two or three drops of suitable indicator are added to each of the conical flasks. The calorimeter is a double Styrofoam cup fitted with a plastic top in which there is a hole for a thermometer. Zn(s) + Cu2+(aq) –> Zn2+(aq) + Cu(s) (ii) Repeat the experiment with 0.5 g of iron powder or iron filings. Test the hot, soft part with the conductivity apparatus. 2.0 QUANTITATIVE ANALYSIS 2.1 Molar solutions and volumetric analysis. Take care that no drops of liquid are in the neck of the flask above the mark. To each test-tube add 1 g sodium chloride, attach a stopper and shake. Be careful not to turn on the heat or you will melt the Styrofoam. The metal ion solution might also give a flame colour or a hydroxide precipitate with sodium hydroxide e.g. copper. The scale he introduced was the pH scale. Replace the stopper, invert the bottle, and shake gently. Identify the liquid as water by its action of turning white anhydrous copper sulphate to blue hydrated copper sulphate. (h) Using a Calorimeter Solutions volumes should be carefully measured with a graduated cylinder. As you approach the endpoint, you may need to add a partial drop of titrant. Heat a thermometer and capillary tube in a beaker of water on a tripod. On heating, these crystals dissolve in some of their water of crystallization. Stir the inflammable liquid gently with the thermometer and read the thermometer when the inflammable liquid boils. Time the volume of oxygen given off at intervals of 15 seconds. Brian Yano | March 25, 2025 | Teachers' Resources | PRACTICAL CHEMISTRY GUIDE Introduction Scientific subjects are, by their nature, experimental. Put 2 nails in the water. This volumetric flask measures 500 mL ± 0.2 mL. Increase the voltage until the bulb lights, showing that a current is flowing. Calculate the boiling point as the average of the two readings. Close the ends of the tube with corks. Take an initial volume reading and record it in your notebook. Since most of the marks for these steps will be for a correct method rather than the numerical answer, it is important that candidates include their working even if this seems to be trivial. Start by squeezing the bulb in your preferred hand. (ii) Put about 10 mL of strong aqueous copper sulphate solution into a wide test-tube or small beaker. Carbon dioxide is a heavy gas and most balances will enable the loss in mass to be found as the gas escapes. Then add distilled water a drop at a time until the bottom of the meniscus lines up exactly with the mark on the neck of the flask. Sometimes it is easier to tell when you have gone past the endpoint. Read the temperature of the saturated solution. Again hold the wire in the flame, moving from the bottom to the top. Note any heat given out by the reaction. The method of collection illustrates that ammonia gas is lighter than air. Coarse rock salt causes less frothing than the fine salt. If the concentration of the acid is known, the concentration of the base can be estimated by comparing the numbers of drops of acid and drops of base that just react. Rather it seeks to help the candidate succeed in practical examination by explaining in more depth what is required of him or her in carrying out the exercises, making observations and measurements with appropriate precision and recording these methodically. CALCULATIONS Usually calculations will be structured. 7(a). (e) Electrolysis of solutions of ionic salts Most ionic salts can be used satisfactorily in electrolysis. QUALITATIVE ANALYSIS NOTES TABLE 1:TESTING FOR GASES TEST FOR TEST METHOD OBSERVATIONS TEST CHEMISTRY Hydrogen gas H2 Lighted splint Squeaky pop sound (might see condensation on test tube) 2H2(g) + O2(g) 2H2O(l) + energy Carbon dioxide gas CO2 Bubble into limewater (aqueous calcium hydroxide solution) Turns cloudy – fine milky white precipitate of calcium carbonate Ca(OH)2(aq) + CO2(g) CaCO3(s) + H2O(l) Oxygen gas O2 Glowing splint re-ignites it – flame C(in wood) + O2(g) CO2(g) Hydrogen chloride gas HCl (i) Damp blue litmus or (ii) Drop of silver nitrate on the end of a glass rod (i) Litmus turns red, (ii) White precipitate with silver nitrate (i) Litmus turns red, (ii) White precipitate with silver nitrate Sulphur dioxide gas SO2 Freshly made potassium dichromate (VI) paper Paper changes from orange to green The dichromate (VI) ion, Cr2O72-(aq) is reduced to the green Cr3+(aq) ion Ammonia gas NH3 Strong pungent odour, (i) red litmus, (ii) fumes conc. Do check the level indicator bubble before weighing. You can pull out the capillary tube from heated glass tubing. The mass of the sodium bicarbonate dissolved = w3 – w1. To do that, we must use values of relative atomic masses expressed on a periodic table. Note whether carbon deposits on a test-tube held in this flame. Record the highest temperature reached. PROCEDURE DURING TITRATION Titrations require continuous shaking of the conical flask and its contents. Put 5 mL of bench hydrochloric acid into each of the four balloons and slip the mouth of the balloon over the top of the tube without letting any acid into the tube. Use the burette to deliver a stream of titrant to within a couple of mL of your expected endpoint. Put powdered sulphur in a porcelain jar; ignite it and collecting the gas formed in a funnel. At the first sign of burning, place the lid on the crucible and remove the Bunsen burner. Alternatively, push a small plug of moistened iron wool to the bottom of the tube. Pencil leads are brittle, and if they are used it is better to fix the electrodes in the following way. Pour the hot water into the beaker so that the level is higher than the inflammable liquid in the test-tube. This rise of temperature in not affected by the volume of 0.2 M copper sulphate used for the experiment. The two rear balance feet serve as levelling screws. Add these pieces to the copper sulphate solution one at a time. Interpolate between the divisions of the thermometer and record temperatures to +/- 0.01 °C. Set up the burette filled with water as in a standard water displacement experiment. Rate of formation of hydrogen gas – very rapid, rapid, slight, very slight, none Metal (b) 3M hydrochloric acid (c) 3M sulphuric acid Magnesium (b) Very rapid (c) Rapid Aluminium (b) Slight (c) None Zinc (b) Moderate (c) Slight Iron (b) Very slight (c) Very slight Tin (b) None (c) None Lead (b) None (c) None Copper (b) None (c) None (ii) Recover the zinc after the reaction has ceased. (iii) Hydrogen burns in air to form water vapour. BREAKDOWN OF STARCH TO SUGAR FEHLING'S TEST FOR REDUCING SUGARS Starch can be recognized by the deep blue colour which develops when it is in contact with iodine solution. All metals conduct electricity. Fit a cork and tube into the flask as shown. The surface of the solid must first be cleaned. These are alkaline, or basic, substances. Footnotes: The lightest gas known. Repeat the experiment with a smaller concentration of thiosulphate. The difference between the initial and final burette readings gives the volume of the acid used commonly known as the titre. Gas cannot escape through the syringe so you do not need to cover the tube of the syringe with acid. The hydrogen bubbles will rise into the air, showing the low density of hydrogen gas. soluble in excess giving a colourless solution White ppt. Note any loss in mass due to the loss of water of crystallization. The sand will remain on the filter paper and may be dried and collected. These nails are in contact with water but not air. First heat the porous pot strongly and then gently warm the cotton wool to produce ethanol vapour. In this experiment the concentration of sodium thiosulphate is made variable, whilst the concentration of acid is kept constant. Needed by green plants during photosynthesis. Hold a piece of clean magnesium ribbon in a pair of tongs; ignite the magnesium with a Bunsen burner flame and plunge it into the carbon dioxide gas. Some colour changes of common indicators are shown below. If we are given the mass of a compound, we can determine the number of moles. We can find the density of a regular solid with a balance and ruler. (iii) Open the air hole again. Press the control bar to cancel out the weight of the container or paper. Note which part of the splint burns. Sorensen. When hydrogen ignites in a dry test-tube, note any vapour or mist on the sides of the test-tube. This experiment investigates the progress of this reaction. Fit a delivery tube to collect ethene gas over water. When dry, note the colours given by sodium bicarbonate solution, washing soda, limewater and a dilute solution of sodium hydroxide. Into the core of this screening wire insert the pencil lead securely. When cool, weigh the crucible plus lid plus contents. Attach the stopper then shake each test-tube vigorously for the same time to show that solubility is a characteristic of a particular substance, e.g. sugar, common salt, potassium nitrate, calcium sulphate. Insert the copper wire into the hole from above and pull it right through the stopper until the screening wire is also pulled a little way into the hole. (d) Pipette A pipette is used to measure small amounts of solution very accurately. The fact that bromine appears only at the positive electrode helps in the understanding of the existence of a negative bromide ion. Fix steel wool into a loop in the lower end of the Nichrome wire. For example if temperature readings between 210C and 280C are plotted, there is no need to begin the axes at zero. The smallest should give the carbon dioxide in the shortest time. Note any change in the zinc oxide. Keep these coloured solutions for use as "indicators" in the next experiment. Using carbon electrodes, the following results will be found. When this happens, cut out the bulb from the circuit by closing the switch, as shown. (c) DISPLACEMENT OF HYDROGEN FROM ACIDS BY METALS (i) Pour 5 cm of the acids in the table below into test-tubes. Metal ion Symbol Flame colour Lithium Li+ Scarlet Sodium Na+ Yellow Potassium K+ Lilac Calcium Ca2+ Brick red Strontium Sr2+ Crimson Barium Ba2+ Apple green TABLE 7: HEAT ANALYSIS Observation on heating Conclusion Water vapour / steam evolved, turning cobalt chloride paper pink Crystals contain water of crystallization, or the solid is a hydroxide which decomposes Colourless gas evolved which relights a glowing splint Oxygen from a nitrate of potassium or sodium Brown gas evolved and a glowing splint relights Nitrogen dioxide and oxygen from the decomposition of a nitrate Gas given off which turns limewater cloudy Carbon dioxide from the decomposition of a carbonate Pungent gas evolved which turns acid dichromate paper from orange to green Sulphur dioxide from the decomposition of a sulphate Sublimate forms on cool part of the tube Likely to be an ammonium salt. You could distinguish Mg2+ from Ca2+ with a flame test Calcium (Ca2+) White ppt. Instead of using marble chips you can use granulated zinc. Again add water to the beaker until the levels inside and outside the tube are the same and mark the new level. Be careful! Sodium sinks in the kerosene and float in the water. Crystals may not form unless you drop a tiny seed crystal of sodium thiosulphate into the solution. Use this concentration for the series of experiments with the temperature of the solution as the variable. Alkaline or basic solutions have a pH value greater than 7. Heat a glass rod until it becomes very hot and begins to soften. Impurities lower the melting point. (b) REACTION OF SODIUM WITH WATER (i) A very safe way of demonstrating the reaction of sodium and water is to drop a very small piece of sodium into a swimming pool. When your burette is conditioned and filled, with no air bubbles or leaks, take an initial volume reading. QUALITATIVE ANALYSIS Qualitative analysis is mainly about identification of substances. (ii) Put some of the original filtrate on to another piece of filter paper. (b) Weigh this fat and then weigh out about one third as much sodium hydroxide pellets. Leave this for a few days. Use the beaker lip to support the tube. Heat gently until all the crystals have dissolved. A small area of the sodium suddenly reacts causing a stream of bubbles to appear. To each test-tube add iodine crystals, attach a stopper and shake. The residual gas does not support combustion of a lighted splint. An air flow over the solution surface given by a fan will also hasten crystal growth. The experiment is repeated for each of the other conical flask, to try to obtain the end point accurately. When you put oil on the water, it pushes the powder aside so you can easily see the area covered by the oil. (Where clocks are specified, candidates may use their own wristwatch if they prefer) Wash bottle Test tubes (some of which should be Pyrex or hard glass). The magnesium continues to burn. Repeat the experiment using the other oxides as catalysts. Also used as the atmosphere in rooms where explosives are stored. (d) PREPARE SULPHUR DIOXIDE Do the following preparations in a fume cupboard. COLOUR CHANGE POSSIBLE HYDRATED SALT Blue to white Copper (II) sulphate Blue to black Copper (II) nitrate Pale green to brown Iron (II) salts TABLE 10: RESIDUE WHEN HOT AND COLD Residue remaining after ignition may have a different colour when hot and cold APPEARANCE OF RESIDUE POSSIBLE IDENTITY HOT COLD White Yellow Zinc Oxide Yellow Red Lead(II)Oxide Brown Black Iron (III)Oxide Sublimes – Ammonium salt TABLE 11: HEATING A SOLID Gases or vapours may be evolved during heating of the solid GAS OR VAPOUR POSSIBLE SOURCE Carbon dioxide Carbonates of metals other than Group 1 or Hydrogen carbonates of group 1 Ammonia Ammonium salts Oxygen alone Group 1 nitrates Oxygen and nitrogen dioxide Nitrates (other than Na or K) Hydrogen chloride Hydrated chloride or ammonium chloride Water Hydrated salts TABLE 12: SOLUBILITY Soluble Insoluble Sodium salts All are soluble None Potassium salts All are soluble None Ammonium salts All are soluble None Chlorides Most are soluble Silver chloride, lead (II) chloride Nitrates All are soluble None Sulphates Most are soluble Barium sulphate, lead (II) sulphate, calcium sulphate Ethanoates All are soluble None Carbonates Sodium, potassium and ammonium carbonates Most are insoluble KEY Ppt = precipitate Sol = solution Insol = insoluble Xs = excess Dil = dilute 1.HYDROGEN CHLORIDE Physical Properties Colour Colourless Odour Pungent odour Poisonous Density compared to air (heavier or lighter) Heavier than air. (ii) Use a very small test-tube or seal one end of a piece of glass tubing, 8 cm length and 3 cm external diameter. The colour of the dissolving crystal will spread throughout the water in quite a short time. White precipitate of silver chloride soluble in dilute ammonia. (a) REACTIONS THAT GIVE OUT HEAT ENERGY Be careful! The reaction is vigorous so do not do the experiment in a stoppered bottle! (i) Put white anhydrous copper sulphate powder to a depth of about 1 cm in a test-tube. All substances should be regarded as being potentially toxic and hazardous. (ii) Fill a very small open bottle with a strong solution of potassium permanganate, potassium manganate (VII). All other metal oxides and hydroxides Salts All nitrates All chlorides except All sulphates except Carbonates of Sodium and potassium Silver chloride and lead chloride (lead chloride is soluble in hot water) Barium sulphate and lead sulphate; calcium sulphate is slightly soluble All other carbonates TABLE 9: GENERAL PRELIMINARY TESTS COLOUR POSSIBLE IONS IN SALT Blue Copper(II) Pale green Iron(II) Green Copper(II) Brown Iron(III) TABLE 10 : IGNITION ANALYSIS Candidates may be asked to heat an unknown alone in an ignition tube. Shake the mixture thoroughly in a closed container then run it into the separating funnel. Melt the following substances, but heat very gently and cautiously because otherwise they may ignite and burn: sulphur, wax, naphthalene, polyethylene material, tin, lead and, if available, a low melting point salt such as lead bromide, m.p. 488oC, or potassium iodide, m.p. 682oC . During the reaction the ions have lost this heat, which we have gained. Fill a jar (with a screw-on lid) with a solution of the salt less than saturation strength before you put the seed crystal in position. The display lights up for several seconds, then resets to 0.0000. The difference in the two readings is the volume of the solid. Candidates should indicate at what stage a change occurs, writing any deductions alongside the observations on which they are based. The list is not intended to be exhaustive: in particular, items (such as Bunsen burners, tripods) that are commonly regarded as standard equipment in a chemical laboratory are not included in this list. Wash the test-tube with water and add this to the filter paper. Test the gas bubbles for oxygen or hydrogen. insoluble in excess Mg2+(aq) + 2OH–(aq) Mg (OH)2(s) white ppt. (c) Grow large crystals (i) Use a 0.5 – 0.8 cm long seed crystal to start growing large crystals. This prevents combustion since carbon dioxide does not support it and the presence of carbon dioxide stops oxygen reaching the combustible material. It reacts with water to form hydrochloric acid. Repeat the experiment, each time warming the thiosulphate solution to just over 30oC (c) CATAL YSTS AND RATE OF REACTION The variable in this reaction is the substance used as a catalyst in the decomposition of an aqueous solution of hydrogen peroxide. Bench dilute acid is usually of this strength. The potential or voltage will reflect the greater activity of zinc over copper. A similar result can be obtained by using potassium chloride instead. Hold a test-tube with its bottom end just above the flame. Make sure you know what the endpoint should look like. Saliva contains enzyme catalysts, which convert starch to sugar. Before recording the mass, close the glass doors and wait until the stability detector lamp goes out. Move your eye to the level of the mark on the neck of the flask and line it up so that the circle around the neck looks like a line, not an ellipse. Place the beaker on a black cross marked on a sheet of paper. If the flame is extinguished at the entrance as at (ii), then the jar is full. Deliver solution to the titration flask by turning the stopcock. The only ions present in this melt are the bromide and lead ions. soluble in excess giving a colourless solution Zinc ion: Zn2+(aq) + 2OH–(aq) Zn(OH)2(s) white ppt. Sodium chloride gives hydrogen gas at the cathode and chlorine gas at the anode. Universal indicator papers that are sensitive over the full range of values can be used. The volume of oil put on the water can be calculated and an estimate made of the thickness of the oil layer, about 10-6 mm. The electrodes should project about 2 cm into the cylinder and also 2 cm below for attaching the leads to the battery. (b) Plant extracts to indicate whether a substance is acidic or basic (i) Put a spot of the coloured flower extract on to a filter paper and leave to dry. Obtain four balloons and blow them up several times to stretch them. Connect copper foil to the positive terminal of a 5 V voltmeter. Allow one more drop to fall on a piece of plastic. Stir the acid into the solution. Yeast cells do the same thing in bread making, though this takes longer. Used in light bulbs and thermometers because it is not reactive. The electrodes may be carbon rods from a dry cell or pencil leads. Hazard labels (e.g. flammable) should be read and appropriate precautions (e.g. keep liquid away from flame) taken. You can watch the reaction through a hand lens held at the side, but never at the top. It is important that when candidates record reading they include the appropriate number of decimal places. This is a very sensitive test. As nearly as possible at the same time, put the ammonia cotton wool at one end of the tube and the acid cotton wool at the other. The temperature change is usually between 9oC and 10oC. Decant off the molten lead bromide carefully into another crucible. This procedure is repeated with the other electrode. 2 M hydrochloric acid is also needed. Gently heat the test-tube. (b) Solubility of a substance in water at a given temperature Put about 50 cm3 of water in a beaker and add baking powder, sodium bicarbonate, gradually while stirring. (v) Dip the loop in the lower end of the Nichrome wire into sulphur powder. Alternatively, carbon dioxide can be collected by displacing air from dry bottles. strong – red, weak – yellow/orange, (ii) fizzing with any carbonate – test for CO2 as above (i) PH meter gives a value of less than 7, the lower the pH number the stronger the acid, the higher the H+ concentration, (ii) HCO3–(aq) + H+(aq) H2O(l) + CO2(g) Ammonium ion NH4+ no smell at first, add COLD sodium hydroxide solution to the suspected ammonium salt and test any gas with red litmus Smelly ammonia evolved and red litmus turns blue Ammonia gas is evolved: NH4+(aq) + OH–(aq) NH3(g) + H2O(l) TABLE 6. The mass of water = w2 – w1 – w3. The degree of cloudiness in this case may be defined as the point at which a black cross marked below the reaction vessel can no longer be seen by looking through the solution from above. The bulb does not light up so pure water does not conduct electricity. Remove the cork from one of these test tubes under water. Note whether carbon dioxide forms when you put sodium bicarbonate into water. After the 30 minutes boiling, stir this salt well into the mixture. These nails are in contact with air, but not moisture. The first titration usually gives and approximate end point and is treated as the trial. It is then dipped into salt powder and introduced into a colourless Bunsen burner flame. Invert the test-tube in a beaker about one third full of water. Used to make bleaching powder, disinfectants and antiseptics Also used to make some explosives, poison gases and pesticides. Use the thermometer to stir the water but do not let water enter the capillary tube. Practice this with water until you are able to use the pipette and bulb consistently and accurately. Answers should include details of colour changes and precipitates formed and the names and chemical tests for any gases evolved. Test for increasing amounts of sugar at the same time as testing for starch. When titres have to be averaged, it is important that the mean is expressed to either the nearest 0.05cm3 or to the second decimal point. The gas from the generator is passed through a jar containing the plant, and excess gas is absorbed in water. The display will again read 0.0000. Sodium chloride dissolves readily in water but not so readily in alcohol DETERMINATION OF DENSITY 9(a) Density of a solid The density of a solid is the ratio of mass to volume. Make a saturated solution by stirring until no more solute will dissolve. (ii) Fill two test-tubes one third full with (a) 88g water and (b) a solution of 1 g potassium iodide in 5 mL water. (e) Volumetric Flask A volumetric flask is used to make up a solution of fixed volume very accurately. Note whether non-metallic solids, e.g. plastics, naphthalene, wax, sugar, sodium chloride and sulphur, conduct electricity. Lead bromide has a low melting point and makes an interesting electrolysis experiment. Put the crucible on a pipe clay triangle supported on a tripod. Add 3 mL of Fehling's solution and warm this mixture almost to boiling point. Pure hydrogen burns with a quiet "pop" sound. Within experimental error, it will always take the same number of drops to neutralize the 20 drops of acid provided that the same dropper is used. Put a piece of magnesium ribbon in the solution. Put the nail in the test-tube and add tap water as you did for tube 5. Allow the fat and the sodium hydroxide to boil for 30 minutes. Add one drop of indicator; either methyl orange or phenolphthalein is satisfactory. Put the nail in the test-tube and almost cover with tap water. 1.1APPARATUS IN A CHEMISTRY LABORATORY 1.2 SPECIAL LABORATORY APPARATUS AND TECHNIQUES (a) USING THE BURETTE Hot Downloads!! 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Using a measuring cylinder, put 50 mL of thiosulphate solution into a 100 mL beaker. soluble in excess giving a deep-blue solution TABLE 4: ORGANIC TESTS TEST FOR TEST METHOD OBSERVATIONS TEST CHEMISTRY ALKENE or alkyne any other non-aromatic unsaturated hydrocarbons bubble gas through, or add liquid to, a solution of bromine in hexane or water the orange/brown bromine, decolourises, as a saturated colourless organic bromo-compound is formed (saturated alkanes give no fast reaction with bromine) R2C=CR2 + Br2 BrR2C-CR2Br Colourless Hydroxy group R-OH in alcohols (in 'dry' conditions) Mix it with a few drops of ethanoyl chloride, test fumes with litmus and silver nitrate Litmus turns red and a white precipitate with silver nitrate, if the mixture is poured into water you may detect a 'pleasant' ester odour, can test for HCl but water and amines produce it too! R-OH + CH3COCl CH3COOR + HCl An ester and hydrogen chloride are formed Carboxylic acids RCOOH Mix with water and add a little sodium hydrogencarbonate solid or solution Fizzing, colourless gas gives white precipitate with limewater RCOOH + NaHCO3 RCOONa + H2O + CO2 TABLE 5: MISCELLANEOUS TESTS TEST FOR TEST METHOD OBSERVATIONS TEST CHEMISTRY Lead (II) ion Add potassium iodide solution yellow precipitate Yellow precipitate Pb2+(aq) +2I–(aq) PbI2(s) lead(II) iodide ppt. View the crystals through Polaroid filters. Ignite the sulphur powder in a Bunsen burner flame and then insert it quickly into another test-tube of oxygen. Metal Carbonates Sometimes heating a metal carbonate strongly to decompose it provides some clues to its identity. Put the inflammable liquid into this tube. The cylinder has a 2-hole rubber stopper carrying two carbon electrodes with connecting leads to a battery, or DC supply of 4 to 6 volts. Hold a piece of glass tubing with one end in the inner cone then ignite the gas that comes out of the other end. Carbon conducts electricity. An alternative to the thistle funnel at A is a syringe as shown at B. (c) Separate salt and sand Prepare a mixture of salt and sand. Measurement of temperature based on a thermometer with 10C graduations. CRYSTALS (a) Crystal growth Sodium thiosulphate crystals grow rapidly from a super-saturated aqueous solution. After a few moments separate the jars, pour a little lime water in the lower one and shake it. Largest online Education web site in Sri Lanka provides Past papers, Model papers, School papers, Campus papers, Marking schemes, Notes, Career guide for school leavers and lot more Articles.We're mainly focused for G.C.E. Advanced Level (A/L) Science & Maths Education.Let your support continue to take this service to the students. Place a container or large, creased weighing paper on the balance pan. The catalyst is not used up during the reaction. A pipette bulb is used to draw solution into the pipette. If we know the original volume of oil and the surface area that it forms, then we can calculate the thickness of a monomolecular layer dividing the volume by the area. When molten, glass is a good conductor of electricity. (b) Crystals of naphthalene grow from the melt Put a little naphthalene on a glass slide. 4.HYDROGEN CHLORIDE GAS Physical Properties Colour Colourless Odour Pungent odour Poisonous Density compared to air (heavier or lighter) Heavier than air. Clean 25 cm of magnesium ribbon and cut into 1 cm pieces. Or, if the masses of chemicals reacting together are known then amounts can be calculated and the balancing numbers deduced from the amounts reacting together. (c) Effect of heat on copper sulphate crystals Crush blue copper sulphate crystals and put them into a dry test-tube to a depth of 4 cm. Stop heating. Heat very gently then strongly. Note any change in the potassium permanganate crystals. Classify substances into the following groups: (a) those which conduct electricity in the solid state and those which do not; (b) those which conduct in the liquid state and those which do not; (c) those which conduct when dissolved in water and those which do not (c) ELECTROLYSIS OF LEAD BROMIDE There are very few suitable low melting point salts. Look for carbon specks in the gas jar. Put pieces of Perspex or polystyrene in a hard glass test-tube. GENERAL EXPERIMENTAL PROCESSES Quantitative Transfer Quantitative Transfer simply means that all the material to be transferred from one place to another must make the trip. Note the maximum reading. The temperature should fall through 90oC. Add 5 mL of acid as before and record the initial time and the temperature of the solution. The question will however instruct the candidate which axes to use for each quantity being plotted. FLAME TESTS A tungsten wire loop is first dipped into some concentrated hydrochloric acid to dissolve any oxides and hence clean the wire. Put a thermometer into the test-tube with the bulb in the liquid. It reacts with water to form a strong acid. When completing the table of results, you will be expected to complete all columns as accurately as the as the limits of the apparatus can allow e.g. burette used is usually read to the nearest 0.05 cm 3, pipette is accurate to 0.05 cm 3 (1 drop). Turn the crystal regularly so that growth on all faces is equal. Put a magnetic stirrer in the flask and add indicator. Burning Does not support combustion Moist pH paper Acidic reaction Red rose petals Are bleached and lose their colour Specific test None Footnotes: It is used as a bleaching agent. This is a reversible change. Lead has both a lower melting point and a greater density than lead bromide and therefore appears as a melt at the bottom of the beaker. This expands the pastry, cake or dough, making it light and pleasant to eat. [Ar values: K = 39, Br = 80] Moles = mass / formula mass, (KBr = 39 + 80 = 119) mol KBr = 5.95/119 = 0.05 mol 400 cm3 = 400/1000 = 0.4 dm3 molarity = moles of solute / volume of solution molarity of KBr solution = 0.05/0.4 = 0.125M 2.3 Volumetric calculations (acid-alkali titrations) Chemical Equations These balancing numbers have an additional meaning where these amount calculations are concerned. Heating must be carefully controlled to enable all the fumes to be condensed in the receiving tube. Be sure the transfer pipette is dry or conditioned with the titrant, so the concentration of solution will not be changed. Used in fire extinguishers since it is heavier than air and forms a "blanket" around the fire. (ii) Close the air hole. During rusting, metallic ion changes to Fe (OH) 3.xH2O. You can preserve large crystals by painting with a clear varnish. Laboratory overalls are recommended. Find the volume of fifty drops by running oil from the burette drop by drop and counting the drops. To test whether the test-tube contains oxygen, light a splint of dry wood, blow out the flame leaving a glowing splint then put the glowing splint in a test-tube of oxygen. (c) HEAT OF A NEUTRALIZATION REACTION Dissolve 40 g of sodium hydroxide pellets in water and make up to 500 mL. An acidic solution turns blue litmus red. Slight smoke where the hot sodium is above the kerosene level suggests a slight reaction with air. When the temperature rises, bubbles slowly come out of the capillary tube. The enzyme in the saliva is therefore slowly breaking starch down into sugar, which is a smaller molecule. Then crystal growth commences and spreads rapidly through the whole solution. You can do this with a rapid spin of a Teflon stopcock or by partially opening the stopcock and rinsing the partial drop into the flask with a wash bottle. A temperature of reading of exactly 350C should be recorded as 35.50C. For more accurate mass measurements or small amounts, use an analytical balance. Candidates will be led through a series of steps leading to a final value. Melt the fat again and strain through several layers of cloth. The endpoint should be approached slowly, a drop at a time. Rainwater is slightly acidic because carbon dioxide dissolves in it. Product of respiration in living things. Chemical Properties Solubility in water Insoluble Burning Explodes when a burning match is placed into it. Potassium iodide gives iodine at the anode and hydrogen gas at the cathode. Filter and collect the filtrate. Most of it reacts with water to form acids. Carefully evaporate the solution in the evaporating dish to dryness and weigh again, w3. A known volume of the alkali is transferred using a pipette into four separate conical flasks. Dissolve the colourless zinc sulphate crystals in water and put two carbon electrodes (central poles of dry cell batteries) in the solution. To condition a piece of glassware, rinse it so that all surfaces are coated with solution, then drain. You can collect hydrogen chloride gas by upward displacement of air, as in the diagram. Examples of indicators include; Methyl orange Phenolphthalein Methyl red Bromothymol blue The pH scale A much more useful measure of the strength of an acid solution was worked out by the Danish biochemist S. The formula for the crystals is Na2S2O3.10H2O. In qualitative analysis exercises, candidates should use approximately 1cm depth of a solution (1-2cm3) for each test and add reagents slowly, ensuring good mixing, until no further change is seen. Starch does not react with Fehling's solution. Read the temperature. Plot the volume of oxygen produced every 15 seconds against the time of the reaction. The soap separates as a layer at the top. Put water in a test-tube and hold a thermometer with the bulb just under the water. 13 COLOURED EXTRACTS FROM FLOWERS AS INDICATORS OF ACIDS AND BASES (a) Extract coloured substances from plants Select brightly coloured flowers, such as the purple and red bougainvillaea, or coloured leaves. The products will be gaseous, or metals which are deposited on the negative electrode. Concentration values may be taken as the volume of the original thiosulphate solution used. Connect a water pump to the sidearm or to the second hole of the 2-hole stopper. This energy has been taken from the surrounding water in the form of heat. Wait for the green dot on the left to go out. Weigh out 1 g each of copper (II) oxide, nickel oxide, manganese (lV) oxide and zinc oxide. Add 20 mL of acetone or methylated spirits. Make up 500 mL of aqueous solution containing 20 g sodium thiosulphate. (iv) Fix a small piece of charcoal into the loop in the lower end of the Nichrome wire. The material contained in this booklet does not extend the curriculum specification content. To do this, put 2 or 3 drops of the reaction mixture into a small test-tube. Add solution completely, to a dry calorimeter. insoluble in excess Iron(II) (Fe2+) Green ppt. Then pull the screening wire with the lead further into the stopper so that the lead electrode is firmly held in the stopper. Burning Does not support combustion Moist pH paper Acidic reaction Red rose petals No reaction Specific test It will fume in moist air Footnotes: Dilute hydrochloric acid is one of the three common dilute acids used in the laboratory. Solubility in water Test different salts taken to show that each has a different solubility in water. The axes must be clearly labelled with the quantity being plotted e.g. mass and its units e.g. kilograms The points plotted may be joined with a straight line or a smooth curve. All substances spilled on the skin should be rinsed off immediately. Discard any disposable tare containers or weighing paper, in the nearest wastebasket. Moist pH paper No reaction Red rose petals No reaction Specific test A lighted match will produce a "squeak" sound. Note: sulphites do not give ppt. Dip the two metals briefly into the copper sulphate solution. Discard any disposable tare containers or weighing paper in the nearest wastebasket. Put a little Vaseline or a few drops of olive oil on the surface of the hot water. (d) ELECTROLYSIS In aqueous solutions there are usually four ions present, two from the water and two from the dissolved salt. Put a cover slip over the liquid and allow to cool.