10th class physics textbook pdf ssc telangana

Telangana SCERT Class 10 Physical Sciences Solution : Here in this page we provides Telangana State Class 10 Physical Sciences full book Solution Chapter-wise. Students of Telangana Board can get here Class 10 Physical Sciences (Physics & Chemistry) Textbook Exercise Solution. Telangana Board Class 10 Physical Sciences Solution: Board Telangana SCERT Class 10 Subject Physical Sciences Topic Question Answers Telangana State Board Class 10 Physical Sciences Chapter-wise Solution: 1. iFreedistributionbyA.P.Government Sri M. Ramabrahmam, Lecturer, Govt.IASE,Masabtank, Hyderabad. Prof. Kamal Mahendroo, Vidya Bhavan Educational Resource Centre, Udaipur,Rajasthan. Dr.TVSRamesh, Co-ordinator, C&T Dept., SCERT,AP,Hyderabad. Miss. Preeti Misra, VidyaBhavanEducationalResourceCentre, Udaipur,Rajasthan. Co-ordinators Academic Support Editors Published by the Government ofAndhra Pradesh, Hyderbad. Respect the Law Get the Rights Grow by Education Behave Humbly PHYSICAL SCIENCEPHYSICAL SCIENCEPHYSICAL SCIENCEPHYSICAL SCIENCEPHYSICAL SCIENCE CLASS X Dr.B. Krishnarajulu Naidu, Retd., Professor of Physics Osmania University, Hyderabad. Dr.M.Adinarayana, Retd., Professor of Chemistry Osmania University, Hyderabad. Dr. M. Salagram Retd., Professor of Physics Osmania University, Hyderabad. Dr. K.Venkateswara Rao Retd., Reader in Chemistry New Science College, Hyderabad. Dr. N. UpendarReddy, Professor & Head C&T Dept., SCERT.,A.P.,Hyderabad. Dr. C.V. Sarveswara Sharma Retd., Reader in Physics Amalapuram. 2. ii © Government ofAndhra Pradesh, Hyderabad. New Edition First Published 2014 Allrightsreserved. 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Nellore, Chittoor. Sri S. Brahmananda Reddy, SA, ZPHS Immadicheruvu, Prakasam. Sri S.U. Siva Ram Prasad, SA, GBHSSultanBazar,Hyderabad. Sri K.V.K. Srikanth,SA, GTWAHSS.L.Puram,Srikakulam. Sri M. Eswara Rao, SA, GHS Sompeta, Srikakulam Sri K. Gagan Kumar, SA, ZPHSMirzapur,Nizamabad. Text Book Development Committee Writers Cover page, Graphics & Designing Sri G. Gopal Reddy, Director, S.C.E.R.T.,A.P.,Hyderabad. Sri B. Sudhakar, Director, Govt. Textbook printing press, A.P.,Hyderabad. Dr. N. UpendarReddy, Professor & Head C&T Dept., S.C.E.R.T.,A.P.,Hyderabad. Sri M. Ramabrahmam, Lecturer, Govt.IASE,Masabtank,Hyderabad. Sri K. Sudhakara Chary, SGT, UPS Neelikurthy, Warangal. Sri Kurra Suresh Babu, B.Tech, MA., MPhill. Mana Media Graphics, Hyderabad. Sri Kishan Thatoju, Graphic Designer, C&TDept.,SCERT,AP,Hyderabad. 4. iv Intro ... We believe that class-10 education is a key aspect of school education and a turning point in student's life. The present tenth class Science textbook in your hands is developed in accordance with the National and State Curriculum Framework and the Right to Education Act. This book helps the student to review various concepts that were learned through the learning experiences provided in the school and to get comprehensive knowledge about these conecepts. The lessons in the textbooks are presented in such way that they help in preparing the student for competitive examinations and also to prepare him/her for intermediate education. The new science textbooks are specially designed with suitable pedagogy in tune with Continuous Comprehensive Evaluation (CCE) which we are right now implementing in school education. These textbooks help the teacher to assess students learning during teaching learning processes. They facilitate effective learning of various concepts of science in scientific method apart from getting knowledge about concepts. It is essential to complete the syllabus in the stipulated time as students have to write the Board Examination in class-10. But don't forget that completion of syllabus means making the students understand the concepts and trying to achieve the learning competencies. It is mandatory on the part of teacher to implement teaching strategies like, making the student to read the content of the textbook, discussion, analysis, lab activity, field trips, preparing reports, etc. Teacher must take special care to avoid the practice of rote memorisation of scientific information from guides and question banks. The classroom teaching of science must be in such a way that it encourages children to think and work scientifically. Also, it must enhance love towards nature. Even it should enable to comprehend and appreciate the laws governing the nature in constructing so much diversity all around. Scientific learning is not just disclosing new things. It is also necessary to step forward without interrupting the interrelationship and interdependency along with understanding of the nature's intrinsic principles.High School children possess cognitive capacity of comprehending the nature and characteristics of the transforming world surrounding them. And they are able to analyze abstract concepts. At this level, we cannot quench their sharp thinking capability with the dryteaching of mere equations and theoretic principles. For that, we should create a learning environment in the classroom which provides an opportunity for them to apply the scientific knowledge, explore multiple alternatives in solving problems and establish new relations. Scientific learning is not just confined to the four walls of classroom. It has a definite connection to lab and field as well. Therefore, there is a lot of importance to field experience/ experiments in science teaching. 5. vFreedistributionbyA.P.Government There is a great need for compulsory implementation of instructions of the National Curriculum Framework- 2005 which emphasizes linking of the science teaching with local environment. The Right to Education Act- 2009 also suggested that priority should be given to the achievement of learning competencies among children. Likewise, science teaching should be in such a way that it would help cultivate a new generation with scientific thinking. The key aspect of science teaching is to make the children understand the thinking process of scientists and their efforts behind each discovery. The State Curriculum Framework- 2011 stated thatchildren should be able to express their own ideas and opinions on various aspects. These Science Text Books are prepared to meet the set standards of the SCF and thus assist children in becoming self- reliant researchers capable of thinking intensely in scientific terms. The new textbooks are developed to achieve desired academic standards. So teachers should develop various teaching learning strategies to make their students to achieve class specific academic standards. We should avoid rote learning methods for the successful implementation of Continuous Comprehensive Evaluation (CCE). It is very impart to know more about different methods to assess students' progress by summative and formative evaluation. The new textbooks reflect Continuous Comprehensive Evaluation and teaching method with respect to discussed concepts. This is very useful to teachers and students. In the new textbooks, the design of concepts and activities help in achieving the specified academic standards. Teachers need to plan appropriate teaching strategies to improve the academic standards among the students by the end of teaching the lesson. For effective implementation of continuous comprehensive evaluation the teaching must move away from the methods of rote memorisation of concepts. There is a need for teachers to have a good understanding of the methods of evaluation which help them in assessing the progress of children in a constructive and comprehensive way. The new textbooks are not confined to simply provide necessary informations about concepts. Instead they focus on the new teaching strategies and evaluation techniques which are very important for both teachers and students. We thank the VidyaBhavan Society, Rajasthan for their cooperation in designing these new text books,the writers for preparing the lessons, the editors for checking the textual matters and the DTP group for cutely composing the textbook. We invite suggestions from educationists, teachers, parents, students and others to make this book more meaningful. Teachers play a pivotal role in children's comprehensive use of the text book. We hope, teachers will make their best efforts for proper utilization of the text book so as to inculcate scientific thinking among children and inspire them to be great scientists. Director, SCERT, AP, Hyderabad 6. vi Dear teachers... NewScienceTextBooksarepreparedinsuchawaythattheydevelopchildren'sobservation powerandresearchenthusiasm.Theofficialdocumentsof NationalandStateCurriculumFrame Works and the Right to EducationAct are aspairing to bring grossroute changes in science teaching. These textbooks are adopted in accordance with such an aspiration. Hence, science teachers need to adapt to the new approach in their teaching. In view of this, let us observe certain Dos and Don'ts: • Thereisanimmediateneedtodiscardthepracticesadoptedintheschoolsonafalsebelief that teaching of 10th class means preparing the children for public examination. In 10th classtheteachinglearningprocessshouldfocusonachievingtheacademicstandardsrather winningraceofscoringmarks. • Avoid practices like using guides and question banks, asking the children to read only importantquestions,focussingonlessonswhichhelpinscoringmoremarks. • Readthelessonthoroughlybeforeyoustartteachingandaskthechildrentoreadthetext. Theninitiateadiscussiontomakethechildrenunderstandtheconceptsinthelessons. • Encouragechildrentoexpresstheirownviewsandideaswhilewritingtheanswers.Give weightagetosuchtypeofwritinginexamination. • Someinstructionsaregiveninthetextbookregardingthecollectionofcertaininformation bytheteacher.Collectsuchinformationandmakeitavailabletostudents. • In public examination, the weightage will be given to all aspects of the syllabus. Except foreword of the textbook everything else must be treated as a part of the curriculum. • Textual concepts are presented in two ways: one as the classroom teaching and the other as the laboratory performance. • Labactivitiesarepartandparcelofalesson.So,teachersmustmakethechildrenconduct allsuchactivitiesduringthelessonitself,butnotseparately. • Teachersareadvisedtofollowthefollowingteachingstepswhiletransactinglessons-mind mapping, reading lesson and identifyng new words by children, performing activities, demonstrationanddiscussion,conclusionandevaluation. • Inthetext,somespecialactivitiesarepresentedasboxitems:'thinkanddiscuss,letusdo, conductinterview,preparereport,displayinwallmagazine,participateinTheatreDay,do fieldobservation,organizespecialdays'.Toperformallofthemiscompulsory. • The abbreviation (A.S.) given at the end of each question in the section "Improve your learning"indicatesacademicstandard. • Collectinformationofrelevantwebsiteaddressesandpassontostudentssothattheycan utilizeinternetservicesforlearningscienceontheirown. • Planandexecuteactivitieslikescienceclub,elocution,drawing,writingpoetryonscience, making models etc.to develop positive attitude among children about environment, biodiversity,ecologicalbalanceetc. 7. viiFreedistributionbyA.P.Government • As a part of continuous comprehensive evaluation, observe and record children's learningabilitiesduringvariousactivitiesconductedinclassroom,laboratoryandfield. Webelieve,youmusthaverealizedthatthelearningofscienceandscientificthinkingare not mere drilling of the lessons but, in fact, a valuable exercise in motivating the children to exploreforsolutionstotheproblemssystematicallyandpreparingthemtomeetlife'sschallenges properly. Dear Students... Learning science does not mean scoring good marks in the subject. Competencies like thinkinglogicallyandworkingsystematically,learnedthroughit, havetobepracticedindaily life.Toachievethis,insteadofmemorizingthescientifictheoriesbyrote,onemustbeableto studythemanalytically.Thatmeans,inordertounderstandtheconceptsofscience,youneed toproceedbydiscussing,describing,conductingexperimentstoverify,makingobservations, confirmingwithyourownideasanddrawingconclusions.Thistextbookhelpsyoutolearnin thatway. What you need to do to achieve such things: • In 10th class the range of concepts is wide. So go through each lesson thoroughly beforetheteacheractuallydealswithit. • Note down the points you came across so that you can grasp the lesson better. • Think of the principles in the lesson. Identify the concepts you need to know further, to understand the lesson in depth. • Donothesitatetodiscussanalyticallyaboutthequestionsgivenunderthesub-heading 'ThinkandDiscuss'withyourfriendsorteachers. • Youmaygetsomedoubtswhileconductinganexperimentordiscussingaboutalesson. Expressthemfreelyandclearly. • Plan to implement experiment/lab periods together with teachers, to understand the concepts clearly. While learning through the experiments you may come to know manymorethings. • Observehoweachlessonishelpfultoconservenature.Putwhatyoulearntintopractice. • Analysehoweachteachingpointhasrelationwithdailylifeanddiscussthethingsyou learned in your science class with farmers, artisansetc. • Work as a group during interviews and field trips. Preparing reports and displaying them is a must. Discuss on the report prepared. • Listouttheobservationsregardingeachlessontobecarriedthroughinternet,school libraryandlaboratory. • Whetherinnotebookorexams,writeanalytically,expressingyourownopinions. • Read books related to your text book, as many as you can. • YouorganizeyourselftheScienceClubprogramsinyourschool. • Observeproblemsfacedbythepeopleinyourlocalityandfindoutwhatsolutionsyou cansuggestthroughyoursciencelassroom. 8. viii ACADEMIC STANDARDS S.No. Academic Standard Explanation 1. 2. 3. 4. 5. 6. 7. Conceptual understanding Asking questions and making hypothesis Experimentation and field investigation. Information skills and Projects Communication through drawing, model making Appreciation and aesthetic sense, values Application to daily life, concern to bio diversity. Children are able to explain, cite examples, give reasons, and give comparison and differences, explain the process of given concepts in the textbook. Children are able to develop their own brain mappings. Children are able to ask questions to understand, to clarify the concepts and to participate in discussions. They are able to make hypothesis on given issues. To understand given concepts in the textbook children are able to do experiments on their own. They are able to participate in field investigation and making reports on them. Children are able to collect information (by using interviews, internet etc.) and analyses systematically. They are able to conduct their own project works. Children are able to explain their conceptual understanding by drawing figures and making models. Able to ploting graphs by using given information or collected data. Children are able to appreciate man power and nature, and have aesthetic sense towards nature. They are also able to follow constitutional values. Children are able to utilize scientific concept to face their daily life situations. They are able to show concern towards bio diversity. 9. ixFreedistributionbyA.P.Government Heat Page No.Periods Month 11111 Chemical Reactions and Equations22222 Reflection of light by different surfaces33333 Acids, Bases and Salts44444 Refraction of Light at Plane Surfaces55555 Refraction of Light at Curved Surfaces66666 Human Eye and Colourful world77777 Structure of Atom88888 Classification of Elements- The Periodic Table99999 1010101010 Electric Current1111111111 Electromagnetism1212121212 Principles of Metallurgy1313131313 Carbon and its Compounds1414141414 Reference Books 8 June 1-19 8 July 20-44 8 July 45-68 8 Aug 69-92 9 Aug 93-111 10 Sept 112-134 8 Sept-Oct 135-159 5 Oct 160-175 10 Nov 176-201 10 Nov-Dec 202-227 9 Dec 228-257 10 Dec-Jan 258-285 5 Jan 286-301 12 Feb 302-341 342 Chemical Bonding INDEX 10. x OUR NATIONAL ANTHEM - RabindranathTagore Jana gana mana adhinayaka Jaya he Bharatha bhagya-vidhata Punjab Sindhu Gujaratha Maratha Dravida Utkala Banga. Vindhya Himachala Jamuna Ganga Uchchala Jaladhi taranga, Tava shubha name jage Tava shubha asisha mage Gahe tava jaya gatha Jana gana mangala-dayaka jaya he, Bharatha bhagya –vidhatha, Jaya he, jaha he, jaya he, Jaya jaya jaya jaya he PLEDGE "India is my country; all Indians are my brothers and sisters. I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it. I shall give my parents, teachers and all elders respect, and treat everyone with courtesy. I shall be kind to animals. To my country and my people, I pledge my devotion. In their well-being and prosperity alone lies my happiness." 11. FreedistributionbyA.P.Government 1 Recall the experiments you did in Class 7 with the glass tumblers containing of cold water, lukewarm water and hot water. We understood that 'hot'and 'cold'are relative terms and that heat was a form of energy. We use the terms "Temperature and Heat" to describe these observations. These words, technically, have special meanings. In order to understand their meanings let us do some activities Activity 1 Take a piece of wood and a piece of metal and keep them in a fridge or ice box.After 15 minutes, take them out and ask your friend to touch them. • Which is colder? Why? When we keep materials in a fridge, they become cold i.e., they lose heat energy. The iron and wooden pieces were kept in the fridge for the same period of time but we feel that the metal piece is colder than the wooden piece. • What could be the reason for this difference in coldness? • Does it have any relation to the transfer of heat energy from our body to the object? When you touch the metal or wooden piece, you feel that they are cold. This means that heat energy is being transferred from your finger to the pieces. When you remove your finger, you don't get a feeling of 'coldness'. This means that when heat energy flows out of your body you get the feeling of 'coldness' and when heat energy enters your body you get a feeling of 'hotness'.You can test this by bringing your finger near the flame of a matchstick! Heat 1 Chapter 12. Heat2 X Class So, if you feel that the metal piece is 'colder'than the wooden piece, it must mean that more heat energy flows out of your body when you touch the metal piece as compared to the wooden piece. In other words, the 'degree of coldness' of the metal piece is greater than that of the wooden piece. The conventional definition of temperature is "the degree of hotness or coldness". We say that the metal piece is at a lower 'temperature'as compared to the wooden piece, when they are taken out of the fridge. • Why does transfer of heat energy take place between objects ? • Does transfer of heat take place in all situations? • What are the conditions for transfer of heat energy? Let us find out Thermal equilibrium-heat and temperature When two bodies are placed in thermal contact, heat energy will be transferred from the 'hotter' body to the 'colder' body. This transfer of heat energy continues till both bodies attain the same degree of hotness (or) coldness.At this stage, we say that the bodies have achieved 'thermal equilibrium'. Thus, the state of thermal equilibrium denotes a state of a body where it neither receives nor gives out heat energy. If you are not feeling either hot or cold in your surroundings, then your body is said to be in thermal equilibrium with the surrounding atmosphere. Similarly, the furniture in the room is in thermal equilibrium with air in the room. So we can say that the furniture and the air in the room are at the same temperature. Heat • What is temperature? • How can you differentiate it from heat? Let us find out Activity 2 Take two cups and fill one of them with hot water and another with cold water. Now take a laboratory thermometer, observe the mercury level in it and note it in your book. Keep it in hot water. Observe changes in the mercury level. Note the reading. • What change did you notice in the reading of the thermometer? (mercury level)? 13. FreedistributionbyA.P.Government 3 • Did the mercury level increase or decrease? Now place the thermometer in cold water and observe changes in the mercury level. Did the level decrease or increase? We know that bodies in contact achieve thermal equilibrium due to transfer of heat energy. When you kept the thermometer in hot water you observe that there is a rise in mercury level. This happens because heat got transferred from the hotter body (hot water) to the colder body (mercury in thermometer). Similarly in the second case you will observe that the mercury level comes down from its initial level because of the transfer of heat from mercury (hotter body) to water (colder body). Thus we define heat as follows: "Heat is a form of energy in transit, that flows from a body at higher temperature to a body at lower temperature." The steadiness of the mercury column of the thermometer indicates that flow of heat between the thermometer liquid (mercury) and water, has stopped. Thermal equilibrium has been attained between the water and thermometer liquid (mercury). The thermometer reading at thermal equilibrium gives the "temperature". Thus 'temperature' is a measure of thermal equilibrium. If two different systems, A and B in thermal contact, are in thermal equilibrium individually with another system C(thermal contact withAand B), will the systemsAand B be in thermal equilibrium with each other? We know that ifAis in thermal equilibrium with C, they both have the same temperature. Similarly, B and C have the same temperature. ThusA and B will have the same temperature and would therefore be in thermal equilibrium with each other. (A,B and C are in thermal contact). The SI unit of heat is Joule (J) and CGS unit is calorie (cal).The amount of heat required to raise the temperature of 1gram of water by 10 C is called calorie. 1cal = 4.186 Joules The SI unit of temperature is Kelvin (K). It can also be expressed as degree Celsius (0 C). 00 C = 273K • How would you convert degree Celsius to Kelvin? Temperature in Kelvin = 273+Temperature in degree Celsius Add 273 to the value of temperature in degree Celsius to get the temperature on the Kelvin scale. 14. Heat4 X Class Note: Temperature measured on Kelvin scale is called absolute temperature. Temperature and Kinetic energy Activity 3 Take two bowls one with hot water and second with cold water. Gently sprinkle food colour on the surface of the water in both bowls .Observe the motion of the small grains of food colour. • How do they move? • Why do they move randomly? • Why do the grains in hot water move more rapidly than the grains in cold water? You will notice that the grains of food colour jiggle (move randomly). This happens because the molecules of water in both bowls are in random motion. We observe that the jiggling of the grains of food colour in hot water is more when compared to the jiggling in cold water. We know that bodies possess kinetic energy when they are in motion. As the speed of motion of particles (grain of food colour) in the bowls of water is different, we can say that they have different kinetic energies.Thus we conclude that the average kinetic energy of molecules / particles of a hotter body is greater than that of a colder body. So we can say that the temperature of a body is an indicator of the average kinetic energy of molecules of that body. "The average kinetic energy of the molecules is directly proportional to the absolute temperature" Activity 4 Take water in a container and heat it to 60°C. Take a cylindrical transparent glass jar and fill half of it with this hot water. Very gently pour coconut oil over the surface of the water. (Take care that the water and oil do not mix). Put a lid with two holes on the top of the glass jar. Take two thermometers and insert them through the holes of the lid in such a way that bulb of the one thermometer lies only inside the water and other lies only inside the coconut oil as shown in figure 1. fig-1 Hot water Coconut oil Thermometer Lid 15. FreedistributionbyA.P.Government 5 Now observe the readings of the two thermometers. The reading of the thermometer kept in water decreases, while, at the same time, the reading of the thermometer kept in oil increases. • Why does this happen? Because the average kinetic energy of the molecules of oil increases, while the average kinetic energy of the molecules of water decreases. In other words, the temperature of oil increases while the temperature of water decreases. • Can you say that the water loses energy? From the above discussion it is clear that, water loses energy while oil gains energy; because of the temperature difference between the water and oil. Thus some heat energy flows from water to oil. This means, the kinetic energy of the molecules of the water decreases while the kinetic energy of the molecules of oil increases. • Can you now differentiate between heat and temperature based on the discussion we made of the above activities? With activities 2, 3 and 4 we can differentiate heat and temperature as follows: Heatistheenergythatflowsfromahottertoacolderbody.Temperature is a quantity that denotes which body is hotter and which is colder. So temperature determines direction of heat (energy) flow, whereas heat is the energy that flows. Specific Heat Activity 5 Take a large jar with water and heat it up to 80o C.Take two identical boiling test tubes with single-holed corks. One of them is filled with 50g of water and the other with 50g of oil, both at room temperature. Insert two thermometers through holes of the corks, one each into two test tubes. Now clampthemtoaretortstandandplacethem in a jar of hot water as shown in figure 2. Observe the readings of thermometers every three minutes .Note the readings in your notebook. • Inwhichtesttubedoesthetemperature rise quickly? fig-2 Hot water at 80o C Water at room temperature Oil at room temperature 16. Heat6 X Class • Are the amounts of heat given to the water and oil same? How can you assume this? We believe that the same amount of heat is supplied to water and oil because they are kept in the jar of hot water for the same interval of time. We observe that the rate of rise in temperature of the oil is higher than that of the rise in temperature of the water. • Why does this happen? We conclude that the rate of rise in temperature depends on the nature of the substance. Activity 6 Take 250 ml of water in one beaker (a small beaker) and 1 litre of water in another beaker (a larger beaker), and note down their initial temperature using a thermometer (initial temperatures should be the same). Now heat both beakers till the temperature of water in the two beakers rises to 60 0 C. Note down the heating times required to raise the temperature of water to 60 0 C in each beaker. • Which beaker needed more time? You will notice that you need more time to raise the temperature of water in the larger beaker when compared to water in the small beaker. That means you need to supply more heat energy to water in a larger beaker (greater quantity of water) than water in a small beaker for same change in temperature. For same change in temperature the amount of heat (Q) absorbed by a substance is directly proportional to its mass (m) $Q \propto m$ (when ΔT is constant) ....(1) Now take 1 litre of water in a beaker and heat it over a constant flame. Note the temperature changes (ΔT) for every two minutes. • What do you notice? Youwillnoticethatthechangeintemperaturerisewithtimeisconstant, that means, for the same mass (m) of water the change in temperature is proportional to amount of heat (Q) absorbed by it. $Q \propto \Delta T$ (when 'm' is constant) ....(2) From equation (1) and (2), we get $Q \propto m\Delta T$ $Q = mS\Delta T$ Where 's' is a constant for a given substance. This constant is called "specific heat" of the substance. 17. FreedistributionbyA.P.Government 7 $S = \frac{Q}{m\Delta T}$ The specific heat of a substance is the amount of heat required to raise the temperature of unit mass of the substance by one unit. • How much heat energy is required to raise the temperature of unit mass of substance by 1°C ? CGS unit of specific heat is cal/g-o C and SI unit of it is J / kg - K 1 cal/g- o C = 1 kcal /kg-K = 4.2 x 103 J/kg-K We have seen that the rise in temperature depends on the nature of the substance; hence the specific heat of a substance depends on its nature. If the specific heat is high, the rate of rise (or fall) in temperature is low for same quantity of heat supplied. It gives us an idea of the degree of 'reluctance' of a substance to change its temperature. • Why is the specific heat different for different substances? Let us find out. We know that the temperature of a body is directly proportional to the average kinetic energy of particles of the body.The molecules of the system (body or substance) have different forms of energies such as linear kinetic energy, rotational kinetic energy, vibrational energy and potential energy between molecules. The total energy of the system is called internal energy of the system. When we supply heat energy to the system the heat energy given to it will be shared by the molecules among the various forms of energy. This sharing will vary from substance to substance. The rise in temperature is high for a substance, if the maximum share of heat energy is utilised for increasing its linear kinetic energy. This sharing of heat energy of the system also varies with temperature .That is why the specific heat is different for different substances. If we know the specific heat of a substance, we can determine how much heat (Q) is needed to raise the temperature of a certain mass of the substance through certain degrees by using the equation $Q = mS\Delta T$ Substance Specific heat In cal/g-o C In J/kg-K Lead 0.031 130 Mercury 0.033 139 Brass 0.092 380 Zinc 0.093 391 Copper 0.095 399 Iron 0.115 483 Glass(flint) 0.12 504 Aluminum 0.21 882 Keroseneoil 0.50 2100 Ice 0.50 2100 Water 1 4180 Sea water 0.95 3900 18. Heat8 X Class Applications of Specific heat capacity 1. The sun delivers a large amount of energy to the Earth daily. The water sources on Earth, particularly the oceans, absorb this energy for maintaining a relatively constant temperature. The oceans behave like heat "store houses" for the earth. They can absorb large amounts of heat at the equator without appreciable rise in temperature due to high specific heat of water.. Therefore, oceans moderate the surrounding temperature near the equator. Ocean water transports the heat away from the equator to areas closer to the north and south poles. This transported heat helps moderate the climates in parts of the Earth that are far from the equator. 2. Water melon brought out from the refrigerator retains its coolness for a longer time than any other fruit because it contains a large percentage of water. (water has greater specific heat). 3. A samosa appears to be cool outside but it is hot when we eat it because the curry inside the samosa contains ingredients with higher specific heats. Method of mixtures Activity - 7 Situation – 1: Take two beakers of the same size and pour 200 ml of water in each of them. Now heat the water in both beakers till they attain the same temperature. If you pour this water from these two beakers into a larger beaker, what temperature could you expect the mixture to be? Measure the temperature of the mixture. • What do you observe? • What could be the reason for the fact you observed? Situation – 2: Now heat the water in one beaker to 90o C and the other to 60o C . Mix the water from these beakers in a larger beaker. • What will the temperature of the mixture be? • Measure temperature of the mixture. What did you notice? • Can you give reasons for the change in temperature? Situation – 3: Now take 100 ml of water at 90o C and 200 ml of water at 60o C and mix the two. • What is the temperature of the mixture? • What difference do you notice in the change of temperature? Let us find out. Let the initial temperatures of the samples of masses m1 and m2 be T1 and T2 (the higher of the two temperatures is called T1 , the lower is called T2). Let T be the final temperature of the mixture. 19. FreedistributionbyA.P.Government 9 The temperature of the mixture is lower than the temperature of the hotter sample but higher than the temperature of the colder sample. This means that the hot sample has lost heat, and the cold sample has gained heat. The amount of heat lost by the hotter sample Q1 is m1 S(T1 - T). The amount of heat gained by the cooler sample Q2 is m2 S(T - T2). Since heat lost by the hotter sample is equal to the heat gained by the cooler sample (assuming no loss of heat) i.e Q1 = Q2 which can be written as m1 S(T1 - T) = m2 S(T - T2) which can be simplified to T = (m1 T1 + m2 T2)/(m1 + m2) You will notice the temperatures of mixtures in situation – 2 and situation – 3 are not equal. • Can you guess the reason for this? • Can we find temperature of the mixture using a thermometer? Principle of method of mixtures When two or more bodies at different temperatures are brought into thermal contact, then net heat lost by the hot bodies is equal to net heat gained by the cold bodies until they attain thermal equilibrium. (If heat is not lost by any other process) Net heat lost= Net heat gain This is known as principle of method of mixtures. Determination of Specific heat of a solid Aim: To find the specific heat of given solid. Material required: calorimeter, thermometer, stirrer, water, steam heater, wooden box and lead shots. Procedure: Measure the mass of the calorimeter along with stirrer. Mass of the calorimeter, m1 = ... Now fill one third of the volume of calorimeter with water. Measure its mass and its temperature. Mass of the calorimeter plus water, m2 = ... Mass of the water, m2 –m1 = Temperature of water in calorimeter, T1 = ... Note: Calorimeter and water are at same temperature. LabActivity 1 20. Heat10 X Class Take a few lead shots and place them in hot water or steam heater. Heat them upto a temperature 100o C. Let this temperature be T2 . Transfer the hot lead shots quickly into the calorimeter (with minimum loss of heat).You will notice that the mixture settles to a certain temperature after some time. Measure this temperature T3 and mass of the calorimeter along with contents (water and lead shots). Mass of the calorimeter along with contents, m3 = ... Mass of the lead shots, m3 – m2 = ... Since there is no loss of heat to surroundings, we can assume that the entire heat lost by the solid (lead shots) is transferred to the calorimeter and water to reach the final temperature. Let the specific heats of the calorimeter, lead shots and water be Sc , Sl and Sw respectively.According to the method of mixtures, we know; Heat lost by the solid = Heat gain by the calorimeter + Heat gain by the water (m3 - m2) Sl (T2 -T3) = m1 Sc (T3 -T1)+(m2 -m1) Sw (T3 -T1) [m1 Sc +(m2 -m1)Sw] (T3 -T1) Sl = ———————————— (m3 -m2)(T2 -T3) Knowing the specific heats of calorimeter and water, we can calculate the specific heat of the solid (lead shots). Evaporation When wet clothes dry, you will notice that water in the clothes disappears. • Where does the water go? Similarly, when the floor of a room is washed with water, the water on the floor disappears within minutes and the floor becomes dry. • Why does water on the floor disappear after some time? Let us see. Activity 8 Take a few drops of spirit on your palm using a droper. • Why does your skin become colder? Take a few drops of spirit (say 1 ml) in two petri dishes (a shallow glass or plastic cylindrical lidded dish used in the laboratory) separately. Keep one of the dishes containing spirit under a ceiling fan and switch on the fan . Keep another dish with its lid closed. Observe the quantity of spirit in both dishes after 5 minutes. 21. FreedistributionbyA.P.Government 11 • What do you notice? You will notice that spirit in the dish that is kept under the ceiling fan disappears, where as you will find some spirit left in the dish that is kept in the lidded dish. • What could be the reason for this change? To answer the above questions, you need to understand the process of evaporation. The molecules of spirit that is kept in petri dish, continuously move with random speeds in various directions.As a result these molecules collide with other molecules. During the collision they transfer energy to other molecules. When the molecules inside the liquid collide with molecules at the surface, the molecules at the surface acquire energy and may fly off from the surface. Some of these escaping molecules may be directed back into liquid when they collide with the particles of air. If the number of escaping molecules is greater than the number returned, then the number of molecules in the liquid decreases. Thus when a liquid is exposed to air, the molecules at the surface keep on escaping from the surface till the entire liquid disappears into air. This process is called evaporation. During the process of evaporation, the energy of the molecules inside the liquid decreases and they slow down. They transfer this energy to escaping molecules during the collisions. "The process of escaping of molecules from the surface of a liquid at any temperature is called evaporation" Let us determine the reason for faster evaporation of spirit kept under the fan. If air is blown over the liquid surface in an open pan or perti dish, the number of molecules returned is reduced to a large extent. This is because any molecule escaping from the surface is blown away from the vicinity of the liquid. This increases the rate of evaporation. This is the reason why the spirit in petri dish, that is kept under ceiling fan evaporates quickly when compared to that kept closed. You will notice that clothes dry faster when a wind is blowing. It means that the temperature of a system falls during evaporation. Evaporation is a surface phenomenon. We can also define evaporation as "the change of phase from liquid to gas that occurs at the surface of the liquid". It is a cooling process, because the particles of liquid continuously give up their energy to the particles that are escaping from the surface. 22. Heat12 X Class Let us look at the following example. • Why do we sweat while doing work? When we do work, we spend our energy mostly in the form of heat energy from the body. As a result the temperature of the skin becomes higherandthewaterinthesweatglandsstartsevaporating.Thisevaporation cools the body. Rate of evaporation of a liquid depends on its surface area, temperature and amount of vapour already present in the surrounding air. • Does the reverse process of evaporation take place? • When and how does it take place? Let us find out. Condensation Activity 9 Place a glass tumbler on the table. Pour cold water up to half its height. • What do you observe on the outer surface of the tumbler? • Why do water droplets form on the outer side of the glass? We know that the temperature of surrounding air is higher than the temperature of the cold water. Air contains water molecules in the form of vapour. When the molecules of water in air, during their motion, strike the surface of the glass tumbler which is cool; they lose their kinetic energy which lowers their temperature and they get converted into droplets. The energy lost by the water molecules in air is gained by the molecules of the glass tumbler. Hence the average kinetic energy of the glass molecules increases. In turn the energy is transferred from glass molecules to the water molecules in the glass. In this way, the average kinetic energy of water molecules in the tumbler rises. Hence we can conclude that the temperature of water in the glass increases. This process is called 'condensation'. It is a warming process. Condensation can also be defined as "the phase change from gas to liquid". Let us examine a situation: You feel warm after you finish your bath under the shower on a hot day. In the bathroom, the number of vapour molecules per unit volume is 23. FreedistributionbyA.P.Government 13 greater than the number of vapour molecules per unit volume outside the bathroom. When you try to dry yourself with a towel, the vapour molecules surrounding you condense on your skin and this condensation makes you feel warm. Humidity Some vapour is always present in air. This vapour may come from evaporation of water from the surfaces of rivers, lakes, ponds and from the drying of wet clothes, sweat and so on. The presence of vapour molecules in air is said to make the atmosphere humid. The amount of water vapour present in air is called humidity. Dew and Fog In early morning, during winter, you might have noticed that water droplets form on window panes, flowers, grass etc. • How are these water droplets formed? Let us find out. During winter nights, the atmospheric temperature goes down. The surfaces of window-panes, flower, grass etc, become still colder. The air near them becomes saturated with vapour and condensation begins. The water droplets condensed on such surfaces are known as dew. If the temperature falls further, the whole atmosphere in that region containsalargeamountofvapour.Sothewatermoleculespresentinvapour condense on the dust particles in air and form small droplets of water. These droplets keep floating in the air and form a thick mist which restricts visibility. This thick mist is called fog. • Does the temperature of the water rise continuously if heat is supplied to it continuously? Boiling Activity 10 Take a beaker of water, keep it on the burner .Note the readings of thermometer for every 2 minutes. • Did you see any rise or fall in the level of the surface of the water, in the beaker? Why? • Does the temperature rise continuously? • When does the rise in temperature of water stop? You will notice that, the temperature of the water rises continuously, till it reaches 100°C. Beyond 100°C no further rise of temperature of 24. Heat14 X Class water is seen.At 100 0 C, though supply of heat continues, the temperature does not increase further. We also observe a lot of bubbling at the surface of water at 1000 C. This is what we call boiling of water • Why does this happen? Water is a solution, there are many impurities dissolved in it including some gases. When water or any liquid is heated, the solubility of gases it contains reduces. As a result, bubbles of gas are formed in the liquid (at the bottom and on walls of the vessel). Evaporation of water molecules from the surrounding causes these bubbles, to become filled with saturated vapour, whose pressure increases as we increase the temperature of the liquid by heating. At a certain temperature, the pressure of the saturated vapour inside the bubbles becomes equal to the pressure exerted on the bubbles from the outside (this pressure is equal to the atmospheric pressure plus the pressure of the layer of water above the bubble). As a result, these bubbles rise rapidly to the surface and collapse at the surface releasing vapour present in bubbles into air at the surface. This process of converting the liquid into vapour (gas) continues as long as you supply heat. This appears as boiling of water for us. "Boiling is a process in which the liquid phase changes to gaseous phase at a constant temperature at a given pressure." This temperature is called boiling point of the liquid. • Are the processes of evaporation and boiling the same? As you have seen in activity – 8 and 10, the boiling of a liquid differs essentially from evaporation. Note that evaporation takes place at any temperature, while boiling occurs at a definite temperature called the boiling point. Let us recall your observation in activity – 10 that, when boiling process starts, the temperature of the liquid cannot be raised further, nomatterhowlongwecontinuetoheatit.Thetemperatureremainsconstant at the boiling point until all of the liquid has boiled away. In activity – 10, you have noticed that, while heating the water in the beaker, the temperature of water rises continuously till it reaches 100 0 C. But once boiling got started, no further rise of temperature is seen though supply of heat continues. • Where does the heat energy supplied go? This heat energy is used to change the state of water from liquid to vapour (gas). This is called latent heat of vapourization. The heat energy required to change 1gm of liquid to gas at constant temperature is called latent heat of vapourization. 25. FreedistributionbyA.P.Government 15 Consider a liquid of mass 'm' that requires heat energy of 'Q' calories to change from its state from liquid phase to gas phase. Then Latent heat of vaporization is Q/m. Latent heat of vaporization is denoted by 'L'. CGS unit of latent heat of vaporization is cal/gm and SI unit is J/kg. The boiling point of water at constant atmospheric pressure (1atm) is 100°C or 373K and Latent heat of vaporization of water is 540 cal/gm. Let us now consider the transformation of ice into water. • Why does an ice cube get converted into water? Melting Activity 11 Take small ice cubes in a beaker. Insert the thermometer into ice cubes in the beaker. Observe the reading of the thermometer. Now start heating the beaker keeping it on a burner. Observe changes in the thermometer reading every 1 minute till the ice completely melts and gets converted into water. • What changes do you notice in the reading of thermometer as time passes by? • Does the temperature of the ice change during the process of melting? You will observe that the temperature of ice at the beginning is equal to or below 0o C. If the temperature of ice is below 0o C, it goes on changing till it reaches 00 C. When ice starts melting, you will notice no change in temperature though you are supplying heat continuously. • Why does this happen? The heat energy supplied to the ice increases the internal energy of the molecules of the ice. This increase in internal energy of molecules weakens the bonds as well as breaks the bonds between the molecules (H_2O) in the ice. That is why the ice (in solid phase) becomes water (in liquid phase).This process takes place at a constant temperature 0°C or 273K. This temperature is called melting point. This process of converting solid into a liquid is called "Melting". The temperature of the ice does not change during melting because the heat energy given to the ice is totally utilized in breaking the bonds between the water molecules. The process in which solid phase changes to liquid phase at a constant temperature is called melting. This constant temperature is called melting point. 26. Heat16 X Class • How much heat energy is required to convert 1gm of ice to liquid? The Heat energy required to convert 1gm of solid completely into liquid at a constant temperature is called Latent heat of fusion. Consider a solid of mass m. Let heat energy Q be required to change it from the solid phase to liquid phase. The heat required to change 1gm of solid into liquid is Q/m. Latent heat of fusion L = Q/m. The value of Latent heat of fusion of ice is 80cal/gm Freezing You might have observed coconut oil and ghee getting converted from liquid state to solid state during winter season. • What could be the reason for this change? • What happens to water kept in a refrigerator? • How does it get converted from liquid phase to solid phase? We know that the water that is kept in a refrigerator converts to solid ice. You know that initial temperature of water is more compared to the temperature of ice. It means that during the process of conversion from liquid to solid, the internal energy of the water decreases so that it becomes a solid ice. This process is called freezing. "The process in which the a substance in liquid phase changes to solid phase by losing some of its energy is called freezing." Freezing of water takes place at 0°C temperature and at one atmospheric pressure. • Are the volumes of water and ice formed with same amount of water equal?Why? Let us find out. Activity 12 Take small glass bottle with a tight lid .Fill it with water completely without any gaps and fix the lid tightly in such a way that water does not come out of it. Put the bottle into the deep freezer of a refrigerator for a few hours. Take it out from the fridge and you will observe that the glass bottle breaks. • Why did the glass bottle break? 27. FreedistributionbyA.P.Government 17 • Iftwodifferentsystems,AandB,(thermalcontact)areinthermalequilibriumindividuallywith anothersystemC,thenthesystemsAandBareinthermalequilibriumwitheachother. • Theaveragekineticenergyofthemoleculesisdirectlyproportionaltotheabsolutetemperature. • The specific heat of a substance is the amount of heat required to raise the temperature of unit mass of the substance by one unit. $S=Q/m\Delta t$ • The process of escaping of molecules from the surface of a liquid at any temperature is called evaporation and it is a cooling process. • Condensation is the reverse process of evaporation. • Boilingistheprocessinwhichtheliquidphasechangestogaseousphaseataconstanttemperature and constant pressure. 1. Whatwouldbethefinaltemperatureofamixtureof50gofwaterat20o Ctemperatureand50g of water at 40o C temperature? (AS1) 2. Explainwhydogspantduringhotsummerdaysusingtheconceptofevaporation?(AS1) 3. Why do we get dew on the surface of a cold soft drink bottle kept in open air? (AS1) 4. Writethedifferencesbetweenevaporationandboiling?(AS1) Improve your learning Key words Temperature, Heat, Thermal equilibrium, Specific heat, Evaporation, Condensation, Humidity, Dew, Fog, Boiling, Latent heat of vaporization, Melting, Freezing. What we have learnt We know that the volume of the water poured into the glass bottle is equal to the volume of the bottle. When the water freezes to ice, the bottle is broken .This means that the volume of the ice should be greater than the volume of the water filled in the bottle. In short, we say that water 'expands' (increases in volume) on freezing! Thus the density of ice is less than that of water and this explains why ice floats on water. 28. Heat18 X Class 5. DoesthesurroundingairbecomewarmorcoolwhenvapourphaseofH2 Ocondenses?Explain. 6. Answer these. (AS1) a) Howmuchenergyistransferredwhen1gmofboilingwaterat100o Ccondensestowaterat 100o C? b) Howmuchenergyistransferredwhen1gmofboilingwaterat100o Ccoolstowaterat0o C? c) How much energy is released or obsorbed when 1gm of water at 0o C freezes to ice at 0o C? d) Howmuchenergyisreleasedorobsorbedwhen1gmofsteamat100o Cturnstoiceat0o C? 7. Explaintheprocedureoffindingspecificheatofsolidexperimentally.(AS1) 8. Covert 20o C into Kelvin scale.(AS1) 9. Your friend is asked to differentiate between evaporation and boiling.What questions could you ask to make him to know the differences between evaporation and boiling? (AS2) 10. What happens to the water when wet clothes dry? (AS3) 11. Equal amounts of water are kept in a cap and in a dish. Which will evaporate faster? Why? (AS3) 12. Suggest an experiment to prove that the rate of evaporation of a liquid depends on its surface area and vapour already present in surrounding air. (AS3) 13. Place a Pyrex funnel with its mouth-down in a sauce pan full of water, in such a way that the stem tube of the funnel is above the water or pointing upward into air. Rest the edge of the bottom portion of the funnel on a nail or on a coin so that water can get under it. Place the pan on a stove and heat it till it begins to boil. Where do the bubbles form first? Why? Can you explain how a geyser works using this experience. (AS4) 14. Collect information about working of geyser and prepare a report. (AS4) 15. Assumethatheatisbeingsuppliedcontinuouslyto2kgoficeat-5o C.Youknowthaticemelts at0o Candboilsat100o C.Continuetheheatingtillitstartsboiling.Notethetemperatureevery minute. Draw a graph between temperature and time using the values you get. What do you understand fromthegraph.Writetheconclusions.(AS5) 16. How do you appreciate the role of the higher specific heat of water in stabilising atmospheric temperatureduringwinterandsummerseasons?(AS6) 17. Suppose that 1l of water is heated for a certain time to rise and its temperature by 2o C. If 2lof water is heated for the same time, by how much will its temperature rise? (AS7) 18. Whatroledoesspecificheatplayinkeepingawatermeloncoolforalongtimeafterremoving it from a fridge on a hot day? (AS7) 19. Ifyouarechillyoutsidetheshowerstall,whydoyoufeelwarmafterthebathifyoustayin the bathroom? (AS7) 29. FreedistributionbyA.P.Government 19 1. The SI unit of specific heat is____________ 2. ____________ flows from a body at higher temperature to a body at lower temperature. 3. ____________ is a cooling process. 4. An object 'A'at 10 0 C and another object 'B'at 10K are kept in contact, then heat will flow from ________ to __________. 5. The latent heat of fusion of ice is ____________. 6. Temperature of a body is directly proportional to ____________. 7. Accordingtotheprincipleofmethodofmixtures,thenetheatlostbythehotbodiesisequalto ____________ by the cold bodies. 8. The sultryness in summer days is due to ____________. 9. __________ is used as a coolant. 10. Ice floats on water because ____________. 1. Whichofthefollowingisawarmingprocess [ ] a)Evaporation b)condensation c)boiling d) all the above 2. Melting is a process in which solid phase changes to [ ] a)liquidphase b) liquid phase at constant temperature c) gaseous phase d) any phase 3. Three bodiesA, B and C are in thermal equilibrium.The temperature of B is 45o C. then the temperature of C is __________ [ ] a) 45o C b) 50o C c) 40o C d) any temperature 4. The temperature of a steel rod is 330K. Its temperature in o C is _______ [ ] a) 55o C b) 57o C c) 59o C d) 53o C 5. Specific heat S = [ ] a) $Q/\Delta t$ b) $Q\Delta t$ c) $Q/m\Delta t$ d) $m\Delta t/Q$ 6. Boiling point of water at normal atmospheric pressure is ________ [ ] a) 0o C b) 100o C c) 110o C d) -5o C 7. Whenicemelts,itstemperature [ ] a)remainsconstant b) increases c) decreases d) cannot say Multiple choice questions Fill in the blanks 30. ChemicalreactionsandEquations20 X Class In lower class you studied about temporary, permanent , natural, man made changes etc. They may be categorized into two types known as physical changes and chemical changes. In this chapter we discuss about the chemical changes and express them in the form of chemical equations. Consider the following processes and think about the reactions taking place during the occurance of these processes. - coal is burnt. - food gets digested in our body. - iron nail is exposed to humid atmosphere for a longtime. - we respire. - milk is converted into curd. - water is added to quicklime. - crackers are burnt. • What changes do you notice? • Are they physical changes or chemical changes? • Are they temporary changes or permanent changes? In all the above processes, the nature of original substance would be changed. If new substances are formed with properties completely unlike those of the original substances, we say a chemical change has taken place. • How do we know a chemical reaction has taken place? Let us perform some activities to know this. Chemical Reactions and Equations 2 Chapter 31. FreedistributionbyA.P.Government 21 Activity 1 Take about 1 g of quick lime (calcium oxide) in a beaker.Add 10 ml of water to this. Touch the beaker with your finger. • What do you notice? Do you notice that the beaker is hot when you touch it. The reason is that the calcium oxide (quick lime) reacts with water and in that process heat energy is released. Calcium oxide dissolves in water producing colourless solution. Test the nature of solution with litmus paper. • What is the nature of the solution? A red litmus paper turns blue when dipped in the above solution. This solution is a basic solution. Activity 2 Take about 100 ml of water in a beaker and dissolve a small quantity of sodium sulphate (Na_2SO_4). Take about 100ml of water in another beaker and dissolve a small quantity of barium chloride ($BaCl_2$), observe the colours of the solutions obtained. • What are the colours of the above solutions? • Can you name the solutions obtained? Add Na_2SO_4 solution to $BaCl_2$ solution and observe. • Do you observe any change on mixing these solutions? Activity 3 fig-1:Formation of barium sulphate precipitate Na_2SO_4 $BaCl_2$ Take a few zinc granules in a conical flask. Add about 5 ml of dilute hydrochloric acid to the conical flask. Observe the changes in the conical flask. • What changes do you notice? Now keep a burning match stick near the mouth of the conical flask. • What happens to burning match stick? • Touch the bottom of the conical flask with your fingers. What do you notice? • Is there any change in temperature? From the above activities you can conclude that during a chemical change: fig-2:Formation of hydrogen gas by action of dilute HCl on zinc and testing of H_2 gas Glass tube Conical plask Dil.HCl Zinc granules H_2 gas 32. ChemicalreactionsandEquations22 X Class 1. The original substances lose their characteristic properties. Hence these may be products with different physical states and colours. 2. Chemical changes may be exothermic or endothermic i.e, they may involve heat energy liberation or heat energy absorption. 3. They may form an insoluble substance known as precipitate. 4. There may be gas liberation in a chemical change. In our daily life we observe variety of changes taking place around us. In this chapter we study various types of chemical reactions and their symbolic representation. Chemical Equations In activity 1, when calcium oxide reacts with water a new substance is formed which is unlike either calcium oxide or water. The description of chemical reactions in a sentence in activity-1 is quite long. It can be written in shorter form as a word equation. The word equation of the above reaction is, calcium oxide + water calcium hydroxide .... (1) (Reactants) (Product) The substances which undergo chemical change in the reaction are called reactants and the new substances formed are called products. A chemical reaction written in the form of word equation shows the change of reactants to products by an arrow placed between them. The reactants, are written on the left side of arrow and the final substances, or products are written on the right side of the arrow. The arrow head point towards the product shows the direction of the reaction. If there is more than one reactant or product involved in the reaction, they are indicated with a plus (+) sign between them. Writing a Chemical Equation • Can you write a chemical reaction in any other shorter way other than the way we discussed above? Chemical equations can be made more precise and useful if we use chemical formulae instead of words. Generally, a compound is written by giving its chemical formula, which lists the symbols of the constituent elements and uses the subscript to indicate the number of atoms of each element present in the compound. If no subscript is written the number 1 is understood. Thus we can write 33. FreedistributionbyA.P.Government 23 calcium oxide as CaO, water as H_2O and the compound formed by the reaction of these two compounds is calcium hydroxide $Ca(OH)_2$. Now the reaction of calcium oxide with water can be written as: $CaO + H_2O$ $Ca(OH)_2$ .... (2) In the above chemical equation, count the number of atoms of each element on left side and right side of arrow. • Is the number of atoms of each element on both sides equal? Observe the following reactions and their chemical equations. Zinc metal reacts with dilute HCl to yield $ZnCl_2$ and liberates Hydrogen gas. $Zn + HCl$ $ZnCl_2 + H_2$ .... (3) Sodium sulphate reacts with barium chloride to give white precipitate, barium sulphate. $Na_2SO_4 + BaCl_2$ $BaSO_4 + NaCl$ .... (4) • Do the atoms of each element on left side equal to the atoms of the element on the right side of the equation? Balancing Chemical Equations According to the law of conservation of mass, the total mass of the products formed in chemical reaction must be equal to the mass of reactants consumed. You know an atom is the smallest particle of an element that takes part in a chemical reaction. It is the atom which accounts for the mass of any substance. The number of atoms of each element before and after reaction must be the same. All the chemical equations must balance, because atoms are neither created nor destroyed in chemical reactions.Achemical equation in which the numbers of atoms of different elements on the reactants side (left side) are same as those on product side (right side) is called a balanced reaction. Balancingachemicalequationinvolvesfindingouthowmanyformula units of each substance take part in the reaction. A formula unit, as the name implies, is one unit – whether atom, ion, or molecule – corresponding to a given formula. One formula unit of NaCl for example is one Na^+ ion and one $Cl^–$ ion; one formula unit of $MgBr_2$ is one Mg^{2+} ion and two $Br^–$ ions and one formula unit of water is one H_2O molecule. Now let us balance the chemical equation using a systematic method. 34. ChemicalreactionsandEquations24 X Class For this take the example of hydrogen reacting with oxygen to form water. Step 1: Write the equation with the correct chemical formulae for each reactant and product. Eg: In the reaction of hydrogen with oxygen to yield water, you can write chemical equations as follow: $H_2 + O_2$ H_2O ......(5) Step 2:After writing the molecular formulae of the substances the equation is to be balanced. For this we should not touch the ratio of atoms in the molecules of the susbtances but we may put suitable numbers as the coefficients before the formulae. In the above equation put '2' before the molecular formula of hydrogen and also '2'before the molecular formula of water. Observe whether atoms of both the elements hydrogen and oxyen are same (or) different on both thesides.Theyareinthesamenumberonbothsides.Therefore,theequation is balanced. $2H_2 + O_2$ $2H_2O$ ....(6) Step 3: Sometimes there is a possibility that the coefficients of all the substances getting divided with a suitable number. Since we require the lowest ratio of coefficient for reactants and products the above operation is to be done. If no common factor is there, there is no need to divide the equation. The above equation needs no division of the coefficients of the substances. Step 4: Verify the equation for the balancing of atoms on both sides of the equations. The above equation (6) is a balanced equation. Letusworkoutsomemoreexamplestoseehowequationsarebalanced. Eg-1: Combustion of propane (C_3H_8) Propane, C_3H_8 is a colourless, odourless gas often used as a heating and cooking fuel. Write the chemical equation for the combustion reaction of propane. The reactants are propane and oxygen and the products are carbon dioxide and water. Write the reaction in terms of symbols and formulae of the substances involved and follow the four steps described in previous discussion. Step 1:Write the unbalanced equation using correct chemical formulae for all substances. $C_3H_8 + O_2$ $CO_2 + H_2O$ ....(7), (Skeleton equation) Element No of atoms LHS RHS H 2 2 O 2 1 35. FreedistributionbyA.P.Government 25 Element No of atoms LHS RHS C 3(inC_3H_8) 1 (inCO_2) H 8 (inC_3H_8) 2(inH_2O) O 2 (inO_2) 3 (inCO_2 H_2O) Note: Unbalanced chemical equation containing molecular formulae of the substances is known as skeleton equation. Step 2: Compare number of atoms of each element on both sides. Find the coefficients to balance the equation. It is better to start with the most complex substance – in this case C_3H_8 .Look at the skeleton equation, and note that there are 3 carbon atoms on the left side of the equation but only 1 on the right side. If we add a coefficient of 3 to CO_2 on the right side the carbon atoms balance. $C_3H_8 + O_2$ $3CO_2 + H_2O$ .... (8) Now, look at the number of hydrogen atoms. There are 8 hydrogens on the left but only 2 on the right side. By adding a coefficient of 4 to the H_2O on the right, the hydrogen atoms get balanced. $C_3H_8 + O_2$ $3CO_2 + 4H_2O$ ....(9) Finally, look at the number of oxygen atoms. There are 2 on the left side but 10 on the right side, by adding a coefficient of 5 to the O_2 on the left, the oxygen atoms get balanced. $C_3H_8 + 5O_2$ $3CO_2 + 4H_2O$ ....(10) Step 3: Make sure the coefficients are reduced to their smallest whole-number values. In fact, the equation (10) is already with the coefficients in smallest whole number. There is no need to reduce its coefficients, but this might not be achieved in each chemical reaction. Let us assume that you have got chemical equation as shown below: $2C_3H_8 + 10O_2$ $6CO_2 + 8H_2O$ .... (11) • Is it a balanced equation as per rules? • How do you say? Though the equation (11) is balanced, the coefficients are not the smallest whole numbers. It would be necessary to divide all coefficients of equation (11) by 2 to reach the final equation. $C_3H_8 + 5O_2$ $3CO_2 + 4H_2O$ .... (12) Step 4: Check the answer. Count the numbers and kinds of atoms on both sides of the equation to make sure they are the same. Eg-2: Iron oxide reacts with aluminum to form iron and aluminum trioxide. Write the chemical equation to show the reaction and balance it. 36. ChemicalreactionsandEquations26 X Class Step 1: Write the equation using the correct chemical symbols and formulae for all the reactants and products. Fe_2O_3 + Al Fe + Al_2O_3 .... (13) Step 2: Find the suitable coefficient for the reactants and products, to equate the number of atoms of each element on both sides. i. Examine the number of atoms of each element present in equation (13) on both sides. In the above equation (13), Number of oxygen atoms is equal on both sides. We have to balance the remaining atoms. ii. There are 2 Fe atoms on left side(on reactant side). There is one Fe atom on right side(on products side). To equate number of Fe atoms, multiply Fe by 2 on product side. Now the partially balanced equation is: Fe_2O_3 + Al 2Fe + Al_2O_3 .... (14) iii. In the above equation(14) number of aluminum atoms still unbalanced.

There is one ‘Al’ atom on left side and 2 ‘Al’ atoms on the right side (in Al2 O3), to balance ‘Al’atoms on both sides multiply ‘Al’by 2 on left side of arrow mark. Now the partially balanced equation: Fe2 O3 + 2Al 2Fe + Al2 O3 ..... (15) The above equation(15), the number of atoms of each element is same on both sides of arrow mark. This is a balanced chemical equation. Step 3: The above equation(15) is balanced and coefficients are also smallest whole numbers. Step4: Finally to check the correctness of balanced equation, count the number of atoms of each element on both sides of equation. Fe2 O3 + 2Al 2Fe + Al2 O3 ..... (16) Elements No. of atoms in reactants No. of atoms in products Fe 2 (in Fe2 O3) 1 (in Fe) O 3 (in Fe2 O3) 3 (inAl2 O3) Al 1 (inAl) 2 (inAl2 O3) Elements No ofAtoms of Reactants No. of Atoms in products Fe 2 (in Fe2 O3) 2(inFe) O 3 (in Fe2 O3) 3(inAl2 O3) Al 2 (in 2Al) 2(inAl2 O3) 37. FreedistributionbyA.P.Government 27 (Note: The above method of balancing is called trial and error method only. Sometimes you may have to take more care to balance the equation.) Making Chemical Equations more informative: Chemical equations can be made more informative by expressing following characteristics of the reactants and products. i. Physical state ii. Heat changes (exothermic or endothermic change) iii.Gas evolved (if any) iv. Precipitate formed (if any) i. Expressing the physical state: To make the chemical equation more informative, the physical states of the substances may be mentioned along with their chemical formulae. The different states ie., gaseous, liquid, and solid states are represented by the notations (g), (l) and (s) respectively. If the substance is present as a solution in water, the word ‘aqueous’ is written. In the short form it is written as (aq). The balanced equation(16) is written along with the physical states as: Fe2 O3(s) + 2Al(s) 2Fe(s) + Al2 O3 (s) ..... (17) ; Δ represents heating. ii. Expressing the heat changes: Heat is liberated in exothermic reactions and heat is absorbed in endothermic reactions. See the following examples. 1. C(s) + O2 (g) CO2 (g) + Q (exothermic reaction) 2. N2 (g) + O2 (g) 2NO (g) - Q (endothermic reaction) fig-3(b): Iron in solid statefig-3(a): Aluminium in solid state Δ 38. ChemicalreactionsandEquations28 X Class ‘Q’is heat energy which is shown with plus ‘+’ sign on product side forexothermicreactionsand minus ‘–’signonproductsideforendothermic reactions. iii. Expressing the gas evolved: If a gas is evolved in a reaction, it is denoted by an upward arrow ’ ’or (g) Eg: Zn (s) + H2 SO4 (aq) ZnSO4 (aq) + H2 (g) iv. Expressing precipitate formed: If a precipitate is formed in the reactions it is denoted by a downward arrow. Eg:AgNO3 (aq) + NaCl (aq) AgCl(s) + NaNO3 (aq) Sometimes the reaction conditions such as temperature, pressure, catalyst, etc are indicated above and/or below the arrow in the equation. For example, sunlight 2AgCl(s) ——— 2Ag (s) + Cl2(g) Sunlight 6CO2 (g) + 6 H2 O (l) ——— C6 H12 O6 (s) + 6O2 (g)Chlorophyll glucose Interpreting a balanced chemical equation i. A chemical equation gives information about the reactants and products through their symbols and formulae. ii. It gives the ratio of molecules of reactants and products. iii. As molecular masses are expressed in ‘Unified Masses’ (U), the relative masses of reactants and products are known from the equation. iv. If the masses are expressed in grams then the equation also gives the molar ratios of reactants and products. v. If gases are involved, we can equate their masses to their volumes and calculate the volumes or those gases liberated at given condition of temperature and pressure using molar mass and molar volume relationship. vi. Using molar mass and Avagadro’s number we can calculate the number of molecules and atoms of different substances from the equation. It gives information about relative masses of reactants and products. from the equation we get, a) mass - mass relationship b) mass - volume relationship c) volume - volume relationship d) mass - volume - number of molecules relationship etc., 39. FreedistributionbyA.P.Government 29 Eg-1: Al (s) + Fe2 O3 (s) Al2 O3 (s) + Fe (s) (atomic masses of Al = 27U, Fe = 56U, and O = 16U) 2Al (s) + Fe2 O3 (s) Al2 O3 (s) + 2Fe (s) , is a balanced equation. (2x27)U + (2x56+3x16)U (2x27+3x16)U + (2x56)U 54 U + 160 U 102 U + 112 U or 2 mol + 1 mol 1 mol + 2 mol 54 g + 160 g 102 g + 112 g Suppose that your are asked to calculate the amount of aluminium, required to get 1120 kg of iron by the above reaction. Solution: As per the balanced equation Aluminium Iron 54 g 112 g x? (1120 x 1000)g (1120x1000)g x 54 g ∴ x g = ——————— 112 g = 10000 x 54 g = 540000 g or 540 kg ∴ to get 1120 kg of iron we have to use 540 kg of aluminium. Eg-2: Calculate the volume, mass and number of molecules of hydrogen liberated when 230 g of sodium reacts with excess of water at STP.(atomic masses of Na = 23U, O = 16U, and H = 1U) The balanced equation for the above reaction is, 2Na (s) + 2H2 O(l) 2NaOH(aq) + H2 (g) (2x23)U + 2(2x1+1x16)U 2(23+16+1)U + (2x1)U 46 U + 36 U 80 U + 2 U or 46 g + 36 g 80 g + 2 g Solution: As per the balanced equation: 46 g of Na gives 2g of hydrogen 230g of Na gives _____? g of hydrogen. 230 g x 2g ——————— = 10g of hydrogen 46 g 1 gram molar mass of any gas at STP i.e, standard temperature 273K and standard pressure 1 bar, occupies 22.4 litres known as gram molar volume. ∴ 2.0g of hydrogen occupies 22.4 litres at STP. 10.0g of hydrogen occupies ……..? litres at STP. 40. ChemicalreactionsandEquations30 X Class 10.0g x 22.4 litres ——————————— = 112 litres 2.0g 2 g of hydrogen i.e, 1 mole of H2 contains 6.02x1023 (NO) molecules 10 g of hydrogen contain ……..? 10.0g x 6.02x1023 molecules ——————————— 2.0g = 30.10 x 1023 molecules = 3.01 x 1024 molecules Types of chemical reactions In chemical reactions atoms are neither created nor destroyed. A chemical reaction is a process that is usually characterized by a chemical change in which the starting materials (reactants) are different from the products. Chemical reactions occur with the formation and breaking of chemical bonds. (you will learn about chemical bonding in chapter ...) Some common reaction types are discussed below. Chemical Combination Activity 4 (This activity needs Teacher’s assistance) - Take a small piece (about 3 cm long) of magnesium ribbon. - Rub the magnesium ribbon with sand paper. - Hold it with a pair of tongs. - Burn it with a spirit lamp or burner. • What you observe? You will notice that, Magnesium burns in oxygen by producing dazzling white flame and changes into white powder. The white powder is magnesium oxide. 2Mg(s) + O2 (g) 2MgO (s) ……..(18) Magnesium Oxygen Magnesium oxide In this reaction magnesium and oxygen combine to form a new substance magnesium oxide.Areaction in which single product is formed from two or more reactants is known as chemical combination reaction. You will also notice release of enormous amount of heat energy when magnesium is burnt in air. fig-4: Burning of magnesium ribbon 41. FreedistributionbyA.P.Government 31 Let us discuss some more examples of combination reactions. i. Burning of Coal: When coal is burnt in oxygen, carbon dioxide is produced. C (s) + O2 (g) CO2 (g) + Q (heat energy) ……..(19) ii. Slaked lime is prepared by adding water to quick lime. Ca O (s) + H2 O (l) Ca (OH) 2 (aq) + Q (heat energy).....(20) Large amount of heat energy is released on reaction of water with CaO(s) . If you touch the walls of the container you will feel the hotness. Such reactions are called exothermic reactions. A solution of slaked lime produced in the reaction equation(20) is used to white wash the walls. Calcium hydroxide reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate on the walls. It gives a shiny finish to the walls. Ca (OH)2(aq) + CO2(g) CaCO3(s) + H2 O(l) The chemical formula of marble is CaCO3 Decompostion Reaction Activity 5 - Take a pinch of calcium carbonate (lime stone) in a boiling tube. - Heat the boiling tube over the flame of spirit lamp or burner. - Now bring a burning match stick near the evolved gas as shown in the figure. - What do you observe? You will notice that match stick would be put off. fig-5: Formation of slaked lime by the reaction of CaO with water Beaker Water CaO fig-6: Heating of calcium carbonate and testing the gas evolved with burning match stick Stand Bunsen burner Clamp Delivery tube Boiling tube Calcium carbonate Burning match stick Putoff match stick 42. ChemicalreactionsandEquations32 X Class In the above activity, on heating calcium carbonate decomposes to calcium oxide and carbon dioxide. Heat CaCO3 (s) ——— CaO(s) + CO2 (g) ……..... (21) Lime stone quick lime It is a thermal decomposition reaction. When a decomposition reaction is carried out by heating, it is called thermal decomposition reaction. Activity 6 - Take about 0.5g of lead nitrate powder in a boiling test tube. - Hold the boiling tube with a test tube holder. - Heat the boiling tube over a flame. (see figure) - Note down the change. - What do you observe? Heating of lead nitrate and emission of nitrogen dioxide On heating lead nitrate decomposes to lead oxide, oxygen and nitrogen dioxide.You observe the brown fumes liberating in the boiling tube. These brown fumes are of nitrogen dioxide (NO2). Heat 2Pb (NO3)2(s) ——— 2PbO(s) + 4NO2 (g) + O2 (g) ……. (22) Lead Nitrate lead oxide Nitrogen dioxide Oxygen This is also a thermal decomposition reaction. Let us perform some more decomposition reactions Activity 7 - Take a plastic mug. Drill two holes at its base. - Fit two ‘one holed rubber stoppers’ in these holes. - Insert two carbon electrodes in these rubber stoppers. - Connect the electrodes to 9V battery as shown in fig. - Fill the mug with water, so that the electrodes are immersed. - Add few drops of dilute sulphuric acid to water. - Taketwotesttubesfilledwithwaterandinvertthemoverthetwocarbon electrodes. - Switch on the current and leave the apparatus undisturbed for some time. • What do you observe in the test tubes? fig-7:Heating of lead nitrate and emission of nitrogen dioxide Stand Clamp Delivery tube NO2 Gas collecting jar Lead nitrate Boiling tube Bunsen burner 43. FreedistributionbyA.P.Government 33 You will notice the liberation of gas bubbles at both the electrodes. These bubbles displace the water in the test tubes. Is the volume of gas collected in both the test tubes same? Once the test tubes are filled with gases take them out carefully.Test both the gases separately by bringing a burning candle near the mouth of each test tube. • What do you observe in each case? Can you predict the gas present in each test tube? In the above activity on passing the electricity, water dissociates to hydrogen and oxygen. Electrolysis 2H2 O (l) ——— 2 H2 (g) + O2 (g) ……..... (23) Activity 8 - Take some quantity of silver bromide on a watch glass. - Observe the colour of silver bromide. - Place the watch glass in sunlight for some time. - Now observe the colour of silver bromide. • What changes do you notice? • Did the colour of the silver bromide change? Silver bromide decomposes to silver and bromine in sunlight. Light yellow coloured silver bromide turns to gray due to sunlight. fig-8: Electrolysis of water O2 H2 + – Anode Cathode 9V battery Plastic mug Test tubes Switch Graphite rods Acidified water fig-9(a): Silver bromide (light yellow colour) fig-9(b) when exposed to sunlight (gray colour) silver metal 44. ChemicalreactionsandEquations34 X Class sunlight 2AgBr(s) ——— 2 Ag (s) + Br2 (g) ……..... (24) This decomposition reaction occurs in presence of sunlight and such reactions are called photochemical reactions. All the above decomposition reactions require energy in the form of heat, light or electricity for converting the reactants to products.All these reactions are endothermic. Carry out the followingActivities: i) Take a pinch of AgCl2 in a watch glass. Keep it in sunlight for some time and observe the change. ii) Take some ferrous sulphate crystals in a boiling tube. Heat it over spirit lamp. iii) Take about 2 gm of barium hydroxide in a test tube.Add about 1 gm of ammonium chloride and mix with glass rod. Touch the test tube with your palm. What do you observe? Displacement reaction. In displacement reaction one element displaces another element from its compound and takes its place there in. Displacement of hydrogen from acids by metals: Generally metals which are more active than hydrogen displace it from an acid. Let us observe the reaction in following activity. Activity 9 - Take a small quantity of zinc dust in a conical flask. - Add dilute hydrochloric acid slowly. - Now take a balloon and tie it to the mouth of the conical flask. - Closely observe the changes in the conical flask and balloon. - What do you notice? You can see the gas bubbles coming out from the solution and the balloon bulges out (figure 10b). Zinc pieces react with dilute hydrochloric acid and liberate hydrogen gas as shown below. Zn (s) + 2HCl (aq) ZnCl2(aq) + H2 (g) .....(25) In reaction (25) the element zinc has displaced hydrogen from hydrochloric acid. This is displacement reaction. 45. FreedistributionbyA.P.Government 35 Activity 10 - Take two iron nails and clean them by rubbing with sand paper. - Take two test tubes and mark them asAand B. - Take about 10ml of copper sulphate solution in each test tube. Dip one iron nail in copper sulphate solution of test tubeAand keep it undisturbed for 20 minutes. - Keep the other iron nail aside. - Now take out the iron nail from copper sulphate solution and compare with the other iron nail that has been kept aside. (see fig11-a) - Compare the colours of the solutions in the test tubes. (see fig11-b) - What changes do you observe? You will find the iron nail dipped in copper sulphate solution becoming brown. The blue colour of copper sulphate solution in test tube ‘A’fades. fig-10(a) fig-10(b) Dil.HCl Conical flask Zinc dust Conical flask Zinc dust Balloon with H2 gas Dil.HCl fig-11(a):Iron nail dipped in copper sulphate solution fig-11(b): Iron nail and copper sulphate solutions compared before and after the experiment A B 46. ChemicalreactionsandEquations36 X Class The chemical reaction in this activity is: Fe (s) + CuSO4 (aq) FeSO4 (aq) + Cu (s) .....(26) Iron is more reactive than copper, so it displaces copper from copper sulphate. This is another example of displacement reaction. Other examples of displacement reaction are: i) Zn(s) + 2AgNO3 (aq) Zn (NO3)2 (aq) + 2 Ag (s) ..... (27) ii) Pb (s) + CuCl2 (aq) PbCl2 (aq) + Cu(s) ..... (28) Double displacement reaction Activity 11 - Take a pinch of lead nitrate and dissolve in 5.0ml of distilled water in a test tube. - Take a pinch of potassium iodide in a test tube and dissolve in distilled water. - Mix lead nitrate solution with potassium iodide solution. - What do you observe? A yellow coloured substance which is insoluble in water, is formed as precipitate. The precipitate is lead iodide. Pb (NO3) 2(aq) + 2KI (aq) PbI2 (s) + 2KNO3 (aq) .....(29) lead nitrate potassium Iodide lead iodide potassium nitrate Thisreactionisdoubledisplacementreaction.Iftworeactantsexchange their constituents chemically and form two products, then the reaction is called as double displacement reaction. Other examples of double displacement reactions are: 1) Sodium sulphate solution on mixing with barium chloride solution forms a white prepitate of barium sulphate and soluble sodium chloride. Na2 SO4 (aq) + BaCl2 (aq) BaSO4(s) + 2 NaCl (aq) .....(30) fig-12: formation of lead iodide and potassium nitrate Pb(NO3)2 KI Lead Iodide KNO3 47. FreedistributionbyA.P.Government 37 2) Sodium hydroxide reacts with hydrochloric acid to form sodium chloride and water. NaOH(aq) + HCl(aq) NaCl(aq) + H2 O(l) .....(31) 3) Sodium chloride spontaneously combines with silver nitrate in solution giving silver chloride precipitate. NaCl (aq) +AgNO3(aq) AgCl(s) + NaNO3(aq) .....(32) Oxidation and Reduction ‘Oxidation’isareactionthatinvolvestheadditionofoxygenorremoval of hydrogen. ‘Reduction’ is a reaction that involves the addition of hydrogen or removal of oxygen. Let us try to understand more clearly doing this experiment. Activity 12 - Take about 1.0g of copper powder in a china dish. - Keep the china dish on a tripod stand containing wire gauge. - Heat it with a bunsen burner or with a spirit lamp. - Do you find any change in colour of copper? You will notice that the surface layer of copper becomes black. • Why does the colour of copper change? • What is the black colour product formed on the surface of copper? In the activity on heating copper it reacts with oxygen present in the atmosphere to form copper oxide. The reaction is shown below. Heat Cu(s) + O2(g) ——— 2 CuO(S) .....(33) fig-13(b) China dish fig-13(a): Black copper oxide fig-13(c): Oxidation of copper to copper oxide Chind dish containing Copper powder Wire gauze Tripod stand Bunsen burner 48. ChemicalreactionsandEquations38 X Class Here copper combines with oxygen to form copper oxide. Here oxygen is gained and the process is called oxidation. Nowpasshydrogengasoverhotcopperoxideobtainedinaboveactivity and observe the change. • What do you notice? • Is there any change in black colour of copper oxide? You will notice that the black coating on copper turns brown because copper oxide loses oxygen to form copper. In this process oxygen is lost and the process is called Reduction. Heat CuO(s) + H2(g) ——— Cu(s) + H2 O (g) In the above reaction hydrogen is gained; such reaction is called reduction reaction. Generally oxidation and reduction occur in the same reaction. If one reactant gets oxidized, the other gets reduced. Such reactions are called oxidation-reduction reactions or redox reactions. In the CuO, H2 reaction CuO is reduced and H2 is oxidized. Some other examples of redox reactions are: i) 2 Fe2 O3(s) + 3C(s) 4 Fe (s) + 3CO2 (g) ……..... (34) ii) 2 PbO (3) + C(s) 2Pb(s) + CO2 (g) ……..... (35) Have you observe the effects of oxidation reactions in daily life Corrosion: You must have observed that a freshly cut apple turns brown after some time. The shining iron articles gradually become reddish brown when left for some time. Burning of crackers produce dazzling light with white fumes. fig-14: Reduction of copper oxide to copper H2 gas H2 O(g) Bunsen burner Stand Glass tube Black copper oxide Cork 49. FreedistributionbyA.P.Government 39 • How do these changes occur? They are all the examples of the process called oxidation. Let us know how? Oxidation is the reaction of oxygen molecules with different substances starting from metal to living tissue which may come in contact with it. Apples pears, bananas, potatoes etc., contain enzyme called polyphenol oxidase or tyrosinase, which reacts with oxygen and changes the colour on the cut surface of the fruit. The browning of iron, when left for sometime in moist air, is a process commonlyknownasrustingofiron.This process is basically oxidation reaction which requires both oxygen and water. Rusting does not occur in oxygen free water or dry air. Burning of crackers is also oxidation process of variety of chemicals. • Did you notice the colour coating on silver and copper articles? When some metals are exposed to moisture, acids etc., they tarnish due to the formation of respective metal oxide on their surface. This process is called corrosion. Look at the following examples: i. The black coatings on silver(see fig-16) 4Ag + 2H2 S + O2 2Ag2 S + 2H2 O ..... (37) black fig-15: Rusting of iron fig-16: Tarnishing of silverware (before & after) 50. ChemicalreactionsandEquations40 X Class Do you know? Gold one of the most valuable of elements has been prized since antiquity for its beauty and resistance to corrosion. ii. Green coating on copper (see fig-17) 2Cu + O2 2CuO ..... (38) Corrosion is the oxidative deterioration of a metal. Corrosion causes damage to car bodies, bridges, iron railings, ships etc., and to all other objects that are made of metals. Especially corrosion of iron is a serious problem. Corrosion can be prevented or at least minimized by shielding the metal surface from oxygen and moisture. It can be prevented by painting, oiling,greasing,galvanizing,chromeplatingormakingalloys.Galvanizing is a method of protecting iron from rusting by coating them a thin layer of Zinc. Alloying is also a very good method of improving properties of metal. Generally pure form of iron is very soft and stretches easily when hot. Iron is mixed with carbon, nickel and chromium to get an alloy stainless steel. The stainless steel is hard and does not rust. A metallic substance made by mixing and fusing two or more metals, or a metal and a nonmetal, to obtain desirable qualities such as hardness, lightness, and strength is known as alloy. For example: Brass, bronze, and steel. fig-17: Corrosion of copper 51. FreedistributionbyA.P.Government 41 Key words Reactants, products, exothermic reaction, endothermic reaction, chemical combination, chemical decomposition, displacement reaction, double displacement reaction, oxidation, reduction, corrosion, rancidity, antioxidants. Some more effects of oxidation on everyday life • Combustion is the most common example for oxidation reactions. Forexample:burningofwoodinvolvesreleaseofcarbondioxide,water vapour along with huge amount of energy. • Rising of dough with yeast depends on oxidation of sugars to carbon dioxide and water. • Bleaching of coloured objects using moist chlorine Cl2 + H2 O HOCl + HCl ..... (39) HOCl HCl + (O) ..... (40) Coloured object + (O) Colourless object. Some times during rainy season the power supply to our home from the electric pole will be interrupted due to formation of the metal oxide layer on the electric wire. This metal oxide is an electrical insulator. On removingthemetaloxidelayerformedonthewirewithasandpaper,supply of electricity can be restored. Rancidity • Have you ever tasted or smelt the fat/oil containing food materials left for a long time? • When fats and oils are oxidized they become rancid. Their smell and taste change. Thus we can say that oxidation reactions in food material that were left for a long period are responsible for spoiling of food. Rancidity is an oxidation reaction. • How can we prevent the spoiling of food? The spoilage of food can be prevented by adding preservatives like Vitamin C andVitamin E. Usually substances which prevent oxidation (Antioxidants) are added to food containing fats and oil. Keeping food in air tight containers helps to slow down oxidation process. Do you know that manufacturers of potato chips flush bags of chips with nitrogen gas to prevent the chips from getting oxidized. 52. ChemicalreactionsandEquations42 X Class • Chemicalchangeispermanentchange. • AChemicalequationrepresentsachemicalreaction. • Complete chemical equation represents the reactants, products and their physical state. • AChemicalequationissaidtobebalanced,whenthenumberofatomsofeachelementissame on both reactants side and products side. • Achemicalequationmustalwaysbebalanced. • In a combination reaction two or more substances combine to form a new single substance. • In a decomposition reaction a single substance decomposes to give two or more substances. • Reactions in which heat energy is absorbed by the reactants are endothermic reactions. • In exothermic reaction heat energy is released by the reactants. • Adisplacementreactionoccurs,whenanelementdisplacesanotherelementfromitscompound. • Twodifferentatomsorionsareexchangedindoubledisplacementreactions. • OxidationisthegainofOxygenorlossofHydrogen. • LossofoxygenorgainofHydrogenisReduction. • Corrosion causes damage to iron appliances. • When fats and oils are oxidized, they become rancid. • Precipitateisaninsolublesubstance. 1. What is a balanced chemical equation? Why should chemical equations be balanced? (AS1) 2. Balancethefollowingchemicalequations.(AS1) a) NaOH + H2 SO4 Na2 SO4 + H2 O b) Hg (NO3)2 + KI Hg I2 + KNO3 c) H2 + O2 H2 O d) KClO3 KCl + O2 e) C3 H8 + O2 CO2 + H2 O 3. Writethebalancedchemicalequationsforthefollowingreactions.(AS1) a) Zinc + Silver nitrate Zinc nitrate + Silver. b) Aluminum+copperchloride Aluminumchloride+Copper. c) Hydrogen + Chlorine. Hydrogen chloride. d) Ammonium nitrate Nitrogen + Carbon dioxide + water. 4. Writethebalancedchemicalequationforthefollowingandindentifythetypeofreactionineach case. (AS1) a) Calcium hydroxide (aq) + Nitric acid (aq) Water (l) + Calcium nitrate (aq) What we have learnt Improve your learning 53. FreedistributionbyA.P.Government 43 b) Magnesium (s) + Iodine (g) Magnesium Iodide. (s) c) Magnesium(s) + Hydrochloric acid(aq) Magnesium chloride(aq) + Hydrogen(g) d) Zinc(s) + Calcium chloride (aq) Zinc Chloride (aq) + Ca(s) 5. Write an equation for decomposition reaction where energy is supplied in the form of Heat/light/electricity.(AS1) 6. What do you mean by precipitation reaction? (AS1) 7. How chemical displacement reactions differ from chemical decomposition reaction? Explain with an example for each. (AS1) 8. Name the reactions taking place in the presence of sunlight? (AS1) 9. Why does respiration considered as an exothermic reaction? Explain. (AS1) 10. Whatisthedifferencebetweendisplacementanddoubledisplacementreactions?Writeequations for these reactions? (AS1) 11. MnO2 + 4HCl MnCl2 + 2H2 O + Cl2 In the above equation, name the compound which is oxidized and which is reduced? (AS1) 12. Givetwoexamplesforoxidation-reductionreaction.(AS1) 13. Intherefiningofsilver,therecoveryofsilverfromsilvernitratesolutioninvolveddisplacement by copper metal.Write the reaction involved. (AS1) 14. What do you mean by corrosion? How can you prevent it? (AS1) 15. Explainrancidity.(AS1) 16. Balancethefollowingchemicalequationsincludingthephysicalstates.(AS1) a) C6 H12 O6 ——— C2 H5 OH + CO2 b) Fe + O2 ——— Fe2 O3 c) NH3 + Cl2 ——— N2 H4 +NH4 Cl d) Na + H2 O ——— NaOH +H2 17. Balancethechemicalequationbyincludingthephysical statesofthesubstancesforthefollowing reactions. (AS1) a) Barium chloride and sodium sulphate aqueous solutions react to give insoluble Barium sulphateandaqueoussolutionofsodiumchloride. b) Sodium hydroxide reacts with hydrochloric acid to produce sodium chloride and water. c) Zinc pieces react with dilute hydrochloric acid to liberate hydrogen gas and forms zinc chloride 18. A shiny brown coloured element ‘X’o n heating in air becomes black in colour. Can you predict the element ‘X’ and the black coloured substance formed? How do you support your predictions?(AS2) 19. Why do we apply paint on iron articles? (AS7) 20. What is the use of keeping food in air tight containers? (AS7) 54. ChemicalreactionsandEquations44 X Class Fill in the blanks 1. The decomposition of vegetable into compost is an example of _____ reaction. 2. Thechemicalreactionsinwhichenergyisabsorbedtoformanewcompoundiscalled_____ 3. The reaction 2N2 O 2N2 + O2 is an example for _____ reaction. 4. The reaction Ca + 2H2 O Ca(OH)2 + H2 is an example for _____ reaction. 5. The substances that are present on left side of a chemical equation are called _____. 6. The arrow mark between the products and reactants of a chemical equation shows _____ of thereaction. 7. Match the following: 1) 2AgNO3 + Na2 CrO4 Ag2 CrO4 + 2NaNO3 ( ) a) combination reactions 2) 2 NH3 N2 + 3H2 ( ) b) decomposition reactions 3) C2 H4 + H2 O C2 H6 O ( ) c) displacement reactions 4) Fe2 O3 + 3CO 2 F2 + 3CO2 ( ) d) double displacement Reactions 1. Fe2 O3 + 2Al Al2 O3 + 2 Fe. [ ] The above reaction is an example of: a)Combinationreaction b)Decompositionreaction c)Displacementreaction d)Doubledecompositionreaction 2. Whathappenswhendil.hydrochloricacidisaddedtoironfilings?Choosethecorrectanswer. a) Hydrogen gas and iron chloride are produced. [ ] b) Chlorine gas and iron hydroxide are produced. c) No reaction takes place. d) Iron salt and water are produced. 3. 2 PbO(s) + C (s) 2Pb(s) + CO2 (g) [ ] Whichofthefollowingstatementsarecorrectfortheabovechemicalreaction? a) Lead is reduced b)Carbon dioxide is oxidized c) Carbon is oxidized d) Lead oxide is reduced. i) (a) and (b) ii) (a) and (c) iii) (a), (b) and (c) iv)all. 4. The chemical equation BaCl2 + Na2 SO4 BaSO4 + 2NaCl represents following type of chemicalreaction. [ ] i)displacement ii)combination iii)decomposition iv)double-displacement 5. Thereactionofformationhydrogenchloridefromhydrogenandchlorideрepresentsfollowing typeofchemicalreaction [ ] i)decomposition ii)displacement iii)combination iv)double-displacement Multiple choice questions 55. FreedistributionbyA.P.Government 45 In class 6, we have learnt about shadows and we carried out many experiments with light rays and also discussed the rectilinear propagation of light i.e., light travels in a straight line. In class 7 we learnt the laws of reflection. Let us recall some of them. − A source of light, an opaque object and a screen are needed to form a shadow. − Light travels in a straight line. − When light gets reflected from a surface, the angle of reflection is equal to the angle of incidence. − The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane. You must have observed shadows and images in your daily life. Sme questions might have come to your mind while observing these shadows or images. • Why does our image appear thin or bulged out in some mirrors? • Why is there right-left inversion (lateral inversion) when we look into a mirror? • Can we focus sunlight at a point using a mirror instead of a magnifying glass? • Why is the angle of reflection equal to the angle of incidence when a light ray gets reflected from a surface? • Are the angle of reflection and angle of incidence also equal for reflection by curved surfaces? Reflection of light by different surfaces 3 Chapter 56. Reflection of Light by Different Surfaces46 X Class In this lesson we are going to learn about reflection of light in detail so that we can answer the above questions. Let’s start with some activities based on your previous knowledge. Activity 1 Formation of image by a pinhole camera Recall how an image forms in a pinhole camera that you have learnt in class 6. Draw a ray diagram of the formation of an image in a pinhole camera. What whould happen if we increase the size of the hole of the pinhole camera. Observe the flame of a candle with a pinhole camera making a big hole.Try to draw a ray diagram of the formation of an image in a pinhole camera with a big hole. Look at figure 1. By observing the figure we can understand that the light rays coming from the top of the candle flame fall at different points on the screen. Similarly the rays coming from bottom of the candle flame also fall at different points on the screen. Thus we get blurred image on the screen due to the big hole of the camera as shown figure 1. Now think about reflection of light, and solve the task given below. Activity 2 Asmart crow is on a tree at point ‘A’as shown in figure-2. Some grains are on the ground. If the crow wants to take a grain and reach the point ‘B’ on the other tree as early as possible(in least time), from where should the crow pick up the grain? fig-1 Think and discuss • Does the explanation match your observation? • What happens if the hole is much bigger i.e. equal to the size of the flame? • If so, can we get an image of a flame on the screen of the pinhole camera? Why? • What happens if we observe the same flame with the same pinhole camera from a long distance? Think and answer. Do the experiment and check your answer.

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