Educational Chemistry software tool OrChem

OrChem is an interactive chemistry tool that's ideal for both high school and university level chemistry. OrChem goes beyond the typical multiple choice software and provides a true interactive environment for educators and students. The program is set-up in question and answer form. Questions range from organic structures to nomenclature to balancing equations. The uniqueness of OrChem is its ability to process a variety of answers (structures, numbers, and words) and to recognize common student mistakes. Students can receive feedback specific to their answer, giving them the direction needed to solve a problem.

For any school curriculum, questions can be easily edited and new question can be written. Marks can be assigned to each question and a record of students' results is kept in an encrypted file accessible only with the teacher version of the program. The self-marking feature of the program allows teachers to administer computerized tests and saves them time on marking.

Both pupils and educators can use the program in numerous ways. Students can use the program at home to reinforce information learned in class, study for tests and exams, and focus in on their problem areas. OrChem is an excellent tool for practicing drawing and naming organic molecules not to mention numerous other chemistry basics. Teachers can use OrChem to assign homework, create at home tests, give in-class tests and organize students' marks in the provided database.

To demonstrate the capabilities of this software we've matched it with the McGraw-Hill Ryerson textbook *Chemistry 11*. The textbook is an excellent introduction to common chemistry themes including matter classification, elements, the periodic table, chemical compounds, chemical bonding, reactions, the mole, acids and bases, Hydrocarbons etc. Up to 10 questions per chapter have been created. Each chapter and its questions are listed below.

The demo version of OrChem comes with 6 questions listed below, 5 of which are based on the Chemistry 11 textbook. To use the Demo download OrChemDemoInstall.exe from http://www.kw.igs.net/~microtec/OrChem/ and run it to install OrChem Demo version.

Problem 1 Draw the structural formula of 2,2-dimethylheptane (C13.1)
Problem 2 What is the molar mass of $Mg(OH)_2$? How many moles in 120g? (C5.5)
Problem 3 What is the empirical formula of a compound that is 79.89% carbon and 20.11% hydrogen? (C6.1)
Problem 4 Balance the equation $P_4O_{10} + H_2O \rightarrow H_3PO_4$ (C4.4)
Problem 5 Complete the reaction $4P + 5O_2 \rightarrow$?
Problem 6 What is the IUPAC name of $NaHCO_3$? (C3.3)

Problems for McGraw-Hill Ryerson textbook Chemistry 11

Chapter 2 " Elements and the Periodic Table"

C2.2 – Complete the Lewis structure of lithium
C2.3 – Complete the Lewis structures of neon and bromine
C2.4 – Complete the Lewis structure of arsenic

Chapter 3 "Chemical Compounds and Bonding"

C3.1 – Find the non-polar molecules.
C3.2 – Find the polar molecules.
C3.3 – What is the IUPAC name of $NaHCO_3$?
C3.4 – Arrange the given bonds from least to most polar CH, OH, CBr, OF, HCl.

C3.5 – One at a time state the molecular formula of copper (II) nitrate, calcium hydroxide, magnesium chloride and ammonium nitrate
C3.6 – Calculate the electronegativity difference between oxygen and hydrogen.

C3.7 – What is the electronegativity difference between carbon (C) and hydrogen (H) and what bond is formed based on that difference?
C3.8 – Arrange the given elements in order of increasing electronegativity.
C3.9 – Are fluorine and neon isoelectric atoms?
C3.10 – Two unknown compounds X and Y are experimented with, based on the given observations, which of the two is ionic?

Chapter 4 "Classifying Reactions: Chemicals in Balance"

C4.1 What element is created by the alpha decay of radium?
C4.2 What element undergroes alpha decay to form cerium?
C4.3 A hydrogen (H) isotope undergoes beta decay to form an unknow atom , what atoms is formed?
C4.4 Balance the equation $P_4O_{10} + H_2O = H_3PO_4$
C4.5 Complete the reaction $AgNO_3 + NaBr = ?$
C4.6 Iron reacts with oxygen to form iron oxide. Write the molecular equation by filling in the needed yellow areas.
C4.7 In an aqeous solution sodium sulfate and lead nitrate undergo a double displacement reaction to form lead sulfate and sodium nitrate. Write the molecular equation for this reaction by filling in the needed yellow areas.
C4.8 Name the type of reaction (synthesis, decomposition, single displacement, double displacement).
C4.9 Complete the reaction $K + Br_2 = ?$ Give the IUPAC name of the product.
C4.10 Balance the equation $FeCl_3 + NH_4OH = Fe(OH)_3 + NH_4Cl$

Chapter 5 "Counting Atoms and Molecules: The Mole"

C5.1 – Determine the average atomic mass of copper given its isotopes and their % abundance.
C5.2 – Determine the average atomic mass of silver given its isotopes and their % abundance.
C5.3 – How many moles are present in 20.00g of pure carbon?
C5.4 – What is the molar mass of water? How many moles of water are present in 54g?
C5.5 – What is the molar mass of $Mg(OH)_2$? How many moles in 120g?
C5.6 – What is the molar mass of NaCl? How much do 3.5 moles of NaCl weigh?
C5.7 – How many moles of $MgCl_2$ are present in 357.04g? How many $MgCl_2$ molecules are there in 357.04g?
C5.8 – How many H atoms are present in 2 moles of water?
C5.9 – How many moles of CH_4 are in 92.24g? How many atoms of H in 92.24g of CH_4?
C5.10 – How many NaOH molecules are found in 130g?

Chapter 6 "Chemical Proportions in Compounds"

C6.1 – What is the empirical formula of a compound that is 79.89% carbon and 20.11% hydrogen?
C6.2 – What is the empirical formula of a compound that is 43.6% phosphate and 56.4% oxygen? Given the molar mass, what is the molecular formula?
C6.3 – What % of NaCl is Na (by mass)?
C6.4 – What % of $NaHCO_3$ is oxygen?
C6.5 – Out of 100g of $CaSO_4.xH_2O$ 79.1g is $CaSO_4$, how many molecules of water are incorporated with every molecule of calcium sulfate?
C6.6 – What % of $LiCl_2.4H_2O$ is water?
C6.7 – What is the value of x if 100g of hydrate contain 48.8g of $MgSO_4$?
C6.8 – What % of $Ba(OH)_2.8H_2O$ is water by mass?

Chapter 7 "Quantities if Chemical Reactions"

C7.1 – In the reaction $Sc_2O_3 + 3H_2O = 2Sc(OH)_3$ how many moles of Sc_2O_3 react with 6 moles of water?
C7.2 – How many moles of NaCl are formed from 2.5 moles of $BaCl_2$?
C7.3 – How many g of NaCl are formed from 46g of Na in $2Na + Cl_2 = 2NaCl$?
C7.4 – $4P + 5O_2 = 2P_2O_5$ if 15 moles of oxygen and 16 moles are present in a test tube, which is the limiting reagent? How much phosphate remains in test tube once the reaction has gone to completion?
C7.5 – A test tube contains 117.3g of K and 319.6g of Br which compound is the limiting reactant and how much of the excess compound will remain?
C7.6 – If 1 mole of copper nitrate and 2 moles of potassium hydroxide react how many moles of copper hydroxide are formed?
C7.7 – An experiment yield 114g of NaCl if the percentage yield is 95% what is the theoretical yield?

C7.8 – A ring weighs 12g if it is 75% gold and 25% impurities what is the weight of the gold?

C7.9 – How much KCl is obtained from 490g of decomposed $KClO_3$? If only 441 g are obtained what is the % yield?

C7.10 – If an experimenter wants to obtain 355g of sodium sulfate how much hydrogen sulfate (in g) should he use?

Chapter 8 "Solutions and Their Concentrations"

C8.1 – 25g of salt are added to 2L of water, what is the concentration of the solution in g/100ml?

C8.2 – 90g of AgCl are dissolved in 150ml of water, what is the mass/volume percent of the solution?

C8.3 – HCl is dissolved in water in a 75%v/v solution how much HCl is there in 500 ml of solution?

C8.4 – A 1kg object contains 0.02g of lead. What is the amount of lead present in ppm?

C8.5 – A student dissolved 0.250mols of HCl in 200ml of water. What is the resulting concentration in mole/L?

C8.6 – A student dissolves 346g of PbI_2 in a 3L solution what is the resulting concentration?

C8.7 – How many moles of CaF_2 are present in 500ml of a 0.8M solution?

C8.8 – What's the mass of ZnO in 4L of a 1.5M solution?

C8.9 – A chemist needs to create 300ml of a 0.1M $CuSO_4$ solution if all she has is 2.5M solution of $CuSO_4$ how much of it should she dilute?

C8.10 – 300ml of water is added to 100ml of 3.0M $AgNO_3$ solution. What's the new concentration of the solution?

Chapter 9 "Aqueous Solutions"

C9.1 – When $NaClO_3$ and $Ca(NO_3)_2$ are mixed in an aqueous solution does a precipitate form? What's the molecular formula of the precipitate?

C9.2 – When BaO and $CsClO_3$ are mixed in solution does a precipitate form? Complete the equation for the reaction.

C9.3 – When $LiNO_3$(aq) is mixed with NaCl(aq) does a precipitate form?

C9.4 – In the given reaction find the spectator ions.

C9.5 – What is the net ionic equation of the reaction given above?

C9.6 – Calculate the concentration of H atoms in 2.5L of a 1.25M aqueous solution of $Ba(OH)_2$.

C9.7 – 416g of $BaCl_2$ is dissolved in 400ml of water. What is the concentration of $BaCl_2$? Of Cl atoms?

C9.8 – A chemist wants to mix enough $BaCl_2$(aq) with 500ml of 0.5M $LiSO_4$(aq) to precipitate out all of the sulfate ions (SO_4^{2-}). How much $BaCl_2$(aq) (in L) should he add?

C9.9 – 500ml of 0.4M $ZnSO_4$(aq) are mixed with 500ml of 0.4M K_2O(aq). How much zinc oxide precipitates out of the solution?

Chapter 10 "Acids and Bases"

C10.1 – What is the pH of a 0.0005M solution of calcium hydroxide?

C10.2 – In the reaction given above ($HCN + H_2O \rightarrow H_3O^+ + CN^-$) which compound acts as an acid?

C10.3 – Identify each of the five compounds as an acid or a base.

C10.4 – In the reaction $HCN + H_2O \rightarrow H_3O^+ + CN^-$ which compound acts as an acid according to the Bronsted-Lowry theory of acids and bases?

C10.5 – $CH_3COO^-(aq) + H_2O(l) \rightarrow CH_3COOH(aq) + OH^-(aq)$ in the given reaction which compound acts as a base?

C10.6 – 1 mole of hydroiodic acid (HI) is dissolved in 2L of water, what is the pH of the resulting solution?

C10.7 – A student needs to neutralize 500ml of 0.25M nitric acid how much 1.0M LiOH should she use?

C10.8 – A solution has a pH of 0.25, what is the hydronium ion concentration in the solution?

Chapter 11 "The Behavior of Gases"

C11.1 – A 2L balloon filled with helium gas has a pressure of 225kPa. If the volume of the balloon is increased so it is equal to 3L what is the new pressure?

C11.2 – A 4L container contains hydrogen gas with a pressure of 300kPa. If all of the gas is place into a 2L container what will the pressure be?

C11.3 – A balloon containing oxygen is blown up inside at room temperature (294K) to a volume of 3L. A child takes the balloon outside to play where the temperature is 300K, what will be the volume of the balloon outside?

C11.4 – A plastic container (with a constant volume) contains chlorine gas whose pressure at 273K is 100kPa. If the container is heated up to 300K what is the new pressure?

C11.5 – An expandable container contains oxygen gas at a pressure of 100kPa, volume of 3L and temperature of 290K. If the volume and temperature are changed to 4L and 350K respectively what is the new pressure?

C11.6 – A glass vessel contains three different types of gases whose partial pressures are 120kPa, 55kPa and 89kPa. What is the total pressure inside the vessel?

Chapter 12 "Exploring Gas Laws"

C12.1 – A 4L container with a mass of 12g is filled with chlorine gas up to a pressure of 99kPa at a temperature of 25^0C. The

container and gas have a mass of 38g. What is the molar volume of chlorine at STP?

C12.2 – At STP a gas has a molar volume of 21.5L/mole. How many moles of the gas are found in 28.0L?

C12.3 – Neon gas has a molar volume of 22.4L at STP. What is the mass of 4L of neon gas at STP?

C12.4 – Oxygen (O_2) has a molar volume of 22.4L at STP. What is the volume of 23.5moles of oxygen at STP?

C12.5 – 25L of oxygen gas are found in a closed vessel at a temperature of 1^oC and a pressure of 101.3kPa. What is the mass of the oxygen?

C12.6 – What is the pressure of 1.50moles of helium gas contained in a 1500ml container at 99K?

C12.7 – What is the temperature (in Kelvin's) of 6 moles of hydrogen gas in a 4L vessel with a pressure of 2.5atm?

C12.8 – What is the density (in g/L) of oxygen gas at a pressure of 141kPa and a temperature of 65K?

C12.9 – 40L of an unknown gas weighs 40g at a temperature of 280K and a pressure of 145kPa. What is the molar mass of the unknown gas?

C12.10 – $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ if 15L of hydrogen gas reacts with excess chlorine gas how much hydrogen chloride (in L) is produced?

Chapter 13 "The Chemistry of Hydrocarbons"

C13.1 – Draw the structural formula of 2,2-dimethylheptane.

C13.2 – What is the IUPAC name of the alkane shown above?

C13.3 – Draw the geometric isomer of trans-3-hexene.

C13.4 – Draw the structural formula of propene.

C13.5 – Name the given aromatic hydrocarbons.

C13.6 – Enter in all possible structures of carbohydrates with the molecular formula C_5H_{12}.

C13.7 – If a hydrocarbon has the root "non" how many carbons are in the main chain?

Chapter 14 " Energy Trapped in Hydrocarbons"

C14.1 – Write down the equation for the complete combustion of propane.

C14.2 – Does the equation $2C_8H_{18} + 15O_2 \rightarrow 8C + 4CO + 4CO_2 + 18H_20$ show complete or incomplete combustion?

C14.3 – A 12g sample of graphite is heated up from 12^oC to 23^oC. Assuming the specific heat capacity of graphite is 0.711, how much energy does the graphite absorb?

C14.4 – A 30g sample of liquid water absorbs 375J of hear energy, by how many degrees does the temperature go up?

C14.5 – 45g of an unknown substance are heated up to 85^{o}C and are quickly transferred to a calorimeter. The calorimeter contains 150g of water with an initial temperature of 24^{o}C. The final temperature of the calorimeter levels off at 29^{o}C. How much heat did the unknown substance lose?

C14.6 – 30g of an unknown substance is heated up and placed in a calorimeter. The temperature of the substance drops by 15^{o}C while the calorimeter gains 2115J of energy. What is the specific heat capacity of the unknown substance?