APPENDIX H

Sample Classroom Interactions of the Treatment

Sample 1: Combination of Elements to form Compounds Based on Electron Structure.

Teacher: last few sessions we discussed about the electron structure of atoms. Give me two examples of elements having one electron in the outer orbit.

Student: Hydrogen.

T: How many electrons does it have?

S: One.

T: What is the arrangement?

S: One in the first orbit.

T: Give me another example.

S: Sodium.

T: What is it's atomic number?

S: Eleven.

T: Then, what is the electron structure?

S: 2, 8, 1.

T: (writes both the structures on the blackboard) give me an example of an element with two electrons in the outer orbit.

S: Magnesium with 2, 8, 2. (T writes on the blackboard)

T: With three electrons.

S: Aluminium with 2, 8, 3. (T writes on the b.b.)

T: With four?

S: Carbon with 2, 4. (T writes on the b.b.)

T: Examples with five, six, seven and eight electrons?

S: Nitrogen with 2, 5; Oxygen with 2, 6; Chlorine with 2, 7 and Neon with 2, 8. (T writes all on the b.b.)

T: Does Neon form compounds?

S: NO, because it has a stable electron structure of eight.

T: What about the rest of elements with less number of electrons in the outer orbit?

S: All those elements form compounds.

T: Why?

S: Because they have less than eight electrons in the outer orbit.

T: Now, here, I have written the electron structures of Na, Mg, Al, C, N, O and Cl. They all have unstable electron structure in their outer orbits. Are these structures stable or not?

S: They are all unstable.

T: How can they attain stability? Suggest any one way in which two elements can attain stability.

S: Na can loose one electron and Cl can take that.

T: When sodium looses one electron what happens to its electron structure?

S: It becomes 2, 8; like that of Ne.

S: Ne has a stable structure.

T: What charge would Na acquire?

S: ....

T: How many electrons are there in a sodium atom?

S: eleven negative.

T: So, if we remove one electron what would happen to the atom?

S: There would be ten negative.

T: How many positive particles are there in the Sodium atom.

S: Eleven positive.

S: So, the Sodium atom which has lost one electron will acquire one positive charge.

T: How can we represent it?

S: With a negative sign.

T: Sodium with all electrons is called an atom and when it acquires a positive charge it is called an 'ion'.
What would happen to Cl atom when it acquires one more electron?

S: It would get eighteen electrons.

S: It will have an extra negative charge.

T: Will it remain an atom?

S: No, it will become a negative 'ion'.

T: How many negative charges will it acquire?

S: One.

T: Why?

S: Because it has acquired only one electron.

T: The positive and negative particle stays together because of their attraction. Thus the compound NaCl is formed.

S: What happens to the charges when they form a compound?

S: The positive of Na and negative of Cl becomes equal.

T: The charges get neutralised. If one of the ions had two positive charges, will it be neutralised by one negative.

S: Yes, because they are positive and negative they will get neutralised.

S: No, only one will get neutralised. It will have one positive.

T: Let us take an example for discussion. How many electrons have magnesium in the outer orbit?

S: Two.

T: How can it attain stability?

S: By loosing the two outer electrons.

T: Suppose it looses its electrons to Chlorine. Then, how can it attain stability?

S: Chlorine can take only one. So Mg cannot give both of them.

S: Cl will take both because it takes electrons.

S: Then Cl will not be stable.

T: Why woud'nt it be stable?

S: Because it will have nine electrons. This is not stable. Eight is stable.

T: Then how can Mg attain stability?

S: It may loose the electrons to any other element.

T: Can you suggest?

S: Oxygen has six in the outer. It needs two more. Mg can give both its electrons to oxygen.

S: Mg can lose its electrons to two Cl atoms.

S: How is it possible?

S: We know that Magnesium chloride is there like Sodium Chloride. Mg looses one electron each to two Cl atoms.

T: Then how will we represent acompound of Mg and Cl.

S: Mg Cl Cl.

T: Instead of Mg Cl Cl, it is usually represented as $MgCl_2$.

T: Will Mg and O form a compound?

S: Mg can give both its outer electrons to one O forming MgO.

T: What will be the charge of the Mg ion.

S: It will have two positive charges and O will acquire two negative charges.

T: How will Al with three electrons in the outer orbit attain stability?

S: It can give one each to three Cl atoms.

T: What would be the charge acquired by Al?

S: It will acquire three positive charges.

S: How can it attain three positive charges?

S: It will give three electrons to one Cl atom each. Because it has given out three negative charges it would get three positive.

T: Will Al and O form a compound and if so how? You try to find an answer. We will discuss it during the next session. Now let us take two other examples, say, Na and Mg. Will they combine to form compounds?

S: Yes, Na will loose one electron and Mg will loose two.

S: It is not possible. Mg will have only three and that is not stable.

S: Na and Mg would loose electrons. Then they are stable.

S: Both would be positive and they will not attract.

S: Positive and positive repels.

T: Yes, like charges repel.

S: Then six Na can loose one electron each to one Mg.

S: Then what would be the charge of Mg?

S: Six negative.

T: So far I have'nt heard of such a compound. But, it may be possible. As you learn further you'll learn about it.

Sample 2: Factors Affecting Rate of a Reaction

T: Here I have two solid substances. Are they the same?

S: No.

T: Why do you say so?

S: Their colour is different.

S: Their shape is different.

S: One is a grey solid and the other is reddish brown pieces.

T: To these two substances I'm adding two colourless liquids. (adds Con. H_2SO_4 to Cu turnings and dil. HCl to Zn rod) What is happening in these two test tubes?

S: A reaction is taking place.

T: How do you know?

S: New substance is produced.

S: In the first a reddish brown gas is produced.

S: It has a suffocating smell.

S: In the second a colourless gas is produced.

T: In this test tube a reaction is taking place where a reddish brown gas is produced and in this test tube a colourless gas is produced. What are the differences in these two reactions?

S: The colour of the gas produced is different.

S: The substances taken are different.

S: This gas has a bad smell, the other one does not have.

S: Here the reaction is faster and here it is slow.

S: No, if you add more acid to this it will also go on faster.

T: Let us try. (adds a few more drops of the acid to the Zn rod.

S: Then also it is slow.

S: May be it needs more acid.

T: Let us try again (adds more acid to the same test tube).

S: There is no difference. This must be a slow reaction.

T: Yes some reactions are slower than others. Here this one is slower than the other. There are other examples. Rusting of Iron where Iron changes into a reddish powder. Is that a slow or fast reaction?

S: It is a slow reaction, because it takes a long time for Iron to become rust.

T: How do you call a reaction as a slow reaction?

S: If the new substance is produced at a fast rate it is a fast reaction. If it goes on slowly it is a slow reaction.

T: What could be the possible reasons for these two reactions to be of different rate?

S: The acid added is different.

T: I'll repeat the experiment with the same amount of acid.

S: No the weight of the substance has also to be the same.

S: Only if the weight is the same we can know the difference.

T: (weighs out equal amount of Cu and Zn and adds the same quantity of acid to both). Here the acids are different. One is H_2SO_4 and the other is HCl. What do you observe?

S: One reaction is fast and the other is slow.

S: The difference is because the substance used is different.

S: All others are equal. So the difference is because of the substance.

T: One factor that determines the rate of a reaction is the nature of the substance.

T: Here I have Zn in three different forms. One, is a rod. The second is in the form of small pieces and the third is in the form of a powder. If I add the same amount of acid to all the three forms will the reaction rate be the same?

S: The matetial is the same and so the rate would be the same.

S: The weight of the three forms should be equal.

S: No, it is not required because the material is the same.

T: Why do you say that the weight has to be the same? (pointing at the student who gave such a hypothesis).

S: If the weights are different we cannot know whether the speed of the reaction changes because of the form of the material.

T: Let us perform the experiment. What have we got to take?

S: Equal weights of the three forms.

Teacher weighs equal quantity of the three forms of Zinc.

S: We have to add equal quantity of acid.

Teacher measures out equal quantity of the acid and adds to the three test tubes.

T: What do you observe?

S: The Zn powder reacts faster and the rod reacts very slowly.

T: What does this indicate?

S: The rate of the reaction depend on the condition of the substance whether it is a rod or a piece or powder.

T: Another factor which determines the rate of a reaction is the physical nature of the substance. The rod has less area for the acid to come in contact and so the reaction is slow.

S: The pieces will have more area where the acid can come and react and so the reaction goes on faster.

S: The powder has the maximum area where the acid can come and react. Therefore, the reaction goes on very fast.

T: The surface area increases as we make the big piece into smaller ones and the acid finds more place for reaction.

T: Suppose the two substances are in the form of gases, will they react faster or slower?

S: They will react fast?

S: Why?

S: Because the substances come in contact with a larger area.

T: How do you say this?

S: Because in gases the molecules are free to move around and the molecules of the two substances will come in contact and hit each other for the reaction, to take place.

T: If such a reaction is very very fast, how long will it take to complete the reaction?

S:

S: Only a few seconds.

S: May be even less.

T: Yes, certain reaction are so fast that the reaction is complete within fractions of seconds. Can you suggest any such example?

S: ....

T: If we mix H and Cl in presence of light the mixture will react so violently that it explodes.

S: Can we do the experiment in the class?

T: Sorry, it is very dangerous.

S: The test tube will break and teacher will get hurt.

T: Such reactions are not carried out in test tubes and so we cannot perform in the classroom.

S: The noise would disurb other classes also.

T: If we want to measure the rate of a reaction how can we do it? How do we express the speed of a moving car?

S: ■ per hour.

T: Similarly how can we express the rate of a reaction?

S: Amount of substance produced per hour.

T: If the reaction is a faster one and it goes to completion within a few minutes, then how would you express it?

S: Amount of substance produced per minute.

T: Depending on the reaction the unit may be changed but in all these cases the amount produced per unit time is taken as the rate of reaction.

S: If it is a very fast reaction then it may be expressed as the substance produced per second.

T: How will you express the rate of rusting of iron?

S: Amount of rust produced per day.

The teacher goes on to revise the factors that affect the rate of reaction one by one and writes them on the black board.
