CHEMISTRY (answer)

by Mike Marcelais

Balancing the equations given doesn't require any chemistry knowledge, but requires only a very basic knowledge of algebra – you basically have to make both sides have the same amount of each element.

Doing this doesn't actually give you a lot of information. The key here is that the next step is to use the information about what compounds exist in the problems and the nuclear reactions to construct a periodic table of the elements.

Only basic chemistry is used here. Compounds are created in a way to make the outer electron shells of the atoms be completely filled.

Compounds can be two different kinds:

- Ionic, where an element on the left side of the periodic table gives up its electrons to an element on the right side of the periodic table. Table salt (NaCl) is a real-world example of this, where sodium gives up the one electron in its outer shell to the chlorine atom which needs that one electron to fill its outer shell.
- Covalent, where two elements on the right side of the periodic table share one or more electrons share electrons to fill their outer shell. Carbon dioxide (CO_2) is a real-world example where the carbon atom shares two electrons with each oxygen atom. The two electrons from the carbon atom fill up the outer shell of the oxygen atom, and the four electrons (two from each oxygen) fill the outer shell of the carbon atom.

In either bond, the number of electrons that an element needs is equal to the distance away from the edge of the table, and it can be inferred from the ratio of elements in the compound. However, you can't tell from the formula whether that indicates they are on the left side or the right side of the table.

Start by making a list of all of the elements and the number of electrons they transact in compounds:

- Oi3Z2 means Oi needs 2 and Z needs 3.
- OiG2 means G needs 2.
- Is3Nr4 means Is needs 4 and Nr needs 3.
- Ov2R3 means Ov needs 3 and R needs 2.
- LlT4 means that Ll needs 4 and T needs 1.
- LlM means that M also needs 4.

- ML2 means that L needs 2 (given that M needs 4).
- Dn2Ie means that Dn needs 1 or 2 and Ie needs 2 or 4 (respectively)
- Av2Ie means that Av needs 1 or 2 (same as Dn)

Summary:

- Need 1: Av, Dn, Gr, T
- Need 2: Ie, Oi, L, R
- Need 3: Nr, Ov, Z
- Need 4: Is, Ll, M

The other elements not mentioned in the chemical equations are: An, G, J, Nk, Tx, Uo, and Wi.

The atomic weights in the second half give some limitations to the atomic numbers of the elements and also some relationships between their atomic weights (since the number of protons is also conserved).

From the example, you know that element G has an atomic weight of 1. T could be 2 or 3. We know from the other half that T is 1-away from the end of the table, this suggests that "something is different" than regular chemistry.

In fact, what is different is that the electron structure of atoms in this problem is different than in the "real" world. The inner shell has 3 electrons instead of 2 and the next two outer shells have 9 instead of 8. This is also indicated by the atom in the corner of the problem page. This means that the top row of the periodic table has 3 elements (and not 2), while subsequent rows have 9 (instead of 8). Assuming no gaps, this means that the 21 elements that you have would fill the first three rows exactly.

At this point, you can count that there are 4 elements that need 2 electrons (two on each side), which means that there "isn't room" for both Av and Dn to need 2 (along with Oi, L, and R), so they must need 1 (and Ie needs 2 instead of 4).

T being 2 is consistent with needing 1 electron. That makes Tx 3.

1 – G							2 – T	3 – Tx
4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21

Looking at the last equation (Is17 = L11 + 3G2) means that Is is 3 heavier than L. Since Is needs 4 and L needs 2, the only places where this is consistent is if L is 5 or 15 and Is is 8 or 17, but since the atomic weight of L is 10, then it can only be 5.

1 – G							2 – T	3 – Tx
4	5 – L	6	7	8 – Is	9	10	11	12
13	14	15	16	17	18	19	20	21

In particular, this makes Gr be 11 or 20. From the first nuclear equation, Gr has a weight of 21 with at least 5 neutrons, so its number is limited to 16. That makes it 11, which makes Wi equal to 6.

Looking at the fusion equation J25 + Ll14 = Ov37 + G2. We also know that Ll is a “need 4” that must be less than 14, and the only remaining option is 7. Ov is a “need 3” that must be larger than Ll (7) + J (?) - G (1): that could be 15 or 18. That would leave 9 or 12 as the value for J. J cannot be 9 though, as we already know the four “need 3” elements (Nr, Ov, Wi, and Z). Thus J is 12 and Ov is 18.

1 – G							2 – T	3 – Tx
4	5 – L	6 – Wi	7 – Ll	8 – Is	9	10	11 – Gr	12 – J
13	14	15	16	17	18 – Ov	19	20	21

Since we know L bonds ionicly (left-side elements can only bond ionicly), then M must be on the right side of the table. There is only one “need 4” element space on the right side remaining: 17.

Looking at Nk44 = Ie43 + G1, Nk and Ie must be adjacent elements. Ie is a “need 2” (10, 14, or 19), while the spots available for Nk that aren’t accounted for are in need 4, 1, or 0. Only “need 1” is adjacent, and since Nk is larger than Ie, both elements must be on the right side of the table. The only spots available are 19 for Ie and 20 for Nk.

Looking at Uo = An34 + Dn + G, you can’t actually fill in the blanks (the first blank must be 35 larger than the second blank), but you can know that Uo is heavier than Dn (and An). The two remaining spots are the “need 4” entry at 16 and the “need 0” entry at 21. Since Uo is heavier than An, Uo is 21 and An is 16. That results in Dn being 4.

By elimination, the last “need 1” element, Av, is 13.

There are four elements remaining. Oi and R are “need 2” (10 and 14) and Nr and Z are “need 3” elements (9 and 15). Since R2L2 is a compound, and L is on the left side of the table, R must be on the right side of the table, at 10, which means Oi is 14.

Oi bonds with Z, which means Z must be on the right side of the table (9). That leaves Nr as 15.

1 – G							2 – T	3 – Tx
4 – Dn	5 – L	6 – Wi	7 – Ll	8 – Is	9 – Z	10 – R	11 – Gr	12 – J
13 – Av	14 – Oi	15 – Nr	16 – An	17 – M	18 – Ov	19 – Ie	20 – Nk	21 – Uo

In the constructed table, if you read in the middle of the table, you can find the two words "Willis Movie" which (given the theme of the puzzle) should lead you to: **THE FIFTH ELEMENT**.