Merit

NZQA Intended for teacher use only

1(a) Using the Resource sheet provided, identify the reaction type occurring here:

- ☐ Neutralisation
- ☐ Combustion
- ☐ Decomposition
- ☐ Precipitation
- ☑ Combination

1(b) Justify your answer to 1(a), by linking to the observations and the predictable pattern expected for this type of chemical reaction.

I identified this as a combination chemical reaction because the generic word equation for a combination reaction is: metal + non-metal → ionic compound. In this situation aluminium (4Al) from the sparkler is ignited in the air causing it to react with the oxygen ($3O_2$) to form aluminium oxide ($2Al_2O_3$)

metal + nonmetal → ionic compound

aluminium(s) (4Al) + oxygen (g) ($3O_2$) → aluminium oxide (s) ($2Al_2O_3$)

1(c) Use the recorded observations to identify the reactants and products and qualitatively describe in terms of the elements present, why mass is conserved.

Reactants: For our reactants we have solid aluminium(4Al) ~~and~~ which is a shiny, silvery solid and Oxygen(O_2) from the air which is a colourless odourless gas.

Products: On the products we have a white solid ionic compound which is aluminium oxide ($2Al_2O_3$).

The law of conservation of mass states that mass of reactants = mass of products.

We can see that the reactants, aluminium (4Al) and oxygen ($3O_2$) fully reacted into aluminium oxide ($2Al_2O_3$) as the sparkler is unable to reignite

Mass is conserved.

2(a) Explain how the recorded observations match the changes expected by the predictable pattern for this type of reaction.

The recorded observations match the changes expected ~~for~~ by the predictable pattern for combination reactions because it was expected that aluminium (4Al) ~~was~~ (the metal) would react with the oxygen ($3O_2$) non metal in the air after being ignited, to then form a white powder/solid called aluminium oxide ($2Al_2O_3$) which is a combination of the two reactants. ionic compound.

2(b) Explain how the balanced chemical equation (given below), shows that mass is conserved by considering how the reactants turn into products.

You should discuss:

- The types of atoms present.
- The number of atoms of each type (this can be shown by a table or a diagram)
- How all of the atoms present in the reactants are rearranged to form the products.

There are only 2 types of atoms in the chemical equation. Namely, they are aluminium (4Al) and oxygen (O_2). In the reactans side there is 4 x aluminium from 4Al and 6x Oxygen from $3O_2$. On the products side there are 4 x aluminium and 6x oxygen from aluminium oxide ($2Al_2O_3$). Table:

$4Al + 3O_2 \longrightarrow 2Al_2O_3$

Al : 4	Al : 4
O : 6	O : 6

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The aluminium ions and oxygen ions react together to form aluminium oxide. From our table we can see that both sides of the chemical equation have the same amount of aluminium atoms (4 of them) and Oxygen atoms (6 of them). This shows that mass is conserved as no new atoms have been created and no atoms have been lost.

3	Using your understanding of conservation of mass, discuss the possible implications (effects) if the manufacturer **reduced** the amount of potassium chlorate in the sparkler.

If the manufactuer had reduced the amount of potassium chlorate in the sparkler the chemical reaction between aluminium (4Al) and oxygen($3O_2$) would occur much slower because the concentration of Oxygen($3O_2$) in the air is to low. This is because potassium chlorate helps make the sparkler sparkle more vigoursly and with out it the reaction is ~~little~~. Also this could affect the conservation of mass as without potassium chlorate the concentration of oxygen in the air becomes insufficient which could cause an inbalance in aluminium (4Al) and Oxygen($3O_2$) atoms on the products vs the reactants side. After the students experiment his sparkler was unable to reignite with potassium chlorate. If potassium chlorate was reduced, the chemical reaction may not have reacted fully reacted meaning there may be unreacted aluminium (4Al) and Oxygen($3O_2$) atoms which could possibly react after reignition.

Grade: Merit
For Merit, the student needs to explain chemical reactions in context. This involves explaining the relationship between the reactants and products for the range of chemical reactions using equations, with reference to conservation of mass. It also involves explaining how each chemical reaction links to a context, using predictable patterns and observations. This student has explained the relationship by showing how the elements in the reactants rearrange into the products supported by the balanced chemical equation and shows how the quantity of each element is the same in the reactants and products. The student has also used both observations (found in questions 1c, 2a, and 3) and the predictable pattern (in question 1b) to explain how the reaction links to the context of sparklers. Similar evidence for another two different reaction types is required for an overall grade of Merit. For Excellence, the student could discuss an implication of conservation of mass for the reaction in the context of sparklers.