Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ date\_\_\_\_\_\_\_\_\_ period \_\_\_\_

1 Exothermic and endothermic reactions

Decide whether each of these reactions is exothermic or endothermic:

1. When two chemicals mix their temperature rises: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. A solid burns brightly and releases heat, light and sound: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
When two chemicals are mixed their temperature drops: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Two chemicals will only react if you heat them continually: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Plants take in light energy for photosynthesis: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| **Identifying Endothermic vs Exothermic Reactions**  |
| Decide whether each of these scenarios is exothermic or endothermic. | Endothermic or Exothermic reaction? | Explain Why? |
| 1. An ice cube melts after being left out on the table. |  |  |
| 2. Cooking an egg in a frying pan. |  |  |
| 3. Burning a match. |  |  |
| 4. The human body uses the energy provided from food digestion. |  |  |
| 5. Morning dew forming on grass and plants. |  |  |
| 6. Dynamite explodes in the destruction of a building. |  |  |
| 7. Making ice cubes. |  |  |
| 8. A puddle of water evaporates. |  |  |
| 9. Plants making sugar through photosynthesis |  |  |
|  10. Snowman melting after the sun shines on it |  |  |
|  11. Converting frost to water vapor. |  |  |

2 Making and breaking bonds

During chemical reactions the bonds between atoms break and new bonds form.

Energy must be absorbed to break a bond, so **breaking bonds is endothermic**.

**Making new bonds is exothermic** because energy is released.

1. When green copper carbonate decomposes, the equation is:

|  |  |  |
| --- | --- | --- |
| CuCO3 | CuO | CO2 |
| copper carbonate | copper oxide | carbon dioxide |

Is the reaction exothermic or endothermic? Use ideas about bonds to explain why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Draw diagrams to show what happens when hydrogen reacts with oxygen. Mark the bonds broken in blue and the new bonds formed in red. The equation is:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2H2hydrogen | + | O2oxygen |  | 2H2Owater |

3 ‘Make or break’

1. Most reactions involve bond breaking and bond making. This equation shows what happens when methane (CH4) burns in oxygen (O2).
Mark the bonds broken with a “B” and the bonds formed with an “R”.
2. Complete the table to show the number of bonds broken and formed:

|  |  |  |  |
| --- | --- | --- | --- |
| Bonds broken | Number | Bonds formed | Number |
| between carbon and hydrogen |  | between carbon and oxygen |  |
| between oxygen atoms |  | between hydrogen and oxygen |  |

1. Is the reaction exothermic or endothermic overall?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The overall energy change is decided by the strength of the bonds that are broken or formed during the reaction. The stronger the bond the larger the energy change.
**Which bonds are stronger in this reaction – the bonds broken or the new bonds formed?**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1 Comparing fuels

A student wanted to compare the energy released when 4 different fuels burned. These are her results:

Hint: subtract the ending temperature from the starting temperature.

|  |  |  |  |
| --- | --- | --- | --- |
| Fuel | Temperature at the start in °C | Temperature at the end in °C | Temperature rise in °C |
| methanol | 25 | 56 |  |
| ethanol | 18 | 53 |  |
| propanol | 17 | 54 |  |
| butanol | 23 | 63 |  |

1. Calculate each temperature rise and state which fuel releases most energy.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Another student used spirit burners for the experiment. She had to weigh them before and after each test to find out how much fuel she had used. To make it a fair test she used each fuel to make the same amount of water 10°C hotter. These are her results:

|  |  |  |  |
| --- | --- | --- | --- |
| Fuel | Mass of burner at the start in g | Mass of burner at the end in g | Mass of fuel used in g |
| methanol | 154.3 | 150.7 |  |
| ethanol | 213.4 | 210.6 |  |
| propanol | 185.8 | 183.4 |  |
| butanol | 198.5 | 196.3 |  |

1. Calculate the mass of each fuel she had to use to release the same amount of energy, and state which fuel must release more energy

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What could these students do to prove their results were repeatable?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Results are reproducible if they lead to the same conclusions when different people do the experiments or when different methods are used. Are the results reported on this page reproducible?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_