**ANSWERS: Additional questions on bond enthalpy**

1,

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| --- | --- | --- |
| **bond breaking**http://upload.wikimedia.org/wikipedia/commons/8/8d/Ethene-2D-flat.png **+** **4 x C–H = 4 x 412 = 1648****1 x C=C = 612****3 x O=O = 3 x 496 = 1488****total bond breaking = 3748** | **🡪** | **bond making** **+** **4 x C=O = 4 x 743 = 2972****4 x O-H = 4 x 463 = 1852****total bond making = 4824** |
| **difference between the two values is 1076****reaction is exothermic as bond making value is higher than bond breaking****Answer: - 1076kJmol-1** |

2.

|  |  |  |
| --- | --- | --- |
| bond breaking1 x  = 9443 x H-H = 3 x 436 = 1308total bond breaking = 2252 | bond making6 x N-H = 6 x ?  | overall energy change- 92 |
| 2252 + 6? = -926? = -92 – 22526? = - 2344? = 2344/6 ? = 390.66Ans 391kJmol-1 |

3.

|  |  |
| --- | --- |
| bond breaking6  + 6  | bond makinghttp://t0.gstatic.com/images?q=tbn:ANd9GcT3IWGI9Lj0xRQA_0CYFH779gHIaEVuXMD-ro2DNuuNv-W1U8nqqA + 6 |
| 12 x 743 + 12 x 463= 8916 + 5556= 14472 | 7 (C – H) + 7 (C-O) + 5 (O-H) + 5 (C-C) + 6 7 x 412 + 7 x 360 + 5 x 463 + 5 x 348 + 6 x 4962884 + 2520 + 2315 + 1740 + 2976= 12435 |
| reaction must be endothermic as bond breaking value is higher than bond making value, although common sense tells us this anyway as for Photosynthesis to occur light energy is requiredThe answer is + 2037 kJ mol-1 |

4.

|  |  |
| --- | --- |
| bond breaking1 x N-N = 163 4 x N-H = 4 x 388 = 15521 x O=O = 496total bond breaking = 2211 | bond making = 9444 x H-O = 4 x 463 = 1852total bond making = 2796 |
| **difference between the two values is 585****reaction is exothermic as bond making value is higher than bond breaking****Answer: - 585kJmol-1** |

5.

2C4H10(g) + 13O2(g) → 8CO2(g) + 10H2O(g)

|  |  |
| --- | --- |
| **bond breaking****6 x C-C = 6 x 348 = 2088****20 x C-H = 20 x 412 = 8240****13 x O=O = 13 x 496 = 6448****total bond breaking = 16776** | **bond making****16 x C=O = 16 x 743 = 11888****20 x H-O = 20 x 463 = 9260****total bond making = 21148** |
| **difference between the two values is 4372****reaction is exothermic as bond making value is higher than bond breaking****Answer: - 4373kJmol-1** |

### 6.

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| --- | --- | --- | --- |
| bond breaking |  | bond making | overall energy change |
| http://upload.wikimedia.org/wikipedia/commons/c/c0/Methane-2D-square.png |  |   | C≡O | 3 H-H |  |
| 4 C-H4 x 412 | 2 O-H2 x 463 |  | 1 C≡O | 3 H-H3 x 436 | +206 kJmol-1 |
| 1648 | 926 |  | ? | 1308 | +206 |

### 2574 –(1308 + ?) = +206

### 1266 + ? = + 206

### ? = +206 – 1266

### ? = 1060 kJmol-1

### 7.

|  |  |  |  |
| --- | --- | --- | --- |
| 1 molecule of S8 | 4 molecules of S2 | 1 molecule of O8 | 4 molecules of O2 |
| 8 x S-S= 8 x 264= 2112 kJmol-1 | 4 x S=S= 4 x 352= 1408 kJmol-1 | 8 x O-O= 8 x 146= 1168 kJmol-1 | 4 x O=O= 4 x 496= 1984 kJmol-1 |
| as can be seen from the values above, considerably more energy is required to breaks the eight single bonds between 8 sulfur atoms in S8, 2112 kJ of energy is required, compared to 1408 kJ of energy required to break four S=S bonds in four molecules of S2 So, sulfur tends to form 1 S8 molecule | as can be seen from the values above, considerably more energy is required to breaks the four double bonds between 4 oxygen atoms in O2, 1984 kJ of energy is required, compared to 1168 kJ of energy required to break eight O-O bonds in 1 molecule of O8 So, oxygen tends to form O2 molecules |

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