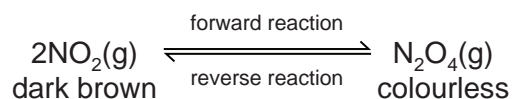


ENDO-EXO-REACTIONS

6.3.1

Almost all samples of nitrogen dioxide are an equilibrium mixture of nitrogen dioxide, NO_2 , and dinitrogen tetroxide, N_2O_4 .



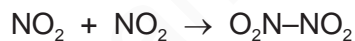
In the forward reaction, a bond forms between the two nitrogen dioxide molecules.

- (a) A sealed tube containing an equilibrium mixture of nitrogen dioxide and dinitrogen tetroxide was placed in a beaker of ice cold water.
The colour of the mixture changed from brown to pale yellow.

Is the forward reaction exothermic or endothermic? Give an explanation for your choice.

.....
..... [2]

- (b) What other piece of information given in the equation supports your answer to (i)



..... [1]

-----Marking Scheme-----

(a) exothermic [1]

low temperatures favour the exothermic reaction **or**
low temperatures moves equilibrium to right / product side / towards N_2O_4 [1]

(b) forward reaction is bond forming [1]

6.3.2

The alcohols form a homologous series. The first four members are methanol, ethanol, propan-1-ol and butan-1-ol.

- (a) One characteristic of a homologous series is that the physical properties vary in a predictable way. The table below gives the heats of combustion of the first three alcohols.

alcohol	formula	heat of combustion in kJ/mol
methanol	CH ₃ OH	-730
ethanol	CH ₃ -CH ₂ -OH	-1370
propan-1-ol	CH ₃ -CH ₂ -CH ₂ -OH	-2020
butan-1-ol	CH ₃ -CH ₂ -CH ₂ -CH ₂ -OH	

- (i) The minus sign indicates that there is less chemical energy in the products than in the reactants. What form of energy is given out by the reaction?

..... [1]

- (ii) Is the reaction exothermic or endothermic?

..... [1]

-----Marking Scheme-----

- (a) (i) heat (energy) [1]
- (ii) exothermic [1]