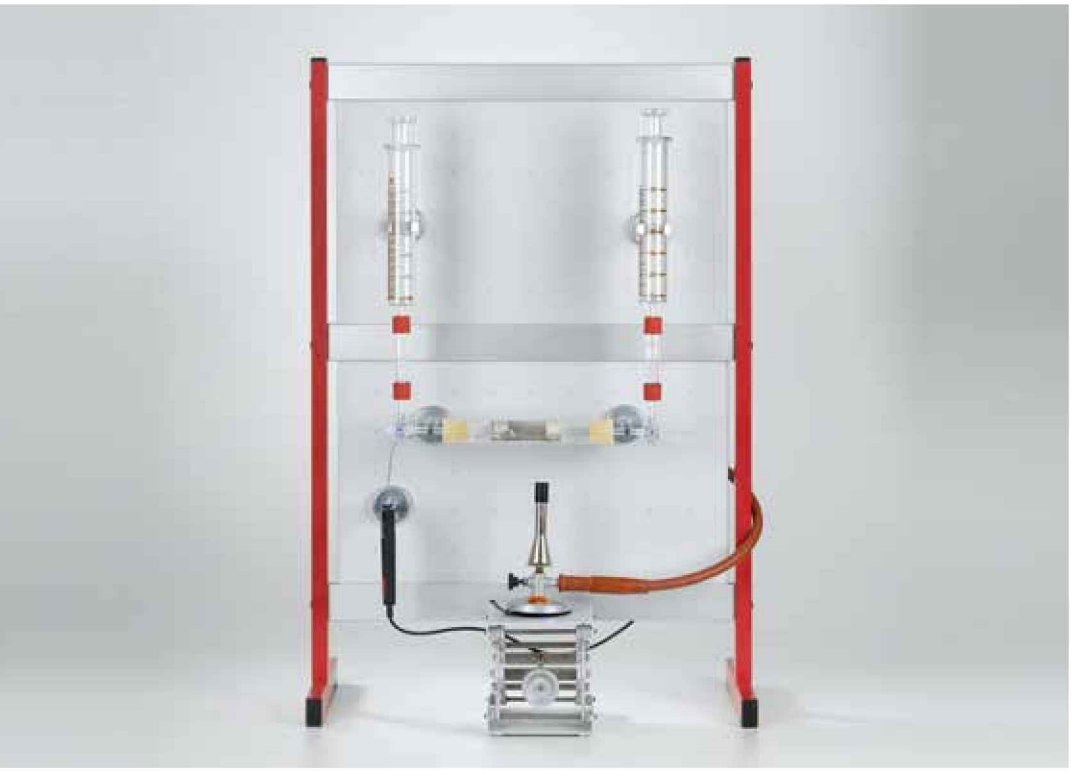

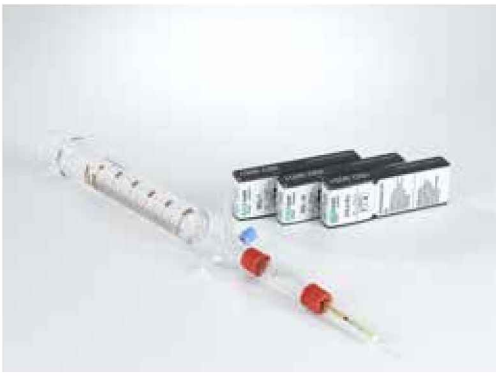

C5.3.1
WASTE GAS PURIFICATION

C5.3.1.1
Analysis of waste gases

C5.3.1.2
Catalytic purification of automobile exhaust gases

Catalytic purification of automobile exhaust gases (C5.3.1.2)

Cat. No.	Description	C5.3.1.1	C5.3.1.2
665 914	Gas syringe, 100 ml with 3-way stopcock	3	2
667 312	Glass connector, 2 x GL 18	3	3
667 305	Screw cap, GL 18, with hole	3	
667 296	Silicone gaskets, GL 18/10, set of 10	3	
666 313	Testing tube for NO_x, 0.5...50 ppm, set of 10	1	1
666 319	Testing tube for CO, 0.5...7.0 %, set of 10	1	1
666 314	Testing tube for SO_2, 1...25 ppm, set of 10	1	1
667 015	Glass file, triganular	1	1
313 27	Hand-held stop-watch, 60s/0.2s	1	1
662 302	Spare air bag, set of 30	1	1
665 009	Funnel PP 75 mm Ø	1	1
666 360	Catalytic converter		1
524 005W	Mobile-CASSY 2 WiFi		1
529 676	Temperature probe, NiCr-Ni, 1.5 mm, type K		1
666 425	Panel frame C50, two-level, for CPS		1
666 4659	Adhesive magnetic board 500 mm		2
666 4661	Holder, magnetic, size 1, 9...11 mm		2
666 4662	Holder, magnetic, size 2, 11...14 mm		1
666 4665	Holder, magnetic, size 5, 30...32 mm		2
656 016	Bunsen burner, universal		1
607 020	Safety gas hose with clamp 0.5 m		1
300 76	Laboratory stand II		1
	additionally required: exhaust sample, such as car exhausts or cigarette smoke	1	
	additonally required: exhaust sample or a self produced exhaust mixture made of nitrogen dioxide and methane or carbonmonoxide		2

The fossil energy carriers coal, oil and natural gas are primarily used as fuels. The combustion processes generate waste gases which enter the atmosphere and are harmful to the environment and to human health. Carbon dioxide (CO_2) intensifies the greenhouse effect, for example, and sulfur dioxide (SO_2) and nitrogen oxides (NO_x) cause acid rain. Today pollution emissions are strictly controlled. Plant operators must reduce their emissions. Catalytic converters are a mandatory feature of automotive exhaust systems.

Under ideal conditions, the combustion of hydrocarbons would generate only water and carbon dioxide. When it involves a mixture of different fuels, e.g. petrol, then combustion can also produce nitrogen oxides or sulphur oxides. Experiment C5.3.1.1 uses detection tubes to test for the presence of such byproducts in different waste gases.

The so-called ‚three-way catalyst' removes the three most important toxic substances from automotive exhaust simultaneously: unburned hydrocarbons, carbon monoxide and nitrogen oxides. It consists of a ceramic carrier to which noble metals such as platinum and palladium are applied. The reactions which take place include the following:

$$CH_4 + 2\,NO_2 \rightleftharpoons CO_2 + 2\,H_2O + N_2$$
$$4\,CO + 2\,NO_2 \rightleftharpoons CO_2 + N_2$$
$$2\,CO + 2\,NO \rightleftharpoons 2\,CO_2 + N_2$$

In experiment V5.3.1.2, waste gases are purified with a three-way catalyst. The waste gas used in the investigation can be either automotive exhaust or a self-made mixture of waste gases.