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## Economic Commission for Europe

### Inland Transport Committee

#### Working Party on the Transport of Dangerous Goods

Joint Meeting of Experts on the Regulations annexed to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (ADN Safety Committee)

#### Fifteenth session

Geneva, 24–28 August 2009

Item 5 of the provisional agenda

#### Catalogue of questions

## Chemicals, knowledge of physics and chemistry, objectives 1, 2, 3, 4, 5, 6

### Transmitted by the Central Commission for the Navigation of the Rhine (CCNR)<sup>1</sup>

1. At its fourteenth session, the ADN Safety Committee, recalling that, under 8.2.2.7.2.3 of the Regulations annexed to ADN, the ADN Administrative Committee was required to prepare a catalogue of questions for the ADN examinations, decided that the item should be put on the agenda for future sessions, in order to enable lists of questions to be translated and adopted progressively (ECE/TRANS/WP.15/AC.2/30, paras. 38 and 40).

2. This document contains the lists of questions proposed by CCNR in respect of knowledge of physics and chemistry for the “chemicals” examination:

- Examination objective 1: General
- Examination objective 2: Temperature, pressure, volume
- Examination objective 3: Physical state
- Examination objective 4: Fire, combustion
- Examination objective 5: Density
- Examination objective 6: Mixtures, chemical bonds

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<sup>1</sup> Distributed in German by the Central Commission for the Navigation of the Rhine under the symbol CCNR/ZKR/ADN/WP.15/AC.2/2009/21.

**Chemicals – knowledge of physics and chemistry****Examination objective 1: General**

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 101	The combustion of butane is: A A physical reaction B A chemical reaction C A biological reaction D A geological reaction	B
C 102	Which of the following could happen to a substance in a physical reaction? A The substance's state changes and the substance itself also changes B The substance's state changes but the substance itself does not change C The substance's state does not change but the substance itself changes D The substance's state does not change, nor does the substance itself	B
C 103	Which of the following reactions is a chemical reaction? A The melting of candle wax B The dissolving of sugar in water C The oxidation of iron D The evaporation of motor spirit or gasoline or petrol	C
C 104	Which of the following reactions is a physical reaction? A The combustion of diesel fuel B The decomposition of water into hydrogen and oxygen C The oxidation of aluminium D The solidification of benzene	D
C 105	Which of the following reactions is a physical reaction? A The decomposition of mercury oxide into mercury and oxygen	B

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<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	B The expansion of gasoil	
	C The polymerization of styrene	
	D The combustion of home heating oils	
C 106		A
	What is the evaporation of UN No. 1846 CARBON TETRACHLORIDE?	
	A A physical reaction	
	B A chemical reaction	
	C A biological reaction	
	D A geological reaction	
C 107		B
	What is polymerization of UN No. 2055 STYRENE?	
	A A physical reaction	
	B A chemical reaction	
	C A biological reaction	
	D A geological reaction	
C 108		C
	What is the combustion of UN No. 2247 n-DECANE?	
	A A biological reaction	
	B A physical reaction	
	C A chemical reaction	
	D A geological reaction	

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**Chemicals – knowledge of physics and chemistry****Examination objective 2: Temperature, pressure, volume**

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 201	Which value is equivalent to 0.5 bar? A 0.5 kPa B 5.0 kPa C 50.0 kPa D 500.0 kPa	C
C 202	A closed container has a pressure of 180 kPa at a temperature of 27° C. The volume of the container does not change. What is the excess pressure at 77° C? A 154.3 kPa B 210.0 kPa C 230.0 kPa D 513.3 kPa	B
C 203	A closed cargo tank is 95% filled with UN No. 1547 ANILINE. When will vaporization of the aniline cease? A Once the pressure of the aniline vapour is equal to the outside air pressure B Once the aniline has completely vaporized C Once the critical temperature has been reached D Once the pressure of the aniline vapour is equal to the saturated vapour pressure	D
C 204	The pressure above a liquid increases. What happens to the liquid's boiling point? A The boiling point increases B The boiling point decreases C The boiling point remains the same D The boiling point increases then drops below the boiling point	A
C 205	A closed bottle of gas is heated in the sun. What happens?	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	A Only the pressure rises B Only the temperature rises C Both the pressure and the temperature rise D The pressure falls, but the temperature rises	
C 206	A closed empty cargo tank with a volume of 240 m <sup>3</sup> has an excess pressure of 10 kPa. The tank receives a liquid cargo of 80 m <sup>3</sup> . The temperature remains constant. What is then the excess pressure in the cargo tank?  A 5 kPa B 7.5 kPa C 15 kPa D 30 kPa	C
C 207	A liquid at constant temperature has: A A specific shape and a specific volume B No specific shape, but a specific volume C A specific shape, but no specific volume D No specific shape or volume	B
C 208	What is the critical temperature? A The temperature above which a gas cannot be liquefied B The lowest temperature possible, namely 0 K C The temperature above which a gas can be liquefied D The temperature at which the lower explosive limit is reached	A
C 209	Which temperature is equivalent to 353 K? A 80° C B 253° C C 353° C D 626° C	A
C 210	At 21° C, the volume of an enclosed gas is 98 litres. The pressure remains constant. What is the volume at 30° C? A 95 litres	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	B 98 litres	
	C 101 litres	
	D 140 litres	
C 211		B
	What is the lowest temperature possible?	
	A 0° C	
	B 0 K	
	C -273 K	
	D 273 K	
C 212		B
	Which liquids have a low boiling point?	
	A Liquids with a boiling point below 0° C	
	B Liquids with a boiling point below 100° C	
	C Liquids with a boiling point between 100° C and 150° C	
	D Liquids with a boiling point above 150° C	
C 213		C
	When a pure substance melts, what happens to the temperature?	
	A It rises	
	B It falls	
	C It remains constant	
	D It rises or falls depending on the substance	
C 214		B
	The boiling point of UN No. 1897 TETRACHLOROETHYLENE is 121° C. What is tetrachloroethylene?	
	A A liquid with a low boiling point	
	B A liquid with a medium boiling point	
	C A liquid with a high boiling point	
	D A gas	
C 215		C
	Which is equivalent to a temperature of 30° C?	
	A 30 K	
	B 243 K	
	C 303 K	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	D -243 K	
C 216	Which are liquids with a high boiling point? A Liquids with a boiling point below 50° C B Liquids with a boiling point below 100° C C Liquids with a boiling point between 100° C and 150° C D Liquids with a boiling point above 150° C	D
C 217	In Gay-Lussac's law, what unit is always used to express temperature? A ° C B K C Pa D ° F	B
C 218	The boiling point of UN No. 1155 DIETHYL ETHER is 35° C. What is diethyl ether? A A liquid with a low boiling point B A liquid with a medium boiling point C A liquid with a high boiling point D A liquid with a very high boiling point	A
C 219	Which unit is used to express pressure? A The kelvin B The litre C The newton D The pascal	D
C 220	What ppm value is equivalent to a volume of 100%? A 1 ppm B 100 ppm C 1,000 ppm D 1,000,000 ppm	D
C 221	A closed container has a pressure of 2 bar at a temperature of	B

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	<p>7° C. The pressure rises to 4 bar. The volume does not change.                      What is the new temperature?</p> <p>A 14° C                      B 287° C                      C 560° C                      D -133° C</p>	
C 222	<p>In an enclosed space, the temperature drops to half the initial temperature. What happens to the pressure?</p> <p>A The pressure doubles                      B The pressure remains constant                      C The pressure drops by half                      D The pressure becomes four times lower</p>	C
C 223	<p>What does the boiling point of a liquid signify?</p> <p>A The pressure of the liquid at a temperature of 100° C                      B The quantity of liquid that reaches boiling point                      C The temperature at which the liquid is converted to a vapour at a pressure of 100 kPa (1 bar)                      D The volume of a liquid at a temperature of 100° C and a pressure of 100 kPa (1 bar)</p>	C



## Chemicals – knowledge of physics and chemistry

### Examination objective 3: Physical state

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 301	What is the transition from solid to gaseous state called? A Solidification B Condensation C Sublimation D Gasification	C
C 302	What is the transition from gaseous to liquid state called? A Solidification B Condensation C Maturation D Sublimation	B
C 303	What is condensation an example of? A The transition from gaseous to solid state B The transition from gaseous to liquid state C The transition from liquid to gaseous state D The evaporation of a substance	B
C 304	Which of the following is an example of sublimation? A The transition of carbonic snow to a gaseous state B The formation of condensation on a cold window C The solidification of molten iron D The evaporation of liquid hexane from soya cake	A
C 305	What is solidification? A The transition from solid to liquid state B The transition from liquid to gaseous state C The transition from gaseous to liquid state D The transition from liquid to solid state	D

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 306	<p>A particular substance has a fixed volume, but no fixed shape.</p> <p>What is the physical state of the substance?</p> <p>A Solid</p> <p>B Liquid</p> <p>C Gaseous</p> <p>D Solid or gaseous</p>	B
C 307	<p>What is the transition from solid to gaseous state called?</p> <p>A Melting</p> <p>B Solidification</p> <p>C Sublimation</p> <p>D Gasification</p>	C
C 308	<p>At normal pressure, the temperature of a substance is higher than its boiling point. What then is the physical state of the substance?</p> <p>A Gaseous</p> <p>B Liquid</p> <p>C Solid</p> <p>D Liquid or solid</p>	A
C 309	<p>What physical state does UN No. 1605 ETHYLENE DIBROMIDE assume at a temperature of +5° C?</p> <p>A A gaseous state</p> <p>B A solid state</p> <p>C A liquid state</p> <p>D An indeterminate state</p>	B
C 310	<p>What is the transition of a substance from a solid state to a gaseous state called?</p> <p>A Evaporation</p> <p>B Condensation</p> <p>C Sublimation</p> <p>D Recombination</p>	C

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<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 311		A
	A new substance is formed as a result of a reaction. What do we call the reaction that has taken place?	
	A A chemical reaction	
	B A physical reaction	
	C A meteorological reaction	
	D A logical reaction	

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## Chemicals – knowledge of physics and chemistry

### Examination objective 4: Fire, combustion

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 401	<p>The explosivity range of UN No. 1547 ANILINE is 1.2% to 11% (by volume). What would the properties of a mixture of 0.1% (by volume) of aniline and 99.9% (by volume) of air be?</p> <p>A Flammable but not explosive            B Neither flammable nor explosive            C Flammable and explosive            D Not flammable, but explosive</p>	B
C 402	<p>The auto-ignition temperature of UN No. 1779 FORMIC ACID is 480° C. Which of the following is true of formic acid at temperatures below 480° C?</p> <p>A The formic acid cannot ignite            B The formic acid cannot ignite spontaneously (of its own accord)            C The formic acid might ignite spontaneously (of its own accord)            D The formic acid might ignite spontaneously (of its own accord), but not explode</p>	B
C 403	<p>What is a catalyst?</p> <p>A A substance that prevents polymerization without contaminating the product            B A substance that prevents static electricity without contaminating the product            C A substance that accelerates a reaction but is not altered by the reaction            D A substance that can be added as a colouring without contaminating the product</p>	C
C 404	<p>What is a detonation?</p> <p>A A cleaning product            B An explosion</p>	B

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	C A test tube D An inhibitor	
C 405	The flash-point of UN No. 1282 PYRIDINE is 20° C. What happens to pyridine at a temperature of 25° C? A It is liable to ignite spontaneously B It does not produce enough vapour to be ignitable C It produces enough vapour to be ignitable D It produces too much vapour to be ignitable	C
C 406	Which reaction requires the highest speed of combustion? A A detonation B A deflagration C An explosion D An implosion	A
C 407	How can an explosion be prevented by thermal intervention? A By heating the substance B By increasing the pressure on the substance C By cooling the substance D By compressing the substance	C
C 408	The explosivity range of UN No. 1114 BENZENE is 1.2 to 8.6% (by volume). What would the properties of a mixture of 5% (by volume) of benzene and 95% (by volume) of air be? A Non-flammable but explosive B Flammable and explosive C Neither flammable nor explosive D Flammable but not explosive	B

## Chemicals – knowledge of physics and chemistry

### Examination objective 5: Density

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 501	<p>A cargo of UN No. 2874 FURFURYL ALCOHOL has a mass of 550 tonnes. The relative density of furfuryl alcohol is 1.1. What is the volume of the cargo?</p> <p>A    5 m<sup>3</sup></p> <p>B    500 m<sup>3</sup></p> <p>C    605 m<sup>3</sup></p> <p>D    2,000 m<sup>3</sup></p>	C
C 502	<p>A cargo of UN No. 1991 CHLOROPRENE has a volume of 500 m<sup>3</sup>. The relative density of chloroprene is 0.96. What is the mass of the cargo?</p> <p>A    0.48 t</p> <p>B    192.0 t</p> <p>C    480.0 t</p> <p>D    521.0 t</p>	C
C 503	<p>A cargo of 600 m<sup>3</sup> UN No. 1218 ISOPRENE has a mass of 420 tonnes. What then is the relative density of the isoprene?</p> <p>A    0.7</p> <p>B    2.03</p> <p>C    1.43</p> <p>D    2.52</p>	A
C 504	<p>How is the density of a substance calculated?</p> <p>A    By dividing the volume by the mass</p> <p>B    By dividing the mass by the volume</p> <p>C    By multiplying the volume by the mass</p> <p>D    By adding the mass and the volume</p>	B
C 505	<p>The temperature of a quantity of UN No. 1547 ANILINE increases. What happens to the density of the aniline?</p>	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	A The density increases B The density remains constant C The density decreases D The density sometimes increases and sometimes decreases	
C 506	The mass density (density) of a substance is given as 2.15 kg/dm <sup>3</sup> . Which value corresponds to this density? A 0.00215 t/m <sup>3</sup> B 2.15 t/m <sup>3</sup> C 21.5 t/m <sup>3</sup> D 215 t/m <sup>3</sup>	B
C 507	The relative density of a liquid is 0.95. What is the mass of 1,900 m <sup>3</sup> of this liquid? A 1,805 kg B 1,805 t C 200 kg D 200 t	B
C 508	The mass of 180 litres of UN No. 1092 ACROLEINE is 144 kg. What is the relative density of the substance? A 0.8 B 1.25 C 2.59 D 3.6	A
C 509	The relative density of a substance is 1.15. What is its volume if its mass is 2,300 tonnes? A 250 m <sup>3</sup> B 500 m <sup>3</sup> C 2,000 m <sup>3</sup> D 2,645 m <sup>3</sup>	C
C 510	The volume of a quantity of gas decreases. What happens to the density?	A

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	A The density increases	
	B The density remains constant	
	C The density decreases	
	D The density sometimes increases and sometimes decreases	
C 511		A
	How is the mass of a substance calculated?	
	A By multiplying the mass density (density) by the volume	
	B By dividing the mass density (density) by the volume	
	C By dividing the volume by the mass density (density)	
	D By dividing the volume by the pressure	
C 512		C
	How is the volume of a substance calculated?	
	A By multiplying the mass density (density) by the mass	
	B By dividing the mass density (density) by the mass	
	C By dividing the mass by the mass density (density)	
	D By dividing the mass by the pressure	
C 513		A
	The temperature of a quantity of UN No. 2789 ACETIC ACID decreases. How does the density of the acetic acid change?	
	A The density increases	
	B The density decreases	
	C The density remains constant	
	D The density sometimes increases sometimes decreases	
C 514		C
	What is the unit of mass density (density) used in the International System of Units (SI)?	
	A m <sup>3</sup>	
	B kg	
	C kg/m <sup>3</sup>	
	D l	



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<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 515		C
	What does the density of a gas depend on?	
	A On temperature only	
	B On pressure only	
	C On pressure and temperature	
	D On volume only	
C 516		B
	<b>In most cases</b> , how does the density of liquid vapours compare with the density of the outside air?	
	A It is equivalent	
	B It is higher	
	C It is lower	
	D None of the above	

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**Chemicals – knowledge of physics and chemistry****Examination objective 6: Mixtures, chemical bonds**

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 601		B
	A metal reacts with oxygen. A black powdery substance results. What do we call this substance?	
	A An element	
	B A compound	
	C An alloy	
	D A mixture	
C 602		D
	Which of the following statements is true?	
	A A mixture always consists of three substances in specific proportions	
	B A mixture involves a chemical reaction	
	C When a mixture is produced, heat is always released	
	D A mixture is a physical notion	
C 603		C
	What is pure water (H <sub>2</sub> O) an example of?	
	A An alloy	
	B An element	
	C A compound	
	D A mixture	
C 604		C
	What does an organic compound always contain?	
	A Hydrogen atoms	
	B Oxygen atoms	
	C Carbon atoms	
	D Nitrogen atoms	
C 605		A
	What is formed when sugar is dissolved?	
	A A mixture	
	B A compound	
	C An alloy	

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<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 606	D An element  What happens when hydrogen is released from a compound? A Being lighter than air, it collects near the ground B Being lighter than air, it rises C It immediately combines with nitrogen in the air D Water is formed in a catalytic reaction	B
C 607	Which elements are contained in the compound nitric acid (HNO <sub>3</sub> )? A Sulphur, nitrogen and oxygen B Carbon, hydrogen and nitrogen C Helium, sodium and oxygen D Hydrogen, nitrogen and oxygen	D
C 608	Can liquids be mixed? A Yes, liquids are always miscible B Yes, but not all liquids are miscible with each other C No, liquids are never miscible D Yes, liquids are miscible in any proportions	B

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