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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 7, 8, 9, 10, 11, 12

Transmitted by the Central Commission for the Navigation of the Rhine (CCNR)¹

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 7: Molecules, atoms
- Examination objective 8: Polymerization
- Examination objective 9: Acids, bases
- Examination objective 10: Oxidation
- Examination objective 11: Knowledge of chemicals
- Examination objective 12: Chemical reactions

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Chemicals – knowledge of physics and chemistry**Examination objective 7: Molecules, atoms**

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 701		A
	What is NaNO_3 ?	
	A An inorganic compound	
	B An organic compound	
	C A mixture	
	D An alloy	
C 702		B
	What is C_3H_8 ?	
	A A mixture	
	B An organic compound	
	C An inorganic compound	
	D An alloy	
C 703		D
	What is the symbol for the element “oxygen”?	
	A Z	
	B H	
	C N	
	D O	
C 704		B
	What is the symbol for the element “nitrogen”?	
	A S	
	B N	
	C O	
	D H	
C 705		C
	Which of the following statements is false?	
	A Molecules are composed of atoms	
	B A pure substance is composed of a single type of molecule	
	C A compound is always composed of a single type of atom	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 706	D An element is composed of a single type of atom What is the symbol for the element “hydrogen”? A H B O C W D N	A
C 707	Which of the following statements is correct ? A A molecule is the smallest unit of a compound B A molecule is the smallest unit of a substance that still has all the properties of the substance C Elements are composed of molecules that comprise several types of atoms D There are approximately 11 million types of atoms	B
C 708	What is an element always made up of? A Atoms B Mixtures C Compounds D Molecules	A
C 709	What is the term for the smallest unit of a substance that still has all the properties of the substance? A An atom B A molecule C An ion D A proton	B
C 710	What is the correct formula for three molecules of water? A $(\text{H}_2\text{O})_3$ B $3 \text{H}_2\text{O}$ C H_6O_3 D H_2O	B

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 711	What is the Latin name for oxygen? A Ferrum B Hydrogenium C Nitrogenium D Oxygenium	D
C 712	In chemical formulae, what is the significance of the letter "N"? A Carbon B Nitrogen C Hydrogen D Oxygen	B
C 713	What is the symbol for carbon? A C B H C K D O	A
C 714	What is the molecular mass of UN No. 1294 TOLUENE (C ₆ H ₅ CH ₃)? (C = 12, H = 1) A 78 B 92 C 104 D 106	B
C 715	At what temperature does the kinetic energy of molecules equal zero? A -273° C B 212 K C 273° K D -100° C	A

Chemicals – knowledge of physics and chemistry

Examination objective 8: Polymerization

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 801	What is an inhibitor? A A substance that accelerates a reaction B A substance that prevents polymerization C A substance that attacks the nervous system D A substance that prevents electrostatic charge	B
C 802	What substance prevents polymerization? A An inhibitor B A capacitor C A catalyst D An indicator	A
C 803	Which of the following statements is correct? A An inhibitor should be properly mixed with the product B An inhibitor may react with the product C An inhibitor may easily evaporate from the product D An inhibitor should have a low flash-point	A
C 804	What is polymerization? A The process by which one or more reactions result in a very large molecule B A process of combustion during which much heat is liberated C The process by which a compound is destroyed under the effect of heat D The process by which a compound is destroyed under the effect of an electric current	A
C 805	A cargo tank contains a product that is liable to polymerize easily. To prevent polymerization, an inhibitor has been added. During carriage, a small quantity of the product evaporates and condenses some time later on the surface of the cargo tanks.	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	What might happen to the condensate?	
	A The condensate will not polymerize since it contains an inhibitor	
	B The condensate will not polymerize since it will evaporate first	
	C The condensate might polymerize since it does not contain an inhibitor	
	D The condensate might polymerize even though it still contains some inhibitor	
C 806		B
	During transport of a cargo of styrene, precautionary measures should be taken to ensure that the cargo is sufficiently stabilized.	
	What particulars do not need to be included in the transport document?	
	A The name and quantity of the stabilizer added	
	B The pressure above the stabilized liquid	
	C The date at which the stabilizer was added and its duration of effectiveness under normal conditions	
	D The temperature limits affecting the stabilizer	
C 807		D
	What does “poly” in polymerization signify?	
	A Large	
	B Long	
	C Atom	
	D Many	
C 808		A
	What characterizes polymerization?	
	A A rise in temperature	
	B A drop in temperature	
	C A change in colour	
	D A change in mass	
C 809		C
	What is an inhibitor?	
	A A type of adhesive	
	B A cleaning product	
	C A stabilizer	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	D A product that lowers the freezing-point	
C 810	A substance is liquid at 20° C and decomposes readily at temperatures above 35° C. What might this substance be? A A stable gas B An unstable gas C A stable liquid D An unstable liquid	D
C 811	What is a positive catalyst? A A substance that prevents polymerization B A substance that prevents electrostatic charge C A substance that accelerates a reaction D A substance that prevents the formation of heat	C
C 812	What is a negative catalyst? A A substance that promotes polymerization B A substance that slows a chemical reaction C A substance that prevents electrostatic charge D A substance that inhibits evaporation of a liquid	B
C 813	What is the difference between a chemically stable substance and a chemically unstable substance? A A chemically stable substance decomposes more readily than a chemically unstable substance B A chemically unstable substance decomposes readily, while a chemically stable substance does not readily decompose C A chemically unstable substance evaporates more readily than a chemically stable substance D A chemically unstable substance has a higher melting-point than a chemically stable substance	B
C 814	What do we call the process whereby monomers band together during a chemical reaction? A Evaporation B Polymerization	B

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	C Decomposition	
	D Condensation	
C 815	Which product should be transported in a stabilized state?	B
	A UN No. 1114 BENZENE	
	B UN No. 1301 VINYL ACETATE, STABILIZED	
	C UN No. 1863 FUEL, AVIATION, TURBINE ENGINE WITH MORE THAN 10% BENZENE	
	D UN No. 2312 PHENOL, MOLTEN	
C 816	Why is a stabilizer (inhibitor) added to certain products?	C
	A To prevent them from exploding	
	B To prevent them from evaporating	
	C To prevent them from polymerizing	
	D To prevent them from freezing	
C 817	What often triggers polymerization?	C
	A An inhibitor	
	B An excess of nitrogen	
	C A rise in temperature	
	D A drop in temperature	

Chemicals – knowledge of physics and chemistry**Examination objective 9: Acids, bases**

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 901	What are solutions with a pH value above 7 called? A Acids B Bases C Soaps D Suspensions	B
C 902	UN No. 1824 SODIUM HYDROXIDE SOLUTION is an example of which of the following? A A strong acid B A weak acid C A strong base D A weak base	C
C 903	UN No. 1830 SULPHURIC ACID containing more than 51% of acid is an example of which of the following? A A strong acid B A weak acid C A strong base D A weak base	A
C 904	What is the pH value of a base? A Always greater than 14 B Always lower than 7 C Always equal to 7 D Always greater than 7	D
C 905	How can a base solution be neutralized? A By carefully adding soap B By carefully adding water C By carefully adding an acid solution	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	D By carefully adding caustic soda	
C 906	Name three properties of an acid. A Corrosive, attacks metal, pH greater than 7 B Corrosive, attacks metal, pH less than 7 C Corrosive, attacks metal, soapy odour D Corrosive, attacks metal, turns litmus paper red, soapy odour	B
C 907	What is the difference between an acid solution with a pH of 1 and an acid solution with a pH of 3? A The solution with a pH of 1 is twice as acidic B The solution with a pH of 1 is three times more acidic C The solution with a pH of 1 is 20 times more acidic D The solution with a pH of 1 is 100 times more acidic	D
C 908	What is the difference between a solution with a pH of 11 and a solution with a pH of 8? A The solution with a pH of 11 is more acidic B The solution with a pH of 11 is more base C The solution with a pH of 11 is weaker D There is no difference	B
C 909	What is the pH value of a neutral solution? A 0 B 1 C 7 D 14	C
C 910	Which is the greatest hazard posed by acids and bases? A Toxicity B Flammability C Explosivity D Corrosivity	D

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 911	What do hydroxides always contain? A OH ⁻ B H ⁺ C H ₃ O ⁺ D CO ⁻	A
C 912	UN No. 1789 HYDROCHLORIC ACID, GE III is an example of which of the following? A A strong acid B A weak acid C A strong base D A weak base	B
C 913	What substance is produced when an acid reacts with a metal? A Oxygen B Hydrogen C Nitrogen D Water	B
C 914	What are bases also called? A Organic substances B Inorganic substances C Alkanoic acids D Alkaline substances	D
C 915	Which of the following products is a base? A UN No. 1685 SODIUM ARSENATE B UN No. 1814 POTASSIUM HYDROXIDE SOLUTION C UN No. 1230 METHANOL D UN No. 1573 CALCIUM ARSENATE	B

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 916	What is the pH value of a strong acid? A 0-3 B 7 C 8-10 D 4-6	A

Chemicals – knowledge of physics and chemistry

Examination objective 10: Oxidation

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 1001		A
	Which is an example of slow oxidation?	
	A The formation of iron rust	
	B An explosion of liquefied gas	
	C The combustion of natural gas	
	D The evaporation of motor spirit or gasoline or petrol	
C 1002		B
	What are reducing agents?	
	A Substances that readily donate oxygen to other substances	
	B Substances that readily take up oxygen from other substances	
	C Substances that are highly flammable	
	D Substances that never react with other substances	
C 1003		C
	What is oxidation?	
	A The bonding of a substance with carbon	
	B The bonding of a substance with hydrogen	
	C The bonding of a substance with oxygen	
	D The bonding of a substance with nitrogen	
C 1004		A
	What are oxidants?	
	A Substances that readily donate oxygen to other substances	
	B Substances that readily take up oxygen from other substances	
	C Substances that are highly flammable	
	D Substances that never react with other substances	
C 1005		B
	What reaction is characteristic of flammable substances?	
	A They release oxygen	
	B They react with oxygen	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	C They do not react with oxygen	
	D They produce oxygen	
C 1006		B
	Which of the following is characteristic of readily flammable substances?	
	A They do not readily react with oxygen	
	B They react readily with oxygen	
	C They never react with oxygen	
	D They release oxygen	
C 1007		A
	What is oxidation?	
	A The bonding of a substance with oxygen	
	B The bonding of a substance with nitrogen	
	C The addition of oxygen	
	D The addition of nitrogen	

Chemicals – knowledge of physics and chemistry

Examination objective 11: Knowledge of chemicals

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 1101		A
	C ₄ H ₁₀ is an example of:	
	A An alkane	
	B An alkene	
	C An aromate	
	D A cycloalkane	
C 1102		C
	Which of the following constitute two important groups of hydrocarbons?	
	A Oxidants and reducing agents	
	B Acids and bases	
	C Alkanes and alkenes	
	D Bases and hydroxides	
C 1103		A
	What is a polymer?	
	A A chain of very large molecules comprising repeated molecular units	
	B A chemical that should prevent a particular substance from polymerizing	
	C A chemical that accelerates a reaction but is not altered by the reaction	
	D A readily flammable product that could trigger a chemical reaction	
C 1104		B
	What are organic nitrogen compounds called?	
	A Aromates	
	B Nitriles	
	C Ethers	
	D Esters	
C 1105		C
	What is the term for hydrocarbons in which one or several hydrogen atoms are replaced by a hydroxyl (OH radical)?	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	A Esters	
	B Ethers	
	C Alcohols	
	D Ketones	
C 1106	What is the term for substances whose molecules contain a very large quantity of oxygen?	C
	A Alkenes	
	B Ketones	
	C Peroxides	
	D Nitriles	
C 1107	Which of the following is an example of a ketone?	D
	A UN No. 1170 ETHANOL	
	B UN No. 1203 MOTOR SPIRIT or GASOLINE or PETROL	
	C UN No. 2055 STYRENE MONOMER, STABILIZED	
	D UN No. 1090 ACETONE	
C 1108	Which of the following constitutes an important group of esters?	D
	A Alcohols	
	B Peroxides	
	C Bases	
	D Soaps	
C 1109	The atomic mass of hydrogen is 1, the atomic mass of oxygen is 16 and the atomic mass of sulphur is 32. What is the molecular mass of sulphuric acid (H ₂ SO ₄)?	B
	A 49	
	B 98	
	C 129	
	D 146	
C 1110	The atomic mass of carbon is 12 and the atomic mass of oxygen is 16. What is the molecular mass of carbon dioxide (CO ₂)?	C

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	A 38	
	B 40	
	C 44	
	D 76	
C 1111		B
	The atomic mass of calcium is 40, the atomic mass of oxygen is 16 and the atomic mass of hydrogen is 1. What is the molecular mass of calcium hydroxide (Ca(OH) ₂)?	
	A 58	
	B 74	
	C 96	
	D 114	
C 1112		A
	Why are aromates so called?	
	A Because of their odour	
	B Because of their colour	
	C Because of their toxicity	
	D Because of their solubility	
C 1113		D
	Which is an example of a nitric compound?	
	A UN No. 2312 PHENOL, MOLTEN	
	B UN No. 1090 ACETONE	
	C UN No. 1203 MOTOR SPIRIT or GASOLINE or PETROL	
	D UN No. 1664 NITROTOLUENES, LIQUID	
C 1114		B
	What is UN No. 1230 METHANOL an example of?	
	A An ester	
	B An alcohol	
	C A nitrile	
	D An ether	
C 1115		D
	Which of the following is an example of an alkene?	
	A UN No. 1011 BUTANE	
	B UN No. 1077 PROPYLENE	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	C UN No. 1170 ETHANOL	
	D UN No. 1001 ACETYLENE, DISSOLVED	
C 1116	Which of the following substances is saturated?	B
	A UN No. 1077 PROPENE	
	B UN No. 1265 PENTANES, liquid	
	C UN No. 1962 ETHYLENE, DISSOLVED	
	D UN No. 1011 BUTANE	
C 1117	Which group of substances tends to be toxic and carcinogenic?	B
	A Alcohols	
	B Aromates	
	C Alkane acids	
	D Alkanes	
C 1118	What is PVC?	C
	A A monomer	
	B An alkane acid	
	C A polymer	
	D An aromate	
C 1119	What is the term for double bond hydrocarbons?	A
	A Alkenes	
	B Alkanes	
	C Alcyones	
	D Alcyones	
C 1120	What information does the temperature classification of a product provide?	C
	A Information on the explosion-point	
	B Information on the evaporation-point	
	C Information on the ignition-point	
	D Information on the flash-point	

Chemicals – knowledge of physics and chemistry

Examination objective 12: Chemical reactions

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 1201		B
	<p>Why is it important to ensure that water does not come into contact with SULPHURIC ACID concentrate containing more than 51% acid (UN No. 1830)?</p> <p>A Because when water is added, flammable hydrogen gas is formed</p> <p>B Because this results in the release of much heat, causing water to evaporate and bubble</p> <p>C Because this results in polymerization of the sulphuric acid</p> <p>D Because sulphuric acid reacts with water, releasing highly toxic vapours</p>	
C 1202		A
	<p>Which of the following is a classic example of self-reaction?</p> <p>A The polymerization of styrene</p> <p>B The decomposition of water into hydrogen and oxygen</p> <p>C The reaction of nitrogen with water</p> <p>D The oxidation of iron</p>	
C 1203		B
	<p>You are loading a chemical that is liable to polymerization. The adjoining cargo tank contains another chemical. What must you ensure with regard to the chemical in the adjoining cargo tank?</p> <p>A The chemical must not contain water</p> <p>B The chemical must not be too hot</p> <p>C The chemical must not be readily flammable</p> <p>D The chemical must not contain any inhibitor</p>	
C 1204		A
	<p>How might the self-reaction of a substance be initiated?</p> <p>A By heating the substance</p> <p>B By adding a stabilizer</p> <p>C By avoiding contamination from another cargo</p> <p>D By adding an inert gas</p>	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 1205	How can reaction of the cargo with air be prevented? A By heating the cargo B By cooling the cargo C By wafting the cargo with an inert gas D By continuously moving the cargo around	C
C 1206	Which two types of substance have corrosive properties? A Alcohols and acids B Alcohols and bases C Precious metals and bases D Acids and bases	D
C 1207	When a metal reacts with an acid, it releases a gas. Which one? A Oxygen B Hydrogen C Methane D Chlorine	B
C 1208	What results from the complete combustion of propane? A Oxygen and hydrogen B Carbon monoxide and water C Carbon dioxide and water D Carbon and hydrogen	C
C 1209	What results from the incomplete combustion of propane? A Oxygen and hydrogen B Carbon monoxide and water C Carbon dioxide and water D Carbon and hydrogen	B
C 1210	How can the self-reaction of cargo be prevented? A By wafting it with an inert gas	A

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
	B By ensuring it is contaminated further	
	C By heating it	
	D By continuously decanting it	
C 1211	What does adding an inhibitor prevent?	A
	A Polymerization	
	B Boiling	
	C A fall in pressure	
	D Condensation	
C 1212	What results from the complete combustion of pentane?	B
	A Oxygen and hydrogen	
	B Carbon dioxide and water	
	C Carbon and water	
	D Pentane oxide and water	
C 1213	What results from the incomplete combustion of hexane?	D
	A Hexanol and water	
	B Carbon dioxide and water	
	C Oxygen and water	
	D Carbon monoxide and water	
C 1214	A chemical reaction releases heat. What is this reaction called?	B
	A An endothermic reaction	
	B A exothermic reaction	
	C A heterogenic reaction	
	D A homogenic reaction	
C 1215	A reaction gives rise to a new substance. What is the term for such a reaction?	A
	A A chemical reaction	
	B A physical reaction	
	C A meteorological reaction	
	D A logical reaction	

<i>Number</i>	<i>Source</i>	<i>Correct answer</i>
C 1216	Auto-oxidation is a chemical reaction in which the substance spontaneously reacts with which component?*	D
	A Carbon dioxide	
	B Carbonic acid gas	
	C Nitrogen	
	D Oxygen	

* Translator's note: According to our research, the original French does not accurately describe this process. Several other questions also require editorial changes: C 903, C 912, C 1101, C 1107, C 1203, C 1214.