47th National Chemistry Olympiad

Utrecht University

THEORY TEST

Marking scheme

Monday 8th June 2026

- This test consists of 7 problems with 35 open questions.
- The maximum score for this test is 120 points.
- The test will last a maximum of 4 hours.
- Required resources: (graphic) calculator and Binas 7th edition or BINAS 5th edition, English version or ScienceData 1st edition.
- The number of points available for each question is given.

Problem 1 Trouble in a cylinder **10 points**

□1 Maximum score 7

Examples of a correct calculation are:

Let $[C_3H_8]$ = x mol L^{-1}, then $[C_3H_6]=[H_2] = \frac{x}{8}$ mol L^{-1} applies.

Substituting into K_c yields: $\frac{\frac{x}{8}\times\frac{x}{8}}{x} = 1.30\cdot10^{-3}$ and this gives x = 0.0832 mol L^{-1}.

So $[C_3H_8]$ = 0.0832 mol L^{-1} and $[C_3H_6]=[H_2] = \frac{0.0832}{8} = 0.0104$ mol L^{-1}.

The total number of moles per dm^3 is therefore 0.0832 + 2 × 0.0104.

The total pressure in the cylinder is therefore

$$p_{\text{total}} = n_{\text{total}}\frac{RT}{V} = (0.0832 + 2\times0.0104)\,\frac{8.314\times(527+273)}{10^{-3}} = 6.91\cdot10^{5}\text{ Pa.}$$

and

The volume percentages C_3H_6 and H_2 are both 10%.

Let the volume of the gas mixture be V dm^3 and the molar volume under the conditions of the experiment be V_m dm^3 mol^{-1}.

Then $[C_3H_8] = \frac{\frac{0.80\times V}{V_m}}{V} = \frac{0.80}{V_m}$ mol dm^{-3} and $[C_3H_6]=[H_2] = \frac{\frac{0.10\times V}{V_m}}{V} = \frac{0.10}{V_m}$ mol dm^{-3}.

The equilibrium expression is $\frac{[C_3H_6][H_2]}{[C_3H_8]} = K_c$.

So $\frac{\left(\frac{0.10}{V_m}\right)^2}{\left(\frac{0.80}{V_m}\right)} = 1.30\cdot10^{-3}$; this gives V_m = 9.6 dm^3 mol^{-1}.

So $[C_3H_8] = \frac{0.80}{9.6} = 0.083$ mol dm^{-3} and $[C_3H_6]=[H_2] = \frac{0.10}{9.6} = 0.010$ mol dm^{-3}.

The total number of moles per dm^3 is therefore 0.083 + 2 × 0.010.

The total pressure in the cylinder is therefore

$$p_{\text{total}} = n_{\text{total}}\frac{RT}{V} = (0.083 + 2\times0.010)\,\frac{8.314\times(527+273)}{10^{-3}} = 6.85\cdot10^{5}\text{ Pa.}$$

- notion that concentrations of C_3H_6 and H_2 are equal to each other 1
- (assuming that $[C_3H_8]$ = x mol L^{-1}) $[C_3H_6]=[H_2] = \frac{x}{8}$ mol L^{-1} 1
- correct equilibrium expression (possibly already partially filled in) 1
- calculation of $[C_3H_8]$, $[C_3H_6]$ and $[H_2]$ 1
- calculation of the total number of moles per dm^3 in the gas mixture 1
- conversion of temperature from °C to K and from dm^3 to m^3 1
- rest of the calculation 1

or

- notion that the volume percentages and the concentrations of C_3H_6 and H_2 are equal to each other 1
- (when stating that the molar volume V_m is) demonstrate that $[C_3H_8] = \dfrac{0.80}{V_m}$ mol dm^{-3} and that $[C_3H_6] = [H_2] = \dfrac{0.10}{V_m}$ mol dm^{-3} 1
- correct equilibrium expression (possibly already partially filled in) 1
- calculation of V_m 1
- calculation of $[C_3H_8]$, $[C_3H_6]$ and $[H_2]$ 1
- calculation of the total number of moles per dm^3 in the gas mixture 1
- conversion of temperature from °C to K and from dm^3 to m^3 and the rest of the calculation 1

□2 Maximum score 3

An example of a correct answer is:

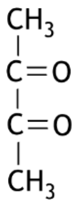
When the volume is halved, the pressure becomes twice as large. However, as the volume decreases, the position of the equilibrium shifts towards the side with the lowest number of gas molecules in the reaction equation, which in this case is to the left. Therefore, the total number of molecules in the cylinder decreases, and consequently, the pressure decreases as well. In the new equilibrium, the pressure is less than twice as large.

- notion that without an equilibrium shift the pressure becomes twice as large (possibly implicit) 1
- correct explanation regarding the shift in the position of equilibrium 1
- conclusion 1

Problem 2 Malaprade 19 points

□3 Maximum score 2

A correct answer might look like this:



- a structure with two double-bonded oxygen atoms to adjacent carbon atoms 1
- rest of the formula is correct 1

□4 Maximum score 8

An example of a correct calculation is:

From the blank determination it follows that the 25.0 mL sodium periodate solution contained $\frac{1}{4} \times \frac{1}{2} \times 23.9 \times 0.502 = 1.50$ mmol IO_4^-. Suppose that the 150 mg antifreeze contained x mmol glycol, then x mmol IO_3^- was formed in the malaprade reaction with $(1.50 - x)$ mmol IO_4^- remaining.

From x mmol IO_3^-, $3x$ mmol I_2 is formed in the reaction with iodide, and from $(1.50 - x)$ mmol IO_4^-, $4 \times (1.50 - x)$ mmol I_2 is formed in the reaction with iodide.

So a total of $3x + 4 \times (1.50 - x)$ mmol I_2 is formed.

For the titration of this amount of I_2, 19.6 mL of sodium thiosulfate solution was required, so $\frac{1}{2} \times 19.6 \times 0.502 = 3x + 4 \times (1.50 - x)$.

This leads to $x = 1.08$.

Therefore, 150 mg of antifreeze contained 1.08×62.07 mg glycol, and that is

$$\frac{1.08 \times 62.07}{150} \times 100 = 44.7 \text{ mass percent.}$$

- calculation of the number of mmol $S_2O_3^{2-}$ in both titrations 1
- calculation of the number of mmol I_2 that reacted in both titrations 1
- calculation of the number of mmol IO_4^- in the 25.0 mL sodium periodate solution 1
- (setting the number of mmol glycol equal to x) calculation of the number of mmol IO_3^- formed in the malaprade reaction 1
- calculation of the number of mmol IO_4^- remaining after the malaprade reaction 1
- calculation of the total number of mmol I_2 formed after the reactions with iodide 1
- calculation of x 1
- calculation of the mass percentage 1

□5 Maximum score 9

An example of a correct answer is:
In the malaprade reaction of glucose, methanal and methanoic acid are formed in the molar ratio methanal : methanoic acid = 1 : 5.
In the malaprade reaction of fructose, methanal, methanoic acid, and carbon dioxide are formed in the molar ratio methanal : methanoic acid : carbon dioxide = 2 : 3 : 1.
The equation of the half-reation (in molecular formulas) for the conversion of glucose is:
$C_6H_{12}O_6 \; + \; 5\,H_2O \; \rightarrow \; H_2CO \; + \; 5\,HCOOH \; + \; 10\,H^+ \; + \; 10\,e^-$
The equation of the half-reation (in molecular formulas) for the conversion of fructose is:
$C_6H_{12}O_6 \; + \; 4\,H_2O \; \rightarrow \; 2\,H_2CO \; + \; 3\,HCOOH \; + \; + \; CO_2 \; + \; 10\,H^+ \; + \; 10\,e^-$
Therefore, 10 moles of electrons are released per mole of sugar in both cases, which means that the number of moles of oxidizing agent (IO_4^-) that reacts per mole of sugar is the same.
Therefore, with iodate, you cannot distinguish between glucose and fructose.
The number of moles of methanoic acid formed per mole of sugar are different, so you can distinguish between them by means of titration with sodium hydroxide.

- with glucose, methanal and methanoic acid are formed 1
- correct molar ratio in which methanal and methanoic acid are formed 1
- with fructose, methanal, methanoic acid and carbon dioxide are formed 1
- correct molar ratio in which methanal, methanoic acid and carbon dioxide are formed 1
- correct equation for the half-reaction of glucose 1
- correct equation for the half-reaction of fructose 1
- conclusion regarding the use of iodate 1
- notion that the amounts of acid formed in both reactions are different 1
- conclusion regarding the use of sodium hydroxide 1

Problem 3 Electrochemical conversion of CO_2 — 23 points

□6 Maximum score 3

$3\ CO_2 + 18\ H^+ + 18\ e^- \rightarrow C_3H_8O + 5\ H_2O$

- CO_2 before the arrow and C_3H_8O plus H_2O after the arrow — 1
- H^+ and e^- before the arrow — 1
- atoms and charge balanced correctly — 1

□7 Maximum score 5

An example of a correct calculation is:

$\Delta_r H = -2.78 \cdot 10^5 + 3 \times (-2.86 \cdot 10^5) - 2 \times (-3.935 \cdot 10^5) = -3.49 \cdot 10^5\ \mathrm{J\ mol^{-1}}$

$\Delta_r S = 161 + 3 \times 70 - 2 \times 214 - 6 \times 131 = -843\ \mathrm{J\ K\ mol^{-1}}$

$\Delta_r G = \Delta_r H - T \times \Delta_r S = -3.49 \cdot 10^5 - 298 \times (-843) = -0.978 \cdot 10^5\ \mathrm{J\ mol^{-1}}$

$-0.978 \cdot 10^5 = -12 \times 9.649 \cdot 10^4 \times \Delta E^0$

$$\Delta E^0 = \frac{-0.978 \cdot 10^5}{-12 \times 9.649 \cdot 10^4} = 0.0845\ \mathrm{V}$$

$$\Delta E^0 = E^0_{CO_2/\text{propan-1-ol}} - E^0_{H_2/H^+}$$

$$E^0_{CO_2/\text{propan-1-ol}} = \Delta E^0 + E^0_{H_2/H^+} = 0.0845 + 0.00 = +0.0845\ \mathrm{V}$$

- calculation of $\Delta_r H$ — 1
- calculation of $\Delta_r S$ — 1
- calculation of $\Delta_r G$ — 1
- calculation of $\Delta_r E$ — 1
- rest of the calculation — 1

□8 Maximum score 4

An example of a correct calculation is:

$$\frac{\left(\dfrac{0.0054 \times 0.90}{63.55} \times 2 + \dfrac{0.0054 \times 0.10}{107.9}\right) \times 9.649 \cdot 10^4}{60} \times 10^2 = 25\%$$

- calculation of the number of moles of Cu and the number of moles of Ag — 1
- calculation of the number of moles of electrons — 1
- conversion to C — 1
- rest of the calculation — 1

□9 Maximum score 2

$4\ OH^- \rightarrow O_2 + 2\ H_2O + 4\ e^-$

If $2\ H_2O \rightarrow O_2 + 4H^+ + 4e^-$ is given — 1

□10 Maximum score 5

An example of a correct calculation is:

$$\frac{\left[1.00-\left(0.336+0.069\right)\right]\times 60\times 60\times 0.030}{9.649\cdot 10^{4}}\times\frac{1}{2}\times 24.5\cdot 10^{3} = 8.2\ \text{cm}^{3}$$

- calculation of the total charge in C 1
- calculation of the number of C used for the formation of H_2 1
- conversion to the number of moles of electrons used for the formation of H_2 1
- calculation of the number of moles of H_2 1
- conversion to the number of cm^3 1

□11 Maximum score 4

An example of a correct calculation is:

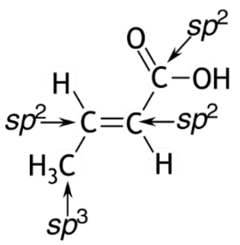
$$\left[\left(\frac{0.035\times 0.0413}{46.07}\right)\times 2+\left(\frac{0.035\times 0.0074}{60.09}\right)\times 3\right]\times 44.01\cdot 10^{3} = 3.3\ \text{mg}$$

- calculation of the masses of ethanol and propan-1-ol 1
- conversion of the masses of ethanol and propan-1-ol to mol 1
- calculation of the number of moles of CO_2 that reacted 1
- conversion of the number of moles of CO_2 to mg 1

Problem 4 Crotonic acid 17 points

▫12 Maximum score 2

A correct answer can be shown as follows:



If the correct hybridization is shown for three C atoms 1

If the correct hybridization is shown for two or fewer C atoms 0

▫13 Maximum score 3

A correct answer can be formulated as follows:

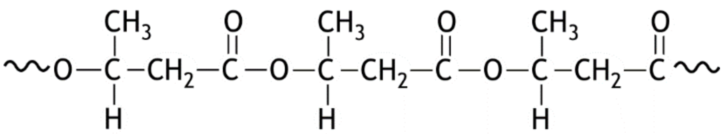
In both mass spectra, the molecular ion peak occurs at m/z = 86, so the molecular formula is the same. The peak patterns/peaks in the mass spectra are different, so the molecules have a different structure (structural formula).

In the mass spectrum of **A** (as with crotonic acid), a peak of the COOH group occurs at m/z = 45.

- in both mass spectra the molecular ion peak occurs with m/z = 86, so the molecular formula is the same 1
- the peak patterns/peaks in the mass spectra are different, so the molecules have a different structure (structural formula) 1
- in the mass spectrum of **A,** a peak occurs at m/z = 45 of the COOH group 1

▫14 Maximum score 3

A correct answer can be shown as follows:



- two ester groups correctly shown 1
- ends correctly shown 1
- rest of the structural formula correctly shown 1

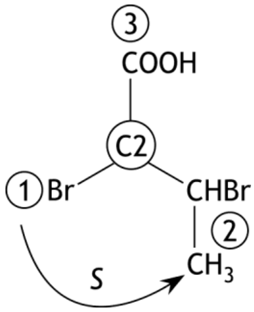
▫15 Maximum score 2

$(C_4H_6O_2)_n \rightarrow n\ C_4H_6O_2$ or $HO{-}(C_4H_6O_2)_n{-}H \rightarrow n\ C_4H_6O_2 + H_2O$

- $(C_4H_6O_2)_n$ or $HO{-}(C_4H_6O_2)_n{-}H$ before the arrow 1
- $n\ C_4H_6O_2$ or $n\ C_4H_6O_2 + H_2O$ after the arrow 1

▫16 Maximum score 3

An example of a correct answer is:



· a correct diagram 1

· the correct prioritization 1

· correct designation of the configuration 1

▫17 Maximum score 2

A correct answer can be formulated as follows:

2,3-dibromobutanoic acid has two asymmetrical carbon atoms,
so there are (2^2 =) 4 possible stereoisomers.

· there are 4 possible stereoisomers 1

· correct explanation 1

▫18 Maximum score 2

A correct answer can be formulated as follows:

Two stereoisomers are formed. In addition to the shown stereoisomer, the mirror image is also produced.

· two stereoisomers are formed 1

· in addition to the shown stereo isomer, the mirror image is also formed 1

Problem 5 CoFe 17 points

□19 Maximum score 3

An example of a correct calculation is:

10.00 mL of 0.0500 M chloropentaamminecobalt(III) chloride solution contains 10.00×0.0500 mmol of chloropentaamminecobalt(III) chloride and therefore $2 \times 10.00 \times 0.0500$ mmol Cl^-.

That reacts with $2 \times 10.00 \times 0.0500$ mmol Ag^+ to form $2 \times 10.00 \times 0.0500$ mmol AgCl.

That is $2 \times 10.00 \times 0.0500 \times 143.32 \times 10^{-3} = 0.14$ g AgCl.

- calculation of the number of mmol Cl^- that can react 1
- calculation of the number of mmol AgCl that can be formed 1
- rest of the calculation 1

□20 Maximum score 2

- I and III are identical 1
- II and IV are identical 1

□21 Maximum score 3

An example of a correct calculation is:

$$E = -\log T = -\log 0.075 = \varepsilon \times 0.0200 \times 1.00$$

So $\varepsilon = \dfrac{-\log 0.075}{0.0200 \times 1.00} = 56\ \text{L mol}^{-1}\ \text{cm}^{-1}$.

- $T = 0.075$ 1
- rest of the calculation 1
- correct unit 1

□22 Maximum score 1

An example of a correct answer is:

Apparently, the unreacted Fe^{2+} (and the formed Co^{2+} and $FeCl^{2+}$) also absorb light at 520 nm.

□23 Maximum score 2

An example of a correct answer is:

Because the Fe^{2+} has been added in large excess, the extinction of the Fe^{2+} can be considered constant (and the extinctions of the small amounts of Co^{2+} and $FeCl^{2+}$ are negligible).

The total extinction of the solution at time t is then $E_{\text{total},t} = E_{\text{cobalt complex},\ t} + E_\infty$,

so $= E_{\text{cobalt complex},\ t} = E_{\text{total},\ t} - E_\infty$, or $\varepsilon \times [Co(Cl)(NH_3)_5]_t \times 1.00 = E_{\text{total},t} - E_\infty$ or

$$[Co(Cl)(NH_3)_5]_t = \frac{E_{\text{total},t} - E_\infty}{\varepsilon \times 1.00}.$$

- explanation that the sum of the extinctions of the unreacted Fe^{2+} (and the formed Co^{2+} and $FeCl^{2+}$) during the reaction is constant 1
- rest of the explanation 1

□24 Maximum score 6

An example of a correct calculation is:

With a large excess of Fe^{2+}, $[Fe^{2+}]$ is constant during the reaction. The reaction rate is then given by $s = k[Co(Cl)(NH_3)_5^{2+}][Fe^{2+}] = k'[Co(Cl)(NH_3)_5^{2+}]$, with $k' = k[Fe^{2+}]$. This is the equation of a (pseudo-)first-order reaction.

This applies to $\ln\dfrac{[Co(Cl)(NH_3)_5]_0}{[Co(Cl)(NH_3)_5]_t} = k't$, or $k' = \dfrac{\ln\dfrac{[Co(Cl)(NH_3)_5]_0}{[Co(Cl)(NH_3)_5]_t}}{t}$.

Enter the data for the interval 10–20 minutes, for example:

$k' = \dfrac{\ln\dfrac{1.15-0.283}{0.875-0.283}}{10}$ min^{-1} or $k' = \dfrac{\ln\dfrac{1.15-0.283}{0.875-0.283}}{10\times 60} = 6.36\cdot 10^{-4}\ s^{-1}$.

During the reaction, the $[Fe^{2+}] = \dfrac{0.300}{2} = 0.150\ mol\ L^{-1}$,

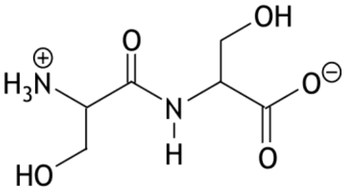
so $k = \dfrac{6.36\cdot 10^{-4}}{0.150} = 4.2\cdot 10^{-3}\ L\ mol^{-1}\ s^{-1}$.

- notion that the reaction is a (pseudo-)first-order reaction 1
- use of $k' = \dfrac{\ln\dfrac{[Co(Cl)(NH_3)_5]_0}{[Co(Cl)(NH_3)_5]_t}}{t}$,possibly already partially filled in 1
- calculation of k' 1
- calculation of $[Fe^{2+}]$ 1
- calculation of k 1
- correct unit 1

Problem 6 Dipeptide 14 points

▫25 Maximum score 1

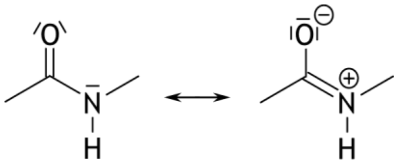
An example of a correct answer is:



▫26 Maximum score 3

An example of a correct answer is:

Two Lewis structures can be drawn for the amide group, one of which has a double bond between the carbon atom and the nitrogen atom:

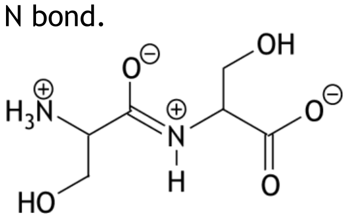


- in both resonance structures all bonding and non-bonding electron pairs correctly drawn 1
- in the right resonance structure the charges correctly indicated 1
- in the right resonance structure a double bond between C and N is drawn 1

▫27 Maximum score 3

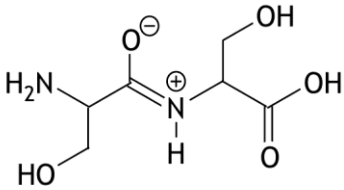
An example of a correct answer is:

E/Z stereoisomerism occurs, because the double bond character prevents free rotation around the C — N bond.

The structure:  occurs most often, because in the other stereoisomer steric hindrance occurs.

- there is no free rotation around the C — N bond 1
- correct diagram 1
- steric hindrance occurs in the other isomer 1

Note:

Do not penalize when the following structure is drawn: 

▫28 Maximum score 2
$H_2PO_4^-$ and HPO_4^{2-} occur most frequently.

· $H_2PO_4^-$ 1
· HPO_4^{2-} 1

▫29 M
aximum score 5
An example of a correct answer is:

$$K_{c,1} = e^{-\frac{\Delta_r G}{RT}} = e^{-\frac{-1.7\cdot 10^4}{8.314\times 298}} = e^{-6.84} = 1.0\cdot 10^{-3}$$

For equilibrium 3, the following applies:
$\Delta G_3^0 = \Delta G_1^0 + \Delta G_2^0 = +\ 1.7\cdot 10^4 + (-\ 2.8\cdot 10^4) = -\ 1.1\cdot 10^4\ \text{J mol}^{-1}$.

So $K_{c,3} = e^{-\frac{\Delta G^0}{RT}} = e^{-\frac{-1.1\cdot 10^4}{8.314\times 298}} = e^{4.4} = 85$.

The equilibrium constant of equilibrium 3 is therefore much larger than that of equilibrium 1, so equilibrium 3 lies further to the right than equilibrium 1 and the yield of the dipeptide is greater in equilibrium 3.

· calculation of $K_{c,1}$ 1
· calculation of ΔG_3^0 1
· calculation of $K_{c,3}$ 1
· explanation that equilibrium 3 lies further to the right than equilibrium 1 1
· conclusion regarding the yield of dipeptide 1

Problem 7 Hydrogen storage 20 points

□30 Maximum score 3

An example of a correct calculation is:
La_2O_3 and NiO must be combined in the molar ratio 1 : 10, so in a mass ratio of 325.8 : (10 × 74.69) = 0.44 : 1.0.

- correct mole ratio 1
- correct molar masses 1
- rest of the calculation 1

□31 Maximum score 4

An example of a correct calculation is:
The reaction equation is: $2\ La_2O_3 + 20\ NiO + 13\ CaH_2 \rightarrow 4\ LaNi_5 + 13\ Ca(OH)_2$.
for every 4 mol of $LaNI_5$, 26 mol of CaH_2 is required for a twofold excess.
So for every 4 × 432.4 g $LaNi_5$ you need 26 × 42.096, that is per 1.0 g $LaNi_5$

$$\frac{26 \times 42.096}{4 \times 432.4} = 0.63\,\text{g}\ Ca(OH)_2.$$

- correct reaction equation (possibly already given in the previous question) 1
- correct processing of double excess 1
- correct molar mass of $LaNi_5$ 1
- rest of the calculation 1

□32 Maximum score 2

An example of a correct answer is:
You can perform an extraction with water. Calcium hydroxide dissolves and calcium hydride reacts with it, but the alloy does not. Then filter (and dry).

- calcium hydroxide and calcium hydride dissolve in water / react with water 1
- so add water and then filter 1

□33 Maximum score 3

An example of a correct answer is:
There can be one nickel atom in the cell; it counts fully.
And there can be eight nickel atoms on the faces (for example, two on the top face, two on the bottom face, and one nickel atom on the side faces), which count for half. (There are no nickel atoms on the edges.)

- correct number inside the cell 1
- correct number on the faces 1
- correct explanation 1

□34 Maximum score 3

An example of a correct calculation is:

The volume of the unit cell is $397 \times 511 \times 511 \times \frac{1}{2} \times \sqrt{3} \times 10^{-36}$ m³.

The mass of the unit cell is $432.4 \times 1.66 \cdot 10^{-27}$ kg.

So the density is $\dfrac{432.4 \times 1.66 \cdot 10^{-27}}{397 \times 511 \times 511 \times \frac{1}{2} \times \sqrt{3} \times 10^{-36}} = 8.00 \cdot 10^{3}\ \text{kg m}^{-3}$.

- correct calculation of the volume of a unit cell 1
- correct calculation of the mass of a unit cell 1
- rest of the calculation 1

Note:
If the same incorrect molar mass for $LaNi_5$ is used in the answer of question 34 as in question 31, do not penalize again.

□35 Maximum score 5

Examples of a correct calculation are:

The density of hydrogen at 273 K and $p = p_0$ is 0.090 kg m^{-3}. A cm^3 is therefore $0.090 \cdot 10^{-3}$ g, and it contains $\frac{0.090 \cdot 10^{-3}}{1.008}$ moles of H atoms, which are $\frac{0.090 \cdot 10^{-3}}{1.008} \times 6.02 \cdot 10^{23}$ H atoms.

Therefore, there are $\frac{0.090 \cdot 10^{-3}}{1.008} \times 6.02 \cdot 10^{23} \times 1244 = 6.69 \cdot 10^{22}$ H atoms in a cm^3 of $LaNi_5$.

The volume of the unit cell is $8.98 \cdot 10^{-23}$ cm^3 (follows from the previous question), so there are $\frac{1}{8.98 \cdot 10^{-23}} = 1.11 \cdot 10^{22}$ unit cells in a cm^3.

$\frac{6.69 \cdot 10^{22}}{1.11 \cdot 10^{22}} = 6$ H atoms can be stored in a unit cell.

And

At 273 K and $p = p_0$, V_m = 22.4 dm^3 mol^{-1}.

Therefore, in a cm^3 there are $\frac{1}{22.4} \times 10^{-3}$ moles of H_2 or $2 \times \frac{1}{22.4} \times 10^{-3}$ moles of H atoms, which are $2 \times \frac{1}{22.4} \times 10^{-3} \times 6.02 \cdot 10^{23} = 5.38 \cdot 10^{19}$ H atoms. Therefore, in a cm^3 $LaNi_5$ there are $1244 \times 2 \times \frac{1}{22.4} \times 10^{-3} \times 6.02 \cdot 10^{23} = 6.69 \cdot 10^{22}$ H atoms.

In one cm^3 $LaNi_5$, $\frac{1}{8.98 \cdot 10^{-23}} = 1.11 \cdot 10^{22}$ unit cells are present.

So $\frac{6.69 \cdot 10^{22}}{1.11 \cdot 10^{22}} = 6$ H atoms can be stored in a unit cell.

- calculation of the number of moles of H atoms in a cm^3 of hydrogen at 273 K and $p = p_0$ 1
- calculation of the number of H atoms in a cm^3 of hydrogen at 273 K and $p = p_0$ 1
- calculation of the number of H atoms in a cm^3 $LaNi_5$ 1
- calculation of the number of unit cells in a cm^3 $LaNi_5$ 1
- calculation of the number of H atoms that can be stored in a unit cell 1