

E-Learning and E-Evaluation

A Case Study

Lorentz JÄNTSCHI, Sorana D. BOLBOACA

Monica M. MARTA, Alexandru LASZLO

Tehnickal University

“Iuliu Hatieganu” University of Medicine and Pharmacy

George Baritiu National College

Cluj-Napoca, Romania

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Aim

- To analyze an e-learning and e-evaluation project, a framework for training, learning and evaluation.

/Education/Training/Gibbs/

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Up

Gibbs free energy

Please select substances:

Na + HCl

Details:

2Na + 2HCl -> 2NaCl + H₂

Please select reaction temperature:

Your options		My 'hidden' data				
2Na + 2HCl -> 2NaCl + H ₂		C:	2	2	2	1
		E:	2Na + 2HCl -> 2NaCl + H ₂			
		R:	Na	HCl		
		P:	NaCl	H ₂		
Please select reaction temperature: 334.5		H:	0	-92.3	-410.9	0
		S:	51.42	186.7	72.36	130.6
		a:	20.92	26.53	45.94	27.28
		b:	22.43	4.6	16.32	3.26
		c:	0	1.09	0	0.502

Up

2Na + 2HCl -> 2NaCl + H₂

H(Na, 334.5 K, 1 atm.) = 1022.3429 kJ/mol
 S(Na, 334.5 K, 1 atm.) = 54.6573 J/mol*K
 H(HCl, 334.5 K, 1 atm.) = 969.0713 kJ/mol
 S(HCl, 334.5 K, 1 atm.) = 190.0619 J/mol*K
 H(NaCl, 334.5 K, 1 atm.) = 1454.1851 kJ/mol
 S(NaCl, 334.5 K, 1 atm.) = 78.2668 J/mol*K
 H(H₂, 334.5 K, 1 atm.) = 1051.7318 kJ/mol
 S(H₂, 334.5 K, 1 atm.) = 133.9313 J/mol*K

$\Delta H(2Na + 2HCl \rightarrow 2NaCl + H_2) = 2 \cdot H(NaCl) + 1 \cdot H(H_2) - 2 \cdot H(Na) - 2 \cdot H(HCl)$
 $\Delta S(2Na + 2HCl \rightarrow 2NaCl + H_2) = 2 \cdot S(NaCl) + 1 \cdot S(H_2) - 2 \cdot S(Na) - 2 \cdot S(HCl)$
 $\Delta G = \Delta H - T \cdot \Delta S$

$\Delta H(2Na + 2HCl \rightarrow 2NaCl + H_2) = -22.7264 \text{ kJ/mol}$
 $\Delta S(2Na + 2HCl \rightarrow 2NaCl + H_2) = -198.9734 \text{ J/mol} \cdot K$
 $\Delta G(2Na + 2HCl \rightarrow 2NaCl + H_2) = 43.8302 \text{ kJ/mol}$

26/05/2008

/Education/Training/Gibbs/

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Up

Test

Uranium-238 atoms decay according to a decay series as noted in the chart at the end of this page. The energy released in the emission of a significant amount of energy - in fact, this energy is the source of most of the energy used in the world today.

- Suppose you have pure, 1 gram samples of the following elements. Which sample will have the greatest mass after 1 year?
 - $^{238}_{92}\text{U}$
 - $^{234}_{92}\text{U}$
 - $^{226}_{88}\text{Ra}$
 - $^{222}_{86}\text{Rn}$
- The first decay in the series is the alpha decay of $^{238}_{92}\text{U}$.

$$^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} + ^4_2\text{He}$$

A lot of energy is released in this reaction. Thinking about the masses of the particles involved, which of the following is true?

 - the mass of the uranium atom is greater than the mass of the thorium atom plus the mass of the alpha particle
 - the mass of the uranium atom is less than the mass of the thorium atom plus the mass of the alpha particle
 - the mass of the uranium atom is the same as the mass of the thorium atom plus the mass of the alpha particle
 - all of the particles gained mass over Thanksgiving, as we all did
- A sample of pure $^{238}_{92}\text{U}$ is sealed in a box, and all of the air is pumped out, so that the only gas in the box is the uranium. Which gas will be present in the box after 1 year?
 - Hydrogen
 - Helium
 - Radon
 - Radium

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Up

Please select correct elements, atomic numbers and/or atomic masses:

- $^{10}_3\text{B} + ^1_0\text{n} \rightarrow$ $+ ^4_2\text{He} + 28\text{MeV}$
- $^{235}_{92}\text{U} + ^1_0\text{n} \rightarrow$ $+ 3(^1_0\text{n}) + ^{216}_{74}\text{Po} + ^{89}_{36}\text{Kr} + 177\text{MeV}$
- $^{224}_{88}\text{Ra} \rightarrow$ $+ ^1_0\text{n}$
- $^{220}_{86}\text{Rn} \rightarrow$ $+ ^{216}_{84}\text{Po}$
- $^{234}_{90}\text{Th} \rightarrow$ $+ ^4_2\text{He} + ^{230}_{88}\text{Ra}$
- $^{14}_6\text{C} \rightarrow$ $+ ^{14}_7\text{N}$
- $^{212}_{83}\text{Bi} \rightarrow$ $+ ^{212}_{81}\text{Pb}$

Done

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/Education/Training/Milikan/

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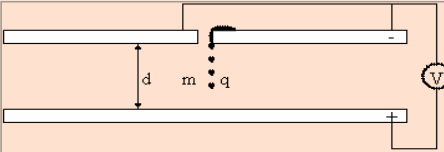
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Milikan's Experiment

In 1911 Robert Milikan set out to try and determine the charge of electron. He did this by balancing charged oil droplets in an electric field, using an equipment silarily with the one shown below.

Two forces govern the movement.

- Coulomb force (qV/d)
- Newton force (mg)



- q = droplet charge;
- V = voltage between plates;
- d = distance between plates;
- m = droplet mass;
- g = let's take as standard gravity

Using the following interface, you can compute one out of five parameters necessary to drops stop moving. Leave blank one of

Done

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/Education/Training/Mendeleev/

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Dmitri Mendeleev is credited as being the primary creator of the first version of the periodic table of elements. Unlike other contributors to the table, Mendeleev predicted the properties of elements yet to be discovered. After becoming a teacher, he wrote the definitive two-volume textbook at that time: Principles of Chemistry (1868-1870). As he attempted to classify the elements according to their chemical properties, he noticed patterns that led him to postulate his Periodic Table. *The program allow constructing and making SQL queries on Periodic System of Elements Information.*

Select	Elements	Properties	Order
Discovery:	H	Discovery	Discovery
Appearance:	He	Appearance	Appearance
Source:	Li	Source	Source
Uses:	Be	Uses	Uses
Biological:	B	Biological	Biological
General:	C	General	General
Number:			
Mass:			
		Melting:	life:
		Boiling:	Ionisation:
		Density:	Fusion:
		Configuration:	Vaporisation:
		Affinity:	main:
		nuclide:	others:
		Atomic:	Bonds:
		abundance:	Symbol:

Use LIKE for string comparisons; Use '%' for an unknown string sequence; Use ' as string delimiter

[Query](#) [Old Version](#) [New Version](#)

First you may wish to learn how are created SQL queries. For this, the interface from above are made.
 Second you may wish to test your ability to create your own queries. For this, you may use one of the applications from below.

[Limited query](#) [Full query](#)

Done

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/Education/Training/titration/



v1.1

Titration is a common laboratory method of quantitative/chemical analysis which can be used to determine the concentration of a known reactant. Because volume measurements play a key role in titration, it is also known as volumetric analysis. In 1855, the German chemist, Friedrich Mohr, defined titration as the "weighing without scale" method, because this process allows determination of the concentration of a sample without using complex instrumentation. The process of determining the quantity of a substance A by adding measured increments of substance B until reaction for some means of recognizing (indicating) the endpoint at which essentially all of A has reacted. If the endpoint is reached, the amount of A to be found from known amounts of B added up to this point, is equal to the amount of A. Thus, there are acid-base, complexometric, chelatometric, oxidation-reduction as well as coulometric titrations, in which the titrant is generated electrolytically

Acid - Base Titration Simulator

Address: <http://l.academicdirect.org/Education/Training/titration/v1.1/>

Acid: CH3COOH Quantity: 10 ml Concentration: 0.01 M

Base: NH3 Quantity: 20 ml Concentration: 0.01 M

Adding quantity: 0.05 ml

Chemical Reaction:

$$HA + BOH \rightarrow AB + H_2O$$

Chemical Parameters:

Substance	Constant	Quantity	Concentration
Acid	$K_a = 1.76e-5$	$V_a = 10$ ml	$C_a = 0.01$ mol/l
Base	$K_b = 1.790e-5$	$V_b = 20$ ml	$C_b = 0.01$ mol/l
Adding Quantity	K_b	$V_a/n = 0.05$ ml, $n = 400$	
Water	$K_w = 1e-14$	$V_w = (1-C_a)V_a + (1-C_b)V_b$	

Mathematical Model:

Significance	Equation
Acid Concentration with Acid Excess	$C_a = (C_a * V_a - C_b * V_b) / (V_a + V_b)$
Salt Concentration with Acid Excess	$C_s = C_b * V_b / (V_a + V_b)$
Salt-Acid Equation ($\alpha = [H^+]$)	$0 = x^2 + (K_a + C_a) * x^2 - (K_w + C_a * K_a) * x - K_w * K_a$
Equilibrium Equation ($\alpha = [H^+]$)	$x = \sqrt{K_a * K_b * (K_b + C_b) / (K_b + C_a)}$
Volume Added at Equilibrium	$V_a = V_b * C_b / C_a$
Salt Concentration at Equilibrium	$C_s = C_a * C_b / (C_a + C_b)$
Salt-Base Equation ($\alpha = [H^+]$)	$0 = x^2 + (K_b / K_a + C_b) * x^2 - (K_w + C_b * K_b / K_a) * x - K_w * K_b$

AcademicDirect Library Education Training Titration v1.1

Sub Concentration at Equilibrium: $C_a = C_a * V_a / (V_a + V_b)$

Sub-Base Equation ($\alpha = [H^+]$): $0 = x^2 + (K_b / K_a + C_b) * x^2 - (K_w + C_b * K_b / K_a) * x - K_w * K_b$

Sub Concentration with Base Excess: $C_s = C_b * V_b / (V_a + V_b)$

Base Concentration with Base Excess: $C_b = C_b * V_b / (V_a + V_b)$

Computed Values:

V _a	pH	Tit bar
0.000	0.050	0.100
0.100	0.100	0.200
0.200	0.200	0.300
0.300	0.300	0.400
0.400	0.400	0.500
0.500	0.500	0.600
0.600	0.600	0.700
0.700	0.700	0.800
0.800	0.800	0.900
0.900	0.900	1.000
1.000	1.000	1.100
1.100	1.100	1.200
1.200	1.200	1.300
1.300	1.300	1.400
1.400	1.400	1.500
1.500	1.500	1.600
1.600	1.600	1.700
1.700	1.700	1.800
1.800	1.800	1.900
1.900	1.900	2.000
2.000	2.000	2.100
2.100	2.100	2.200
2.200	2.200	2.300
2.300	2.300	2.400
2.400	2.400	2.500
2.500	2.500	2.600
2.600	2.600	2.700
2.700	2.700	2.800
2.800	2.800	2.900
2.900	2.900	3.000
3.000	3.000	3.100
3.100	3.100	3.200
3.200	3.200	3.300
3.300	3.300	3.400
3.400	3.400	3.500
3.500	3.500	3.600
3.600	3.600	3.700
3.700	3.700	3.800
3.800	3.800	3.900
3.900	3.900	4.000
4.000	4.000	4.100
4.100	4.100	4.200
4.200	4.200	4.300
4.300	4.300	4.400
4.400	4.400	4.500
4.500	4.500	4.600
4.600	4.600	4.700
4.700	4.700	4.800
4.800	4.800	4.900
4.900	4.900	5.000
5.000	5.000	5.100
5.100	5.100	5.200
5.200	5.200	5.300
5.300	5.300	5.400
5.400	5.400	5.500
5.500	5.500	5.600
5.600	5.600	5.700
5.700	5.700	5.800
5.800	5.800	5.900
5.900	5.900	6.000
6.000	6.000	6.100
6.100	6.100	6.200
6.200	6.200	6.300
6.300	6.300	6.400
6.400	6.400	6.500
6.500	6.500	6.600
6.600	6.600	6.700
6.700	6.700	6.800
6.800	6.800	6.900
6.900	6.900	7.000
7.000	7.000	7.100
7.100	7.100	7.200
7.200	7.200	7.300
7.300	7.300	7.400
7.400	7.400	7.500
7.500	7.500	7.600
7.600	7.600	7.700
7.700	7.700	7.800
7.800	7.800	7.900
7.900	7.900	8.000
8.000	8.000	8.100
8.100	8.100	8.200
8.200	8.200	8.300
8.300	8.300	8.400
8.400	8.400	8.500
8.500	8.500	8.600
8.600	8.600	8.700
8.700	8.700	8.800
8.800	8.800	8.900
8.900	8.900	9.000
9.000	9.000	9.100
9.100	9.100	9.200
9.200	9.200	9.300
9.300	9.300	9.400
9.400	9.400	9.500
9.500	9.500	9.600
9.600	9.600	9.700
9.700	9.700	9.800
9.800	9.800	9.900
9.900	9.900	10.000

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Y axis values: 3.386; 3.414; 3.442; 3.470; 3.498; 3.525; 3.551; 3.578; 3.603; 3.628; 3.653; 3.677; 3.700; 3.723; 3.746; 3.767; 3.788; 3.809; 3.829; 3.849; 3.868; 3.887; 3.905; 3.925

X axis values: 0.000; 0.050; 0.100; 0.150; 0.200; 0.250; 0.300; 0.350; 0.400; 0.450; 0.500; 0.55; 0.600; 0.650; 0.700; 0.750; 0.800; 0.850; 0.900; 0.950; 1.000; 1.050; 1.100; 1.150

Y's legend: [Empty]

X's legend: [Empty]

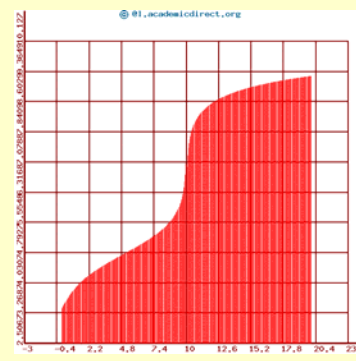
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pixels, no.: margin 15, grid 15, font 5

font: type white, back olive, text maroon

colors: axis blue, line red, pixel red




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Elementary Reaction Simulator

In 1864, Peter Waage pioneered the development of chemical kinetics by formulating the law of mass action, which states that the speed of a chemical reaction is proportional to the product of the concentrations of the reactants raised to their respective stoichiometric coefficients.

Reaction Type: First rate constant: Second rate constant:

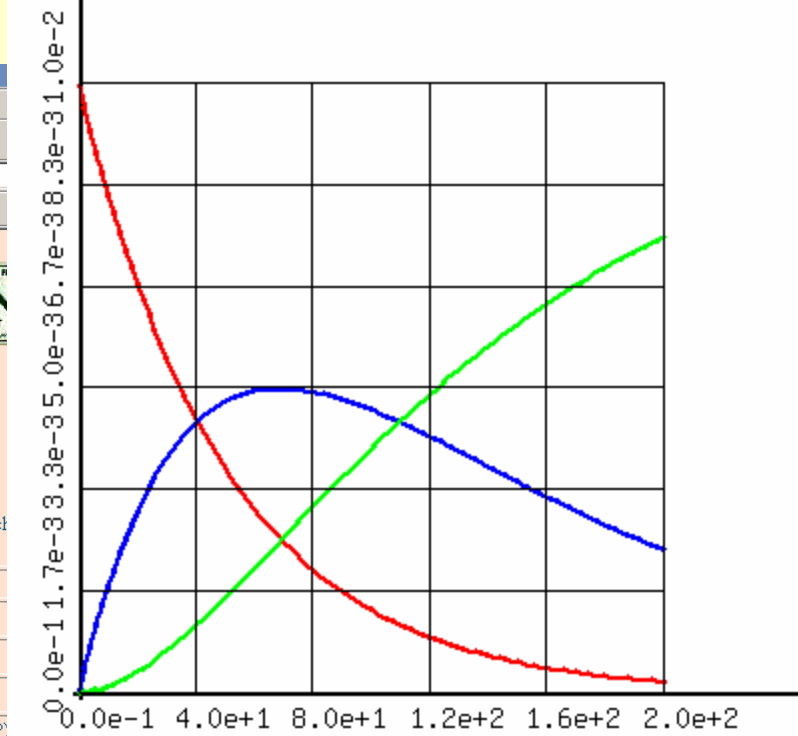
Initial concentration: Observation Time: Number of divisions:

Extra data

B Concentration: (for third order & opposed)

C Concentration: (for third order)

type	reaction
null order	$X_2(R) \rightarrow X_1(P)$
first order	$X_1(R) \rightarrow X_2(P)$
second order	$X_1(R) \rightarrow X_2(P)$
third order	$X_1(R) + X_2(R) + X_3(R) \rightarrow X_4(P)$
opposed	$X_1(R) \leftrightarrow X_2(P)$
consecutive	$X_1(R) \rightarrow X_2(P)$
	$X_2(R) \rightarrow X_3(P)$
parallel	$X_1(R) \rightarrow X_2(P)$
	$X_1(R) \rightarrow X_3(P)$



		$\frac{dX_1}{dt} = k_2X_2 - k_1X_1$ $\frac{dX_2}{dt} = k_1X_1 - k_2X_2$
		$\frac{dX_2}{dt} = k_{1,2}X_1 - k_{2,3}X_2$ $\frac{dX_1}{dt} = -k_{1,2}X_1$ $\frac{dX_3}{dt} = k_{2,3}X_2$
		$\frac{dX_1}{dt} = -k_{1,2}X_1 - k_{1,3}X_1$ $\frac{dX_2}{dt} = k_{1,2}X_1$ $\frac{dX_3}{dt} = k_{2,3}X_1$

e-Evaluation (1/4)

- Security
 - Running: HTTP_X_FORWARDED_FOR, HTTP_VIA, REMOTE_ADDR, SERVER_ADDR
 - Actions (limited on resources depending on moment): global variables per discipline T/F: time_for_view time_for_update, time_for_test
 - Authentication: both professor's and student passwords (encrypted MD5)

e-Evaluation (2/4)

- Flexibility
 - To allow defining the number of questions that a test will contain.
 - To allow defining the Questions & Answers table name, and the name of the discipline.
 - To allow defining the end of the evaluation - date and time.
 - To allow questions with five possible answers, with one to four correct answers.

e-Evaluation (3/4)

- Features
 - The students are involved in the task of creating and adding questions to the database, a task that is voluntary;
 - The student's work is rewarded through supplementary points added to the final mark.
 - The bonus points for this task are given according to the quality of work. This is an imposed rule, related with the calculation bonus method: the number of correct answers for all inserted questions must have a uniform distribution. The highest bonus can give a plus of 1/5 to the final mark.

Results (1/3)

Discipline		Instrum	Kinetic	Mater	Polluta	Toxicol
Answers	Total	654 (%)	232 (%)	863 (%)	439 (%)	767 (%)
As is in dB (from 0 to 5 possibilitie s)	1	331 (50	146 (63	297 (35	154 (35	419 (55
	2	155 (24	45 (19	201 (23	101 (23	147 (19
	3	105 (16	22 (10	181 (21	100 (23	116 (15
	4	63 (10	19 (8	184 (21	84 (19	85 (11
students who inserted quest. (2005-2007)		23 (32	11 (46	30 (30	19 (49	28 (44

Results (2/3)

Year	2005-2006			2006-2007			Total		
Discipline	Tests	Studs	%	Tests	Studs	%	Tests	Studs	%
Instrumental	86	42	205	47	30	157	133	72	185
Kinetic	n.a.	n.a.	-	35	24	146	35	24	146
Materials	236	99	238	n.a.	n.a.	-	236	99	238
Pollutants	n.a.	n.a.	-	69	39	177	69	39	177
Toxicology	80	37	216	55	27	204	135	64	211
Total	402	178	226	206	120	172	608	298	204

Percentual tests by student (95% confidence): 193 ± 17 %

Results (3/3)

- Table 3a: Parameters of evaluations: Instrumental Analysis
- Table 3b: Parameters of evaluations: Toxicology
- Table 3c: Parameters of evaluations: Kinetics
- Table 3d: Parameters of evaluations: Pollutant
- Table 3e: Parameters of evaluations: Materials

<i>Param</i>	<i>Correct answ</i>		<i>Time /corr.answ(s)</i>		<i>Bonus (from 10)</i>	
	2006	2007	2006	2007	2006	2007
Year	2006	2007	2006	2007	2006	2007
n_{valid}	50	35	50	35	12	16
μ	15.94	11.8	40.7	61.8	0.7	1.1
SD	6.62	5.7	40.0	57.3	0.5	0.5
Me	16	13	32.7	46.7	0.5	1.1
Min	2	3	7.6	10.5	0.2	0.3
Max	29	24	273.5	290	1.7	1.9

Year = of evaluation; n_{valid} = sample size; μ = arithmetic mean;

SD = standard deviation; Me = median; **TABLE 3B**

Analysis (1/3)

- Mean of correct answers obtained by students that took the Instrumental Analysis test in the academic year 2005-2006 was significantly lower (up to eight correct answers, $p < 1 \text{ ‰}$) compared with the students that took the test in the academic year 2006-2007
- The difference was inverse for the students that took the Toxicology test (up to four correct answers, $p < 1\%$)

Analysis (2/3)

- Average time per correct answer was significantly higher ($p = 0.002 \text{ ‰}$) for the students that took the Instrumental Analysis test in the academic year 2005-2006 (almost 83s, Tab.3A) compared with those that took the test in the academic year 2006-2007.
- The students who performed the examination in the academic year 2006-2007 obtained better performances due to the previously interaction with the evaluation system. They performed previously two similar examinations, being familiarized with the system and its components.

Analysis (3/3)

- The students that took the Materials Chemistry test obtained the lowest value for time per correct answer (avg=21.86s) and highest value for correct answers (~22/30).
- Pearson correlation coefficient on time vs. number of correct answers obtained by these students give a value of -0.72 ($p < 0.05$: time significantly related with number of correct answers; $r^2 \approx 52$: number of correct answers relates with time per correct answer with about 52%).

Discussion (1/2)

- Many online-training and evaluation systems are available today for different domains of interest.
- The impact (of the proposed system) on teaching and learning can be evaluated in statistics terms.
- The examination using multiple choice questions is seen by the students as an easily exam comparing with other forms of examination (both passing rates and student's opinions).
- The students that used previously the system learn that it is necessary to have knowledge on the subject tested in order to pass the exam (number of fails at first contact)
- Those of students which used the system for the third time had better results compared with other students.

Discussion (2/2)

- Time is one of the factors included into the evaluation for two reasons. First, any decision is limited in time, especially in engineering domain. Second, the time was used for discouraging the cheating (communication between students on the time of evaluation, the use of the forbidden materials as courses and books).
- The e-evaluation environment was constructed as a training and evaluation instrument. The active involvement of the students in the creation of multiple-choice banks introduces a new method of learning. This activity motivates students to ask questions and to find answers, thus involving them into an active learning process and an active interaction with the teacher, which are useful for their development.

Remarks

- The time needed to evaluate each test is considerably low (from 5 to 10 min. for a good student => an advantage when testing large classes);
- The evaluation is as objective as it could be;
- The idea of cheating by looking for the correct answer (the marking depends on the number of correct answers as well as by the time needed to give the correct answer) or by asking a colleague are discouraged.
- Basic computer skills are necessary in order to use the system.

References

- Leonardo El J Pract Technol 9:179-92;2006.
- Proc 10 WMSCI 1:97-101;2006.