THE EChemTest® PROFICIENCY CERTIFICATE QUALIFICATION LEVELS

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1) INTRODUCTION: A EUROPEAN STANDARD FOR CHEMISTRY EDUCATION

1995 – Establishing ECTN: The Erasmus Conference "Chemistry in Europe" (Lyon, 1995) prompted the submission of a proposal to establish the European Chemistry Thematic Network (ECTN). The proposal was successfully submitted by A.K. Smith (CPE, Lyon) to the SOCRATES/ERASMUS programme and gathered together over 130 Chemistry departments from all the Member States of the European Union, Norway, Iceland, Switzerland, Bulgaria and Romania. Here we summarize the steps relevant to **EChemTest®**.

1996/2000 – ECTN-1: Core Chemistry and practical skills - The first ECTN project started the design and development of a valid *de facto* European standard for chemistry Higher Education through various work groups (WG). In particular WG2 (Chair P. Todesco) defined the EU harmonized curricula Core Chemistry for Organic Chemistry (OC) and Physical Chemistry (PC), for Inorganic Chemistry (IC) and Analytical Chemistry (AC), for Mathematics and Physics while WG7 (Chair T. Mitchell) defined practical skills. (http://www.ec2e2n.net/past-networks/ectn1/)

2000/2003 – ECTN-2: e-learning and EChemTest® - The second ECTN project tackled the design and development for the use by the member institutions of appropriate e-test libraries of Questions and Answers (Q&A)s in WG10 (Chair P. Mimero) using a commercial software. The Q&As were developed for General Chemistry (GC) 1 and 2 - Group Leader: K. Wähälä, Helsinki, FI; Analytical Chemistry (AC) 3 - Group Leader: M. Karayannis, Ioannina, GR; Biological Chemistry (BC) 3 - Group Leader: A. van der Gen, Leiden, NL; Inorganic Chemistry (IC) 3 - Group Leader: D. Cardin, Reading, UK; Organic Chemistry (OC) 3 - Group Leader: P. Gärtner, Vienna, AT; Physical Chemistry (PC) 3 - Group Leader: J.A.R. Renuncio, Madrid, ES; Synthetic Chemistry (SC) 4 - Group Leader: H.-G. Schmalz, Cologne, DE; Computational Chemistry (CC) 4 - Group Leader: A. Laganà, Perugia, IT. ICT Support was provided for new developments by H. Krebs, Vienna and for server maintenance by C. Manuali (Perugia). E-tools for teaching and learning chemistry Multimedia were developed in WG3 (Chair A. Laganà). In December 5, 2002 a non-profit making ECTN Association was also created and registered in Belgium to provide a sustainable future for the European Chemistry Thematic Network (see http://ectn.eu/about-us/what-is-ectn/ and http://www.ec2e2n.net/past-networks/ectn2/)

2003/2006 – ECTN-3: EChemTest® network technical support and students' mobility - The third ECTN project worked at linking developed e-tests to ECTS (the European Credit Transfer System) as a tool to design chemistry curricula and to create an EU common framework for second-cycle degrees. Technical support for ICT evolution was provided by Vienna, Perugia and Thessaloniki SMEs Krebs Inc, Master-UP s.r.l. and Polymechanon. (http://www.ec2e2n.net/past-networks/ectn3/)

2006/2009 – ECTN-4: From a community of practice to a virtual community - The fourth ECTN project developed the virtual organization guidelines to offer EChemTest® to the Higher Education community using multimedia and networked ICT technologies (see ref. [1]). (http://www.ec2e2n.net/past-networks/ectn4/)

2) THE VIRTUAL EDUCATION COMMUNITY FOR CHEMISTRY

2009/2012 - EC2E2N-1: The development of a telematic assessment service - The first EC2E2N project shifted the emphasis of ECTN from a purely academic approach into a more service oriented one. This led to the establishing of the Virtual Education Community (VEC)

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committee aimed to foster the adoption of innovative networked open and distance digital technologies and the definition of standards for producing, collecting and making shareable the educational material continuously produced by the teachers of the member institutions. A key target of the development of such shared repertoires was to support telematic activities aimed to assess and certify chemical knowledge at various levels (from compulsory to professional education). (http://www.ec2e2n.net/1/)

2012/2015 - EC2E2N-2: Entrepreneurship, the Virtual Education Community and Chemistry for every day life - The second (and final) EC2E2N project devoted a specific work group, WG5 (Chair A. Laganà) to develop entrepreneurship related initiatives by involving the ECTN Association, a group of academic spinoffs and CEFIC. WG5 also gathered together a group of academic spinoffs operating in Higher education Institutions to act as cultural mediators between University research and the innovation market (i.e. a network of spinners of application oriented research in University laboratories context and of providers of market innovative solutions). In particular 5 of them were grouped into the DRAG cluster in order to operate under the ECTN Association umbrella organization to bring **EChemTest®** to the market. During this project the new EchemTest® Q&A database focused on various aspects of Chemistry in Everyday Life was created. (http://www.ec2e2n.net/2/)

2016 - The ECHEMTEST+ project: LIBRE-EOL implementation of Q&As - In order to make **EChemTest®** activities sustainable the ECTN Association launched the ECHEMTEST+ project. For this purpose a project fund of 25 k€ was set aside and the LibreEOL software (developed in Perugia within the DASP European LLLP project (1997-2000) and registered as a Creative Commons license [2]) was adopted. Then the Q&As Libraries were ported from several sources into LibreEOL before the end of July and corrections were made till the mid of September. On September 16 the first training event attended by 13 experts (who signed also the ECTN Intellectual Property Agreement (IPA)) from the established Test Centres (TC)s was held.

3) ANALYSIS OF THE EChemTest® OUTCOMES

Before a formal adoption of the qualification scheme for the EChemTest® IPCs it has been necessary to work out a clear correspondence between the outcomes of Q&A Self Evaluation Sessions (SES)s and the qualification levels. Here, we outline the approach adopted by the VEC committee (with particular reference to the guidelines of the VEC report to the ECTN Gdansk General Assembly and Brussels Administrative Council in the year 2016) when formulating a proposal for the official decision.

A preliminary analysis of the outcomes of EChemTest® SESs was performed at the Milano TC (http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/28) on an ensemble of about thousand SESs (sample I) and was presented at the ECTN Gdansk General Assembly. It refers to level 3 AC, IC, OC and PC Q&As Libraries. In the presentation the outcomes (without weighting them for the level of difficulty) were given as per cents (in brackets we give here also the actual number of occurrence): ≥50% (115), ≥40% <50% (272), ≥30% <40% (357), ≥20% <30% (358), <20% (238). The outcomes were associated with qualifications as follows:

1. Advanced Understanding ≥50 (8.6%)
2. Good Understanding ≥40 and <50 (20.3%)
3. Meets the standards ≥30 and <40 (26.6%)
4. Passed ≥20 and <30 (26.7%)
5. Not Passed <20 (17.8%).

On this ground the VEC proposed to the ECTN Administrative Council held in Brussels on October 2016 to adopt the following qualification correspondence for the IPCs:

1. Excellent ≥75%
2. Optimum ≥50% and <75%

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3. Pass ≥25% and <50%
4. Not passed <25%.

At that Administrative Council meeting it was asked a shift of both the lower and the upper limit of the qualification levels (to 30 and 70 respectively). In order to carry out such revision, the per cent outcomes of sample II (a set of 3000 Q&As sampled from subsets of different difficulty as adopted in ref. [2]), run by Milano (MI) and Krakow (KR) TCs were examined (KR and MI are the EChemTest® TCs running the largest number of SESs). Sample I values (blue line of the lower panel) and sample II values (blue line (AV) of the upper panel) are compared with the separate outcomes of the latter ones in Figure 1.

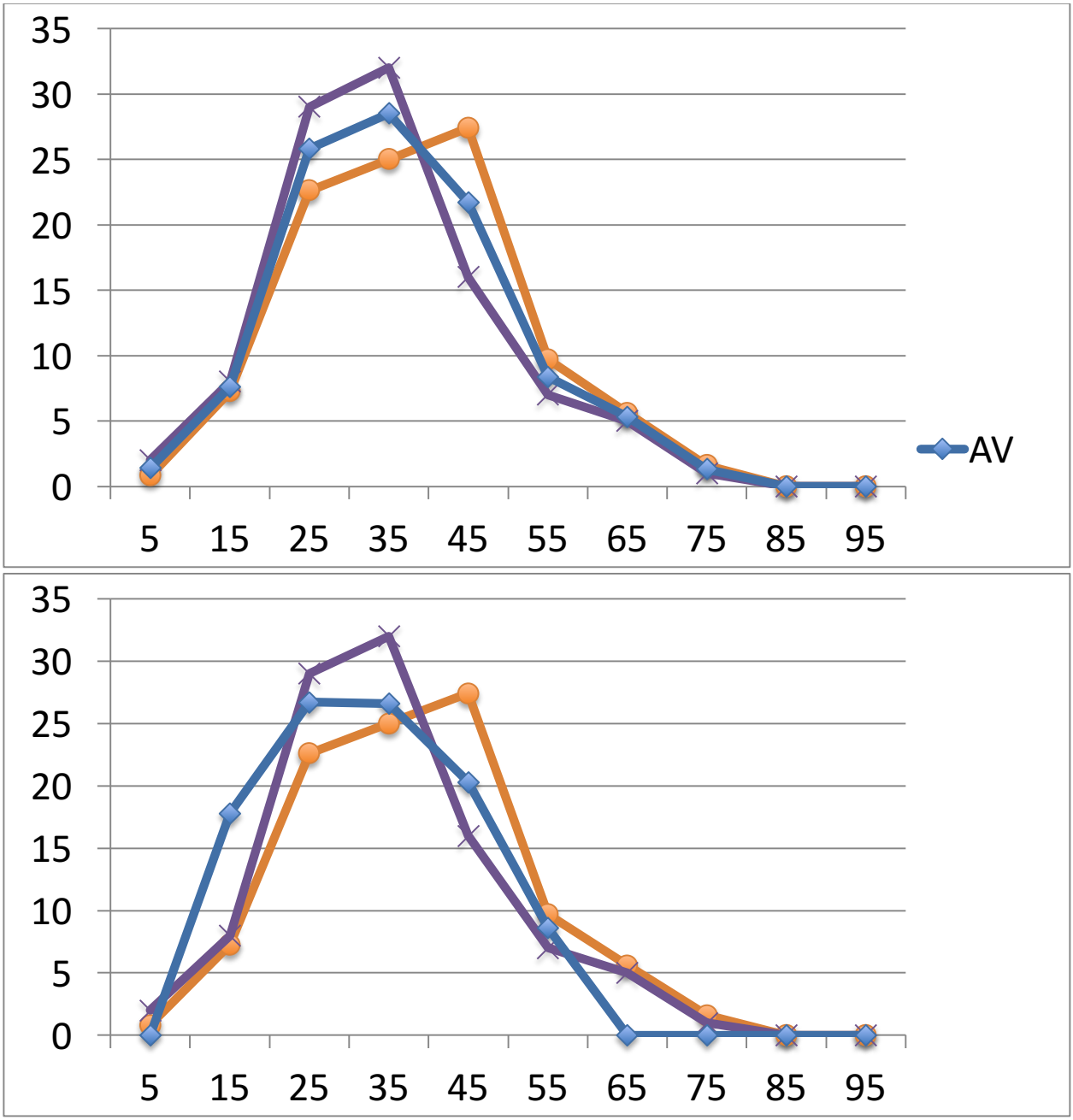

Fig. 1 – Lower panel: comparison of the plot of sample I values (blue) with sample II separate MI (orange) and KR (violet) contributions; Upper panel: plot of sample II values (blue AV) with its separate MI (orange) and KR (violet) contributions.

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In Figure 2 the sample II scores of the IC library are compared with those of the OC and PC libraries. The plots confirm that by shifting upward the pass threshold to 30% one drops out for the three disciplines considered about 1/3 of the students and by shifting downward the excellent threshold to 70% one still selects about the best 1/20 of the students. Leveraging the study reported here the qualifications were adopted for the current Prosumer implementation[3] of EChemTest®.

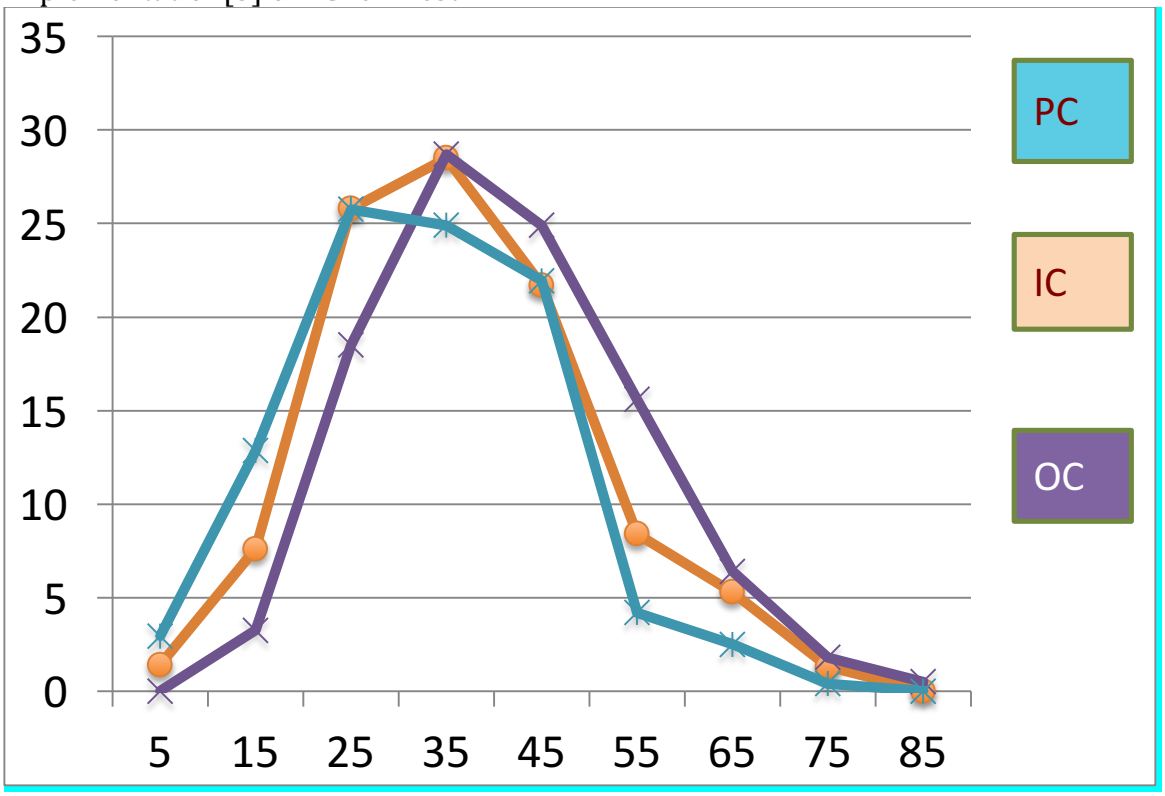

Fig. 2 – Comparison of the plot of sample II scores for IC, OC and PC Libraries.

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