

Exploring e-exams

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Targeting...

- Supervised
- High stakes
- On campus
- Large scale

(image credit: Dr Fluck UTAS)



*What we are **not** specifically addressing here is off campus, online only, distance education, cross institutional students – there are some existing e-solutions to address these needs (covered briefly later).*

Drivers

Policy

- Realising 'unfulfilled potential' in higher education
 - Also - is a lack of e-exams in higher education hampering the wider uptake of ICT in other areas of education? *Ref- TAS*
- National participation targets - Higher student numbers...
e.g. UQ: 2007-2012 = **30K extra annual exam sittings.**
- Graduate attributes of Australian institutions - Feature current knowledge, skills for the modern world... this means ICT skills.
- Strategic & E-learning plans - significant activity with MOOCs, online learning, blended learning, flipped classrooms all depending on ICT success.
 - An internal UQ survey of senior teaching leaders placed 'e-assessment / online marking' at the top of their priority list for development.

Drivers

Practical

- Hand written assessment decreasing
- Technology provides and opportunity to enhance exam questions and scenarios
 - Some examples to follow later
 - More Examples at [TransformingAssessment.com](https://www.TransformingAssessment.com)
- Increasing use of ICT, study, work social
 - 98% ownership of mobile WiFi enabled devices
 - **91%** laptop ownership highest of any device
 - 80% of students accessing online LMS weekly

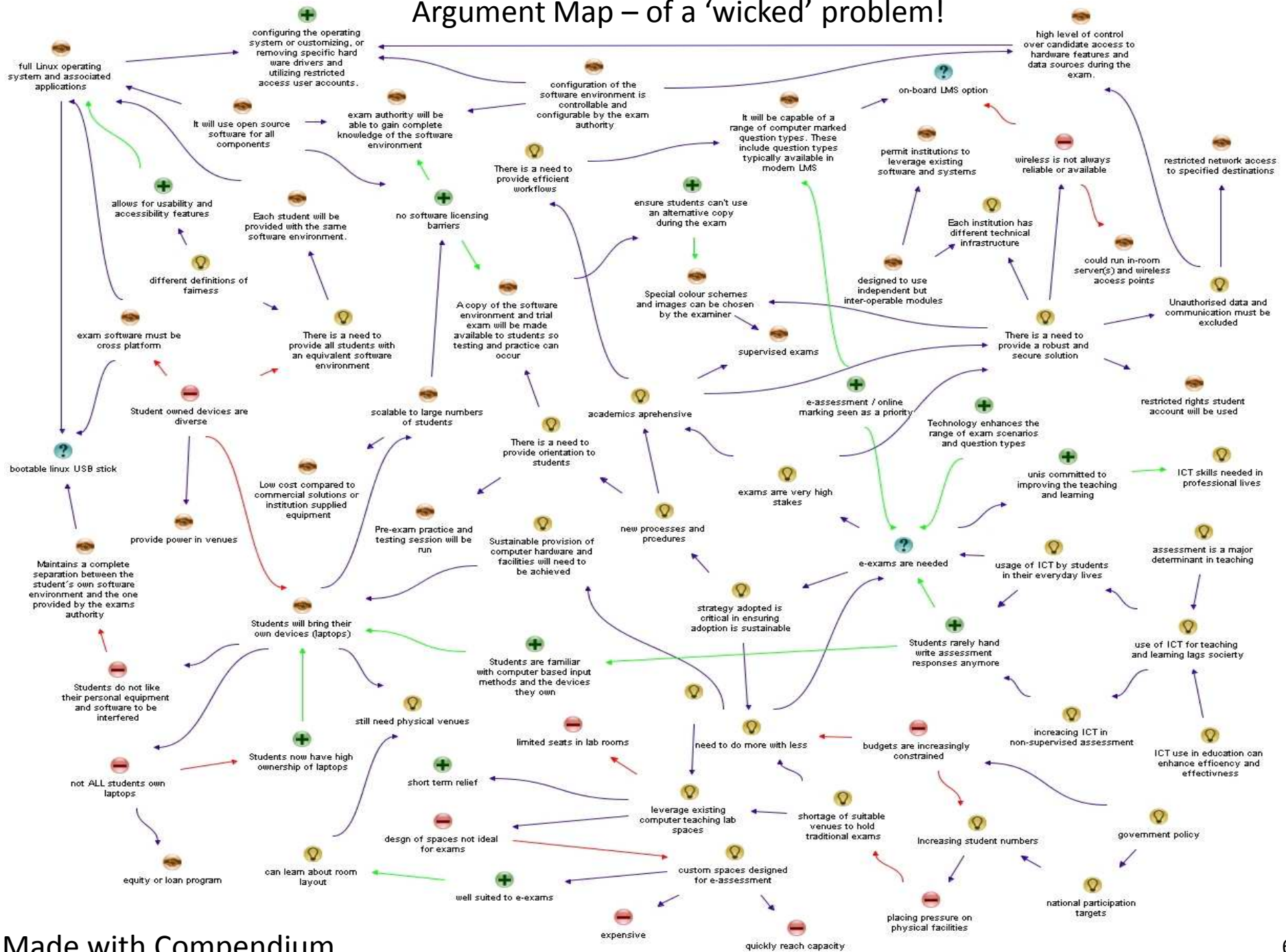
So?

All of thisleads to a growing disconnect between the way high stakes testing is conducted using pen on paper exams and students' everyday experiences.

Are e-exams are the next step on from computer assisted marking and e-assessment of progressive assessments?

An e-exams solution is needed ... But!

Argument Map – of a ‘wicked’ problem!



More Issues

- Fairness & Equity → *equivalent* environment
- Highest stakes → must be reliable and robust
- Many stakeholders - needs/concerns
- Security (end-to-end ref IT security principles)
- Invigilation (easy to identify misconduct)
- Administration (reduce manual/double handling)
- Sustainability, efficiency, facilities, spaces, equipment, set-up, logistics, processing, workflows...

Existing solutions ...

Include one or more of:

- Built in quiz tools within a Learning Management System (LMS), not designed to be e-exams environments, students have access to other tools within the LMS. Thus requires invigilation - currently requires the campus labs... Scalable?
- Tests and exams undertaken in fixed computer teaching labs on campus, spaces normally limited to 20 per room, finite number of labs, layouts often not suitable for high stakes exams.
- Proprietary testing software applications. dependent on the use of a particular operating system, few being cross platform. institution owned equipment need(?) many install invasive components into computers in an attempt to secure an inherently insecure environment.
- Outsourced testing centres or services, control is passed to other organisations/individuals. Mainly intended for small numbers, external/distance education students, costly on a per student basis(?);
- Online proctoring services, distance education /off-campus at exam time, raises risks of exam protocol breaches, intrusive software installed into student owned computers.

Developing e-exams

- Buy in a proprietary solution?
 - Needs met adequately? Pedagogically sound?
 - Software \$ licence fees – costly, reoccurring
 - Closed architecture and restrictions –
 - unknown internals
 - customisation and flexibility?
 - give to students for practice?
 - pull it apart for experimentation/ innovation /research?
 - new features to meet new needs? who decides?
 - Ongoing technical and procedural support?
 - Vendor lock in, can stop supporting it, can go broke.
- Build your own? - fully known but, all risk in one institution, knowledge in few minds – may leave, documentation, support, back-up, ongoing updates?

Nup, lets try something else...

Developing e-exams

- An alternative model – the case of Moodle
 - Open source, can be fully known
 - Pedagogically based
 - Free libre, available for experimentation, innovation, research, customisation and you can give it to students to take home.
 - Open development, new features from user demands not marketing demands, anyone with the skills to do so can contribute and many do.
 - Scalable from single user on a PC or USB stick up to 100K+ user online institutions (Open U UK).
 - No licence fees (and no resources spent on tracking licences, no intrusive audits).
 - However maintenance isn't free of costs though... but you can...
 - Support in-house or outsource to multiple 'fee for service' and 'hosted solutions' providers, less risk of vendor lock-in.
 - Get help from the large, open support community of coal face users and technical developers.
 - Caution! Should be pedagogically lead, not administratively lead.

Revisit - sustainable facilities

Provision of facilities must be sustainable

- How to provide computer hardware and facilities for large infrequent e-assessment events (exams):
 - Use existing campus computer labs? (Finite in number, small 20~ish room size, problematic layouts/poor design [Dermo, 2012])
 - Build dedicated e-exam space? (good design, but costly, although capital cost done once, still finite, potentially low utilisation out of exam periods)
 - Hire / build temporary space? (costly and high reoccurring)
 - share facilities between institutions? (scheduling issues)
 - provide each student with hardware ? (costly ~ give or rent to students? - reoccurring, maintenance?, low utilisation?)
 - *Rent or build options are not scalable or sustainable.*
- Given the already high ownership of suitable equipment by students -> how can we make use of this equipment?

Issues - BYOD

- Given high ownership of laptops – we can leverage these
 - But ...
 - Diversity of devices (hardware, operating systems (Windows, Mac, Linux), software applications.
 - Need a ‘cross platform’ solution
 - Need to provide same (equivalent) software environment
 - A potential source of unauthorised assistance
 - Need ability to completely control student owned equipment for the exam duration – ref security principles.
 - Students have a lot ‘invested’ in their devices (for work, for study, for personal and social uses, etc)
 - Need to respect this domain, maintain privacy and integrity of student equipment.
 - Need to return student equipment as ‘untouched’ when done - separation of the exam environment and the student owned ‘host’ equipment.
 - Equipment does fail on occasion
 - Need appropriate back-up facilities and processes, data progressively saved, provide power, spare laptops etc

Issues

Varying technical infrastructure between / within
Institutions

- How to:
 - Be applicable across the higher education sector
 - Fit into existing software and hardware landscapes
 - Leverage existing infrastructure
 - Cater for flexible needs
 - Not be a nightmare to support...

A gap still exists for...

- Scalable, sustainable, supervised e-exams platform and processes that meet the needs of students, academics, disciplines, institutions,...

A basis for further development

- The well developed 'eExam' system (**Andrew Fluck, UTAS**) – ticks many boxes:
 - Bootable USB sticks.
 - Full operating and application suite onboard.
 - Typed student responses (human marked)
 - Student owned equipment used as host and left untouched.
 - Open source code base, commodity components.

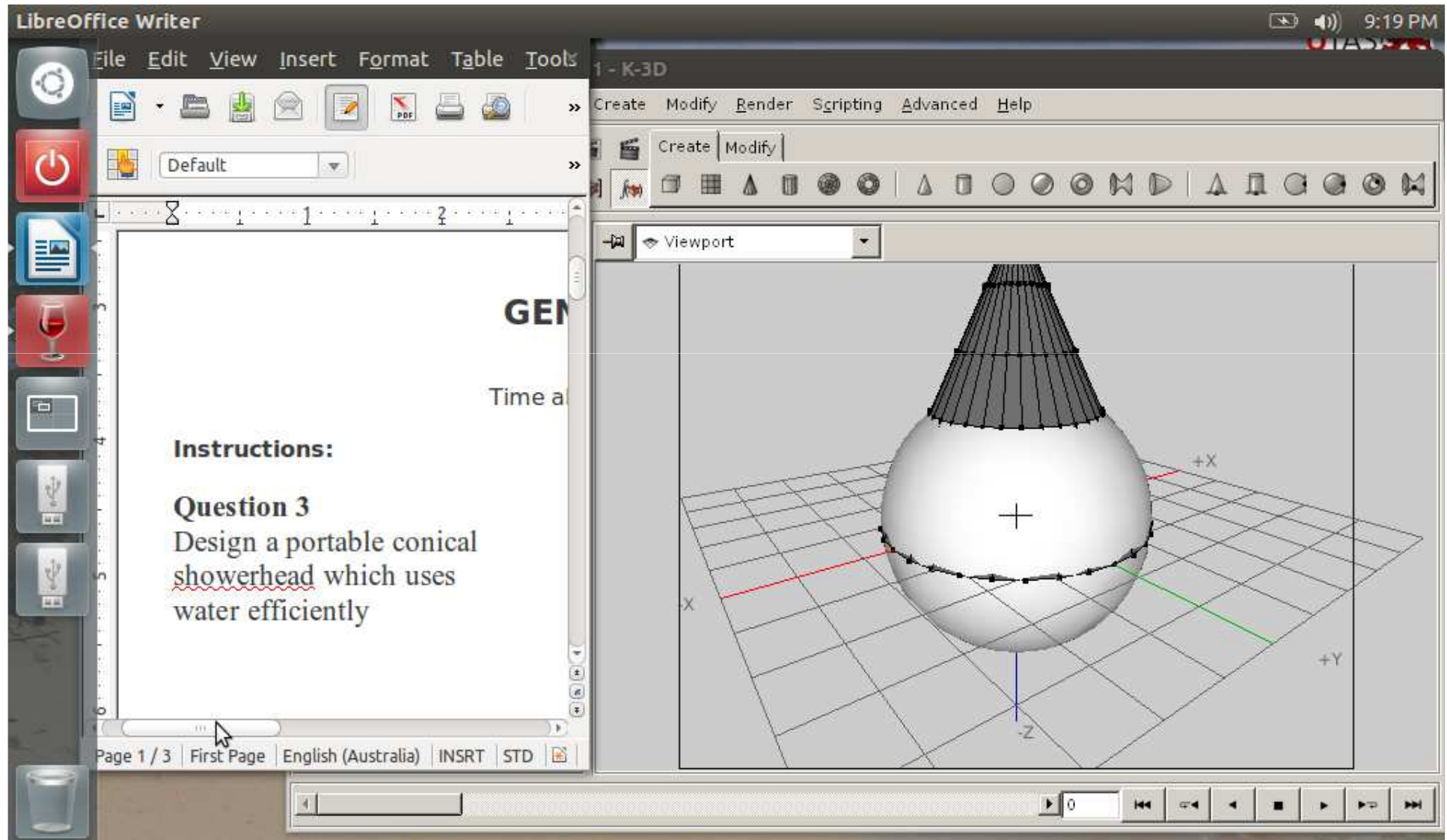


Current eExam Modes

- Modes (phases of introduction)
 1. Paper replacement – computer optional (a typewriter) essay, short answer, limited multiple choice.
 2. Post-paper – a computer becomes compulsory
 - Adds multimedia prompts, video, audio and software tools can be made available in the exam so that students can construct a response.
- Responses need to be human marked either on-screen or printed then shuffled....

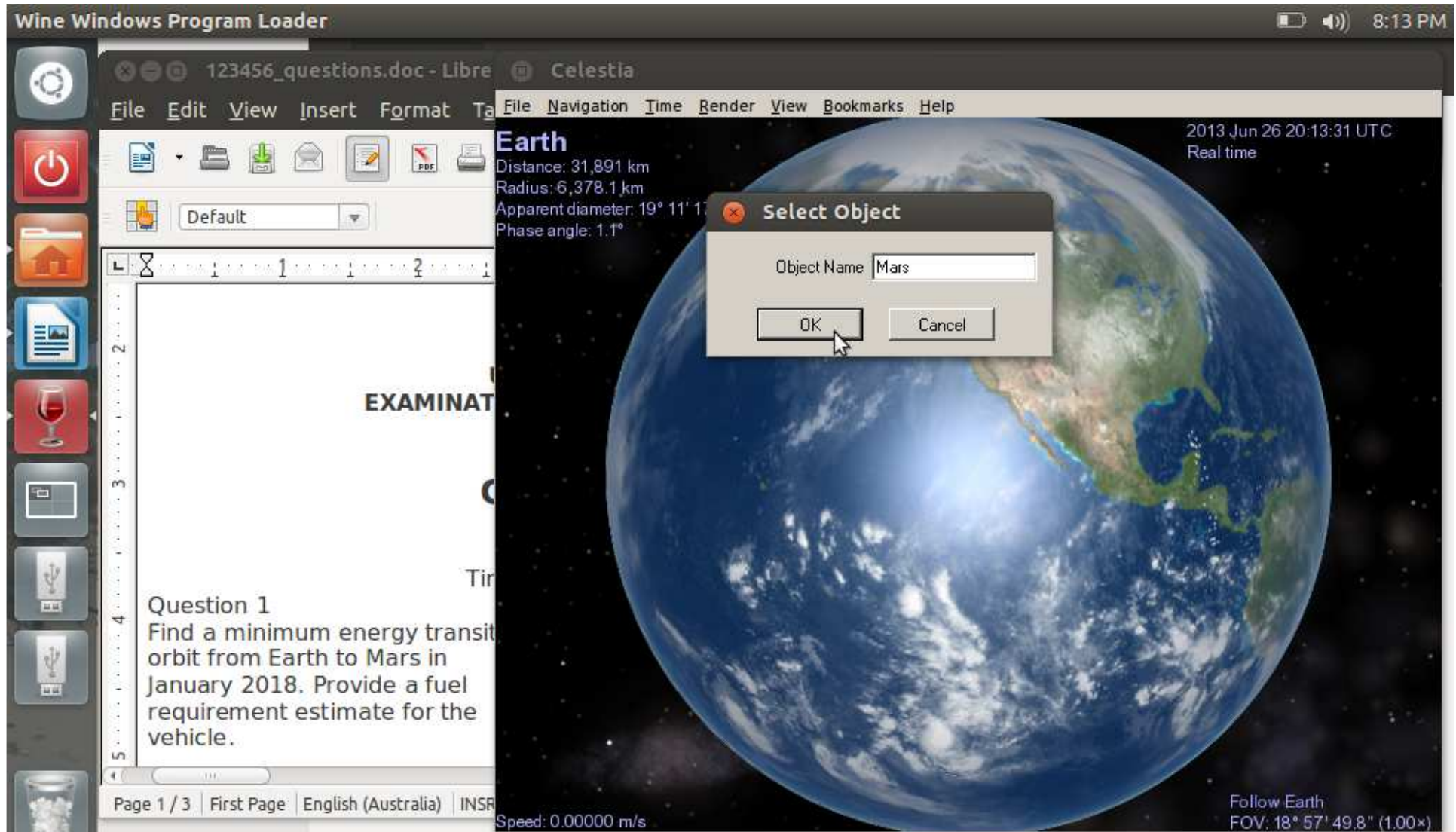
Post-paper - Can Include Software Tools

- Software tools can be made available in the exam



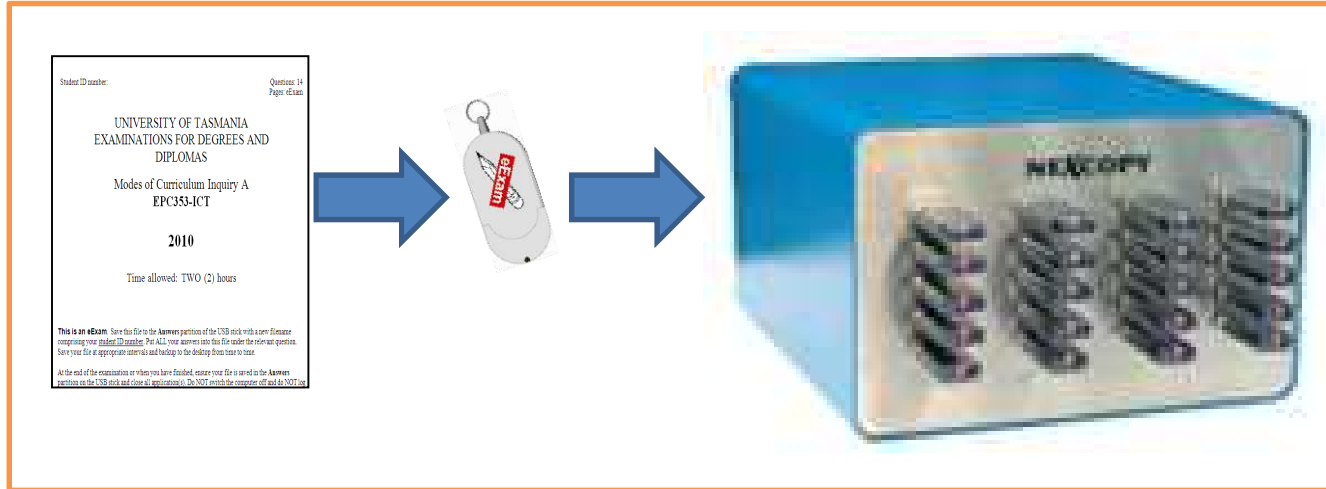
Post-paper - Can Include Software Tools

- Software tools can be made available in the exam



The Current Process – it works.

Prep



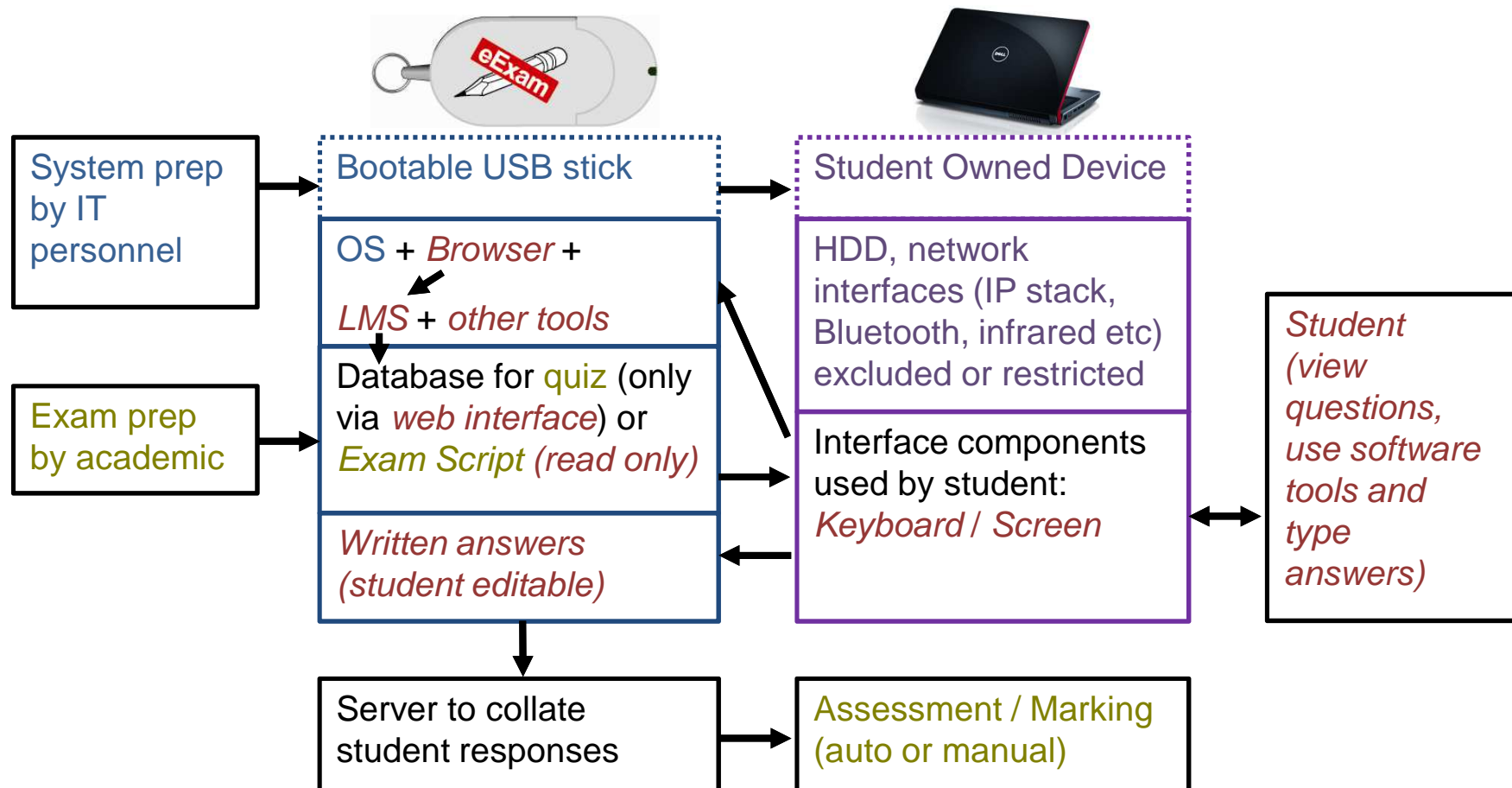
Post Exam



(credit: Dr Fluck UTAS)

Future - an e-exam system for BYOD

- Planned improvements – add:
 - LMS / question engine for computer marked question types (Moodle?)
 - Electronic answer reticulation/workflows.
- Modular architecture so academics / institutions can choose the features and mode of operation that suit them...



Planned enhanced modes of use

- **Wireless always on** mode – where reliable, redundant and high capacity wireless network access exists in the exam room (could also use wired / as a boot image for labs)
 - Doesn't require an LMS on-board the stick
 - Web browser to access a LMS server via restricted network
 - Custom network config by institution IT (done once, reused)
- **Ad-hoc wireless** mode
 - LMS will be on-board the stick itself.
 - Periodic connections to upload/update student answers on a collation server in background or via a student initiated final submission with confirmation shown on screen.
- **Non wireless** mode
 - LMS will be on-board the stick itself.
 - Duplicating equipment to reverse copy student answer files/databases from the USB sticks to a collation location
 - Fall back in all cases - manual copying each student's answer file(s)

What it could do

Computer marked question types (Moodle)

Standard:

- Calculated (Wildcards and datasets, calculated MCQ)
- Matching
- Embedded Answers (Cloze Test / Gap Fill – text with multiple choice, short answers and numerical answers)
- Short Answer (sentences)
- Numerical
- True/False
- Short essay (with response template)

Custom types:

- Algebra, Multinumerical, Spreadsheet,
- Chemistry Molecular editor questions,
- Music (key signature, scales, intervals)
- Hot spots, drag and drop (labels, text, images),
- Set splitting,
- Missing words, Gapfill,
- Regular expression...

Marking: delayed, Certainty-Based Marking... manual override.

Examples – Confidence questions

- Confidence based approaches penalise guessing. Students need to choose a response and declare their level of certainty. Available in Moodle now.

Certainty levels and consequences

Certainty level:	C=1	C=2	C=3	No Reply
Mark if correct:	1	2	3	0
Penalty if wrong (T/F Q)	0	-2	-6	0

Qu. 1:

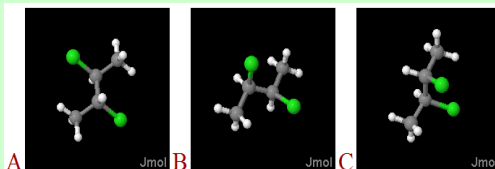
Which structure shown below represents meso 2,3-dichlorobutane, A, B or C?

[Click on the text below to open a window with the three choices]

[Three structures, A, B and C](#)

Choose one of the following:

- C
 A
 B



No Reply

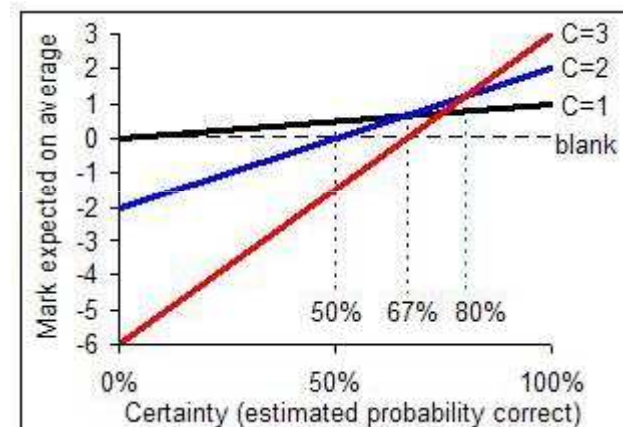
Certainty:

C=1 (low)

C=2 (mid)

C=3 (high)

Certainty v Mark Expected



University College London

Examples – Short text response

Students type in a short sentence response which can be marked by computer based on pattern matching.

Available in Moodle now.

Example question

Example settings

A boy climbs slowly to the top of a slide and then slides down it. At which point will his kinetic energy be a maximum?
Note: Your answer should ignore the effects of friction.

*You should give your answer as a **short phrase or sentence.***

Kinetic energy will be at maximum when at the bottom of the slide.

The screenshot shows the Moodle question settings interface. It is divided into several sections:

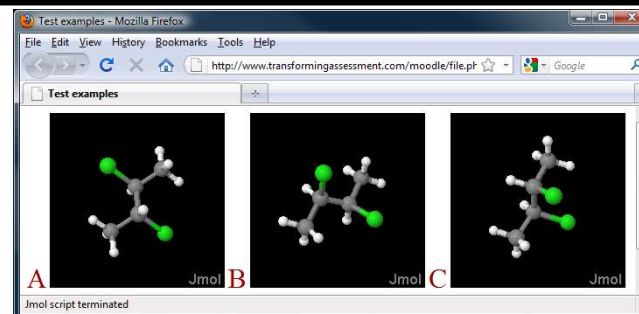
- Options For Entering Answers:** Includes dropdowns for Case sensitivity (No, case is unimportant), Allow use of subscript (No), Allow use of superscript (No), and a dropdown for "If answer is more than 20 words" (warn that answer is too long and invite responsee to shorten it). There is also a "Check spelling of student" dropdown (Yes) and a text area for "Add these words to dictionary".
- Convert the following characters to a space:** A text input field containing ".,:()".
- Define Synonyms For Words in Answers:** A table with two rows: "Word: impact" with "Synonyms: stop|land*|finish*|complet*", and "Word: just" with "Synonyms: prior|when|point|instant|moment|immediat&|second".
- Answer:** A text area containing the pattern: `match_mw (bottom|base|end|flat*|floor|ground|horizo`
- Grade:** A dropdown menu set to "100%".
- Answer:** A text area containing the pattern: `match_any (match_mw (fast*|quick*) match_mwp4 (great*|max*_velocity|speed) match_mwp4 (velocity|speed_great*|max*))`
- Grade:** A dropdown menu set to "50%".

evaluation

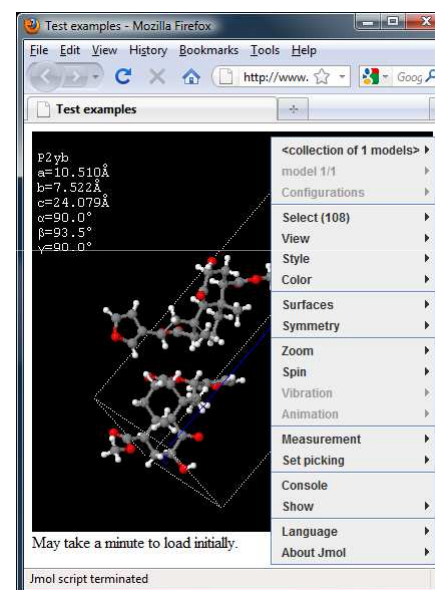
Examples – embedded applets

Moodle Quiz

1 Marks: --/1
Which structure shown below represents **meso** 2,3-dichlorobutane, A, B or C?
[Click on the text below to open a window with the three choices]
Three structures, A, B and C
Answer:

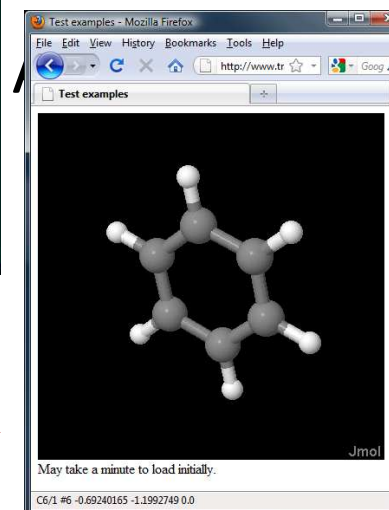


2 Marks: --/1
Use the **Jmol applet** to view the crystal structure of the presented molecule. Use the Jmol applet display to match the following statements.
There are 7 stereogenic centres in the molecule
There is evidence for an intramolecular hydrogen bond
There is evidence for an intermolecular hydrogen bond



Students interact with tools to obtain data to construct an answer.

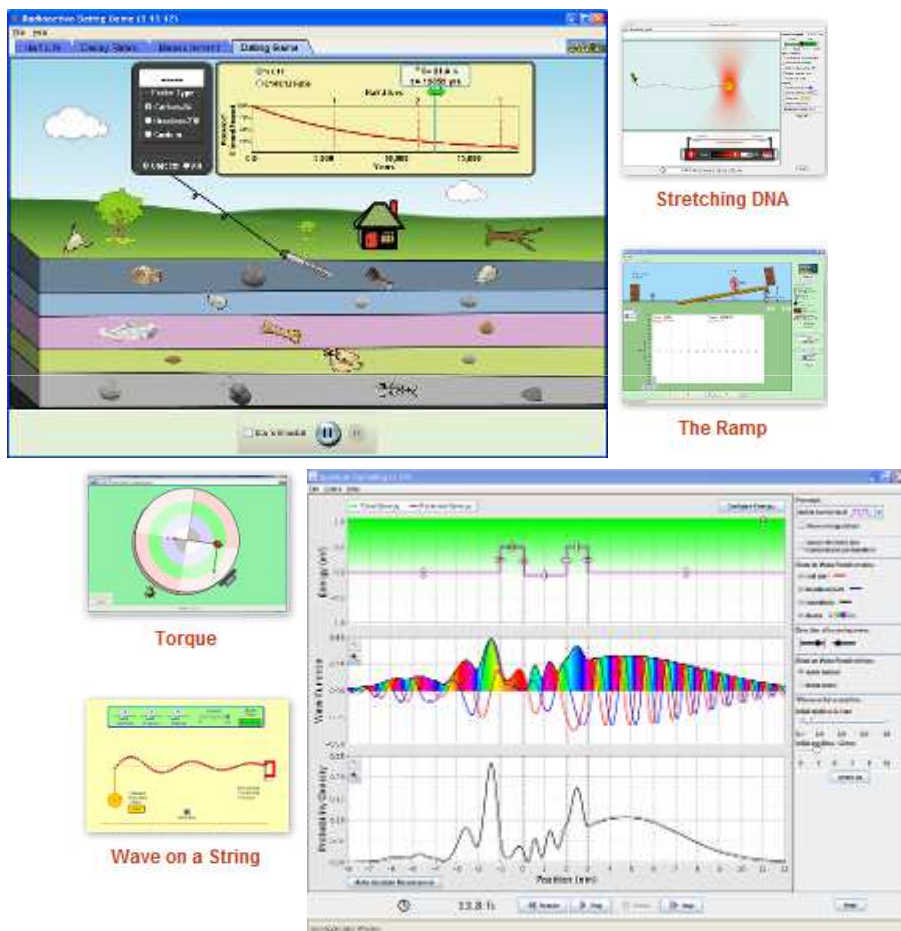
3 Marks: --/1
Use the **Jmol applet** to view the molecular structure of the presented molecule. Use the Jmol applet display to match the following statements.
The most electron rich region of this molecule is
The most electron poor region of this molecule is
The lowest energy molecular orbital for the molecule is
The highest energy molecular orbital for the molecule is



<http://www.transformingassessment.com/moodle/file.php/27/jmol/jmol01.html>

Examples – Virtual Labs / Sims

Conduct experiments via locally run simulations¹ or internet connected hardware²



1
Marks: 1

What peak voltage is produced across the coil when a voltage of 3.5 is applied to the driving motor?

Use the remote laboratory experiment shown below to run the experiment and observe the peak voltage produced on the positive side of the scale. Note that the red bars indicate whole even numbers.

Enter an average of the peak values you have observed into the answer box shown at the bottom. Enter a positive number only.

Electromagnetic induction

View of the experiment

Electromotive voltage on the rotating coil

time (s) (1 red division is 1 s)

Voltage on the driving motor

Stop 3.2 V

- Magnetic induction: 17 mT +/- 1mT
- Number of loops in coil: 33
- Coil size: 18,2 mm x 32,1 mm +/- 0,5 mm

Data recording

13	part of record	sp. of record
----	----------------	---------------

Choice of the measurement

Export for Excell

Answer:

Save without submitting Submit all and finish

(1) <http://phet.colorado.edu/>

(2) <http://www.transformingassessment.com/moodle/course/view.php?id=72>

Examples – Augmented Reality Experiment

Firefox

www.transformingassessment.com/moodle/mod/quiz/attempt.php?id=584

AR101: Example Quiz that includes Aug...

1
Marks: 1 Use the colour coded AR Markers to simulate the mixing of Zinc and Copper Sulphate Solution. When you are done, choose the correct reaction from below.

Choose a resource

Chemistry
Reactivity series of metals.
Experiment with the metals and solutions and find out what reactions happen when one metal is mixed with a solutions.

Marker key

Blue	Silver
Purple	Magnesium
Yellow	Zinc
Green	Iron
Red	Lead
Orange	Copper
Pink	Copper Sulphate Solution
Turquoise	Magnesium Sulphate Solution
Grey	Silver Nitrate Solution
Black	Lead Nitrate Solution

Results
zinc + copper (II) sulphate solution → copper and zinc sulphate solution
 $Zn(s) + CuSO_4(aq) \rightarrow Cu(s) + ZnSO_4(aq)$

AR Marker Colour Key

Blue = Silver
Purple = Magnesium
Yellow = Zinc
Green = Iron
Red = Lead
Orange = Copper
Pink = Copper Sulphate Solution
Turquoise = Magnesium Sulphate Solution
Grey = Silver Nitrate Solution
Black = Lead Nitrate Solution

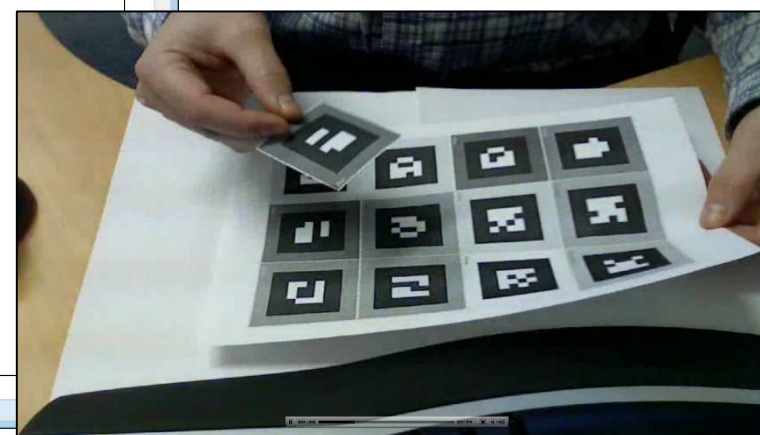
Choose one answer.

- a. $Cu(s) + ZnSO_4(aq)$
- b. $Zn(s) + CuSO_4(aq)$
- c. $Cu(s) + Ag_2SO_4(aq)$

Web cam



AR markers



AR software embedded in question

Examples – Virtual 3D Spaces

1 Click on the link for Question 1 on the external web page. Use the emission and absorption spectroscopy tool below to determine the element corresponding to the colour orange-red in the gas discharge tube.

Marks: 1

Choose one answer.

- a. sodium
- b. copper
- c. neon
- d. barium

As if the student was doing the activity in the LMS



Set up Quiz in the LMS. Results are stored in the in grade book.

Screenshot of the Moodle SLOODLE Controller configuration page. It shows the status as 'Enabled' and a list of SLOODLE object configurations including Choice, LoginZone, MetaGloss, Password Reset, Picture Gloss, Presenter, PrimDrop, Quiz Chair, Quiz File-On, Registration/Enrolment Booth, SLOODLE Set, Second Life Tracker, Sloodle API HQ, Sloodle Award System, Vending Machine, and WebIntercom.

Attempts: 16

Showing graded and ungraded attempts for each user. The one attempt for each user that is graded is highlighted. The grading method for this quiz is **Highest grade**.

	first name / surname	Started on	Completed	Time taken	Grade/10	#1	#2	#3	#4
<input type="checkbox"/>	Geoffrey Clip	5 May 2010, 06:09 PM	5 November 2010, 09:50 PM	184 days 3 hours	2.5	0/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		29 June 2010, 02:53 PM	5 November 2010, 09:50 PM	129 days 6 hours	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		6 July 2010, 02:46 PM	5 November 2010, 09:50 PM	122 days 7 hours	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		6 July 2010, 03:22 PM	5 November 2010, 09:50 PM	122 days 6 hours	7.5	2.5/2.5	2.5/2.5	2.5/2.5	0/2.5
<input type="checkbox"/>		6 July 2010, 04:16 PM	5 November 2010, 09:50 PM	122 days 5 hours	2.5	0/2.5	2.5/2.5	-/2.5	-/2.5
<input type="checkbox"/>		8 July 2010, 02:41 PM	5 November 2010, 09:50 PM	184 days	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		5 May 2010, 02:04 PM	5 November 2010, 09:50 PM	183 days 11 hours	2.5	0/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		6 May 2010, 10:18 AM	5 November 2010, 09:50 PM	183 days 11 hours	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		6 May 2010, 10:20 AM	5 November 2010, 09:50 PM	183 days 8 hours	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		6 May 2010, 12:55 PM	5 November 2010, 09:50 PM	183 days 2 hours	2.5	0/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		7 May 2010, 12:28 PM	5 November 2010, 09:50 PM	182 days 9 hours	2.5	0/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		16 June 2010, 05:29 PM	5 November 2010, 09:50 PM	142 days 4 hours	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>	Mathew Hillier	7 May 2010, 03:44 PM	7 May 2010, 03:45 PM	31 secs	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
<input type="checkbox"/>		29 June 2010, 03:56 PM		26 secs	5	2.5/2.5	2.5/2.5	0/2.5	0/2.5
Overall average					6.25	2.5/2.5	2.5/2.5	1.25/2.5	0/2.5

A set of scripts for Moodle and VW that acts as a bridge.

A screenshot of a virtual 3D space. A student character is sitting on a chair, interacting with a quiz interface. The interface displays a question about centripetal force. In the background, there are various objects and text, including 'Chemistry', 'Physics', and 'Blood Pressure Cuff'.

Student undertakes assessment in the virtual world



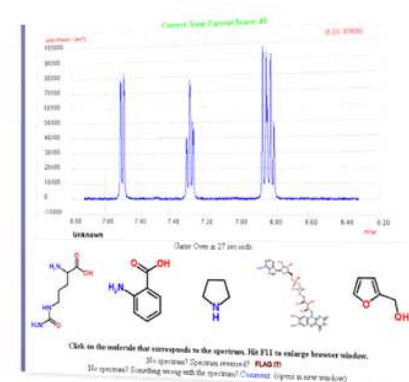
(e.g. Sim-on-a-stick)

Examples – Serious Games

- Serious games, simulations, role plays. Business, science, history, language/communication.



SPECTRAL GAME



Research program outputs

- The e-exam system is situated within a wider research program to develop:
 - A working prototype of an exams platform and documentation allowing others to reproduce it
 - A set of example questions that can be used in e-exams
 - A research-informed set of good practice guidelines on e-exam processes and procedures.
 - A guide on preparing students for e-exams.

Further Information

Contact: m.hillier@uq.edu.au

Get these slides: <http://bit.ly/EN-eexams>

References upon request.

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