Replacing lectures with study packs: a method to improve student engagement and achievement.

Dr Neil Williams
School of Pharmacy and Chemistry
Kingston University

Introduction

- Alternatives to Lectures
  - What's the use of lectures?
  - Programmed learning

- Getting rid of lectures
  - A Blended Learning approach
  - Format
  - Examples of materials

- Evaluation

“What’s the use of lectures”, Bligh, 2000

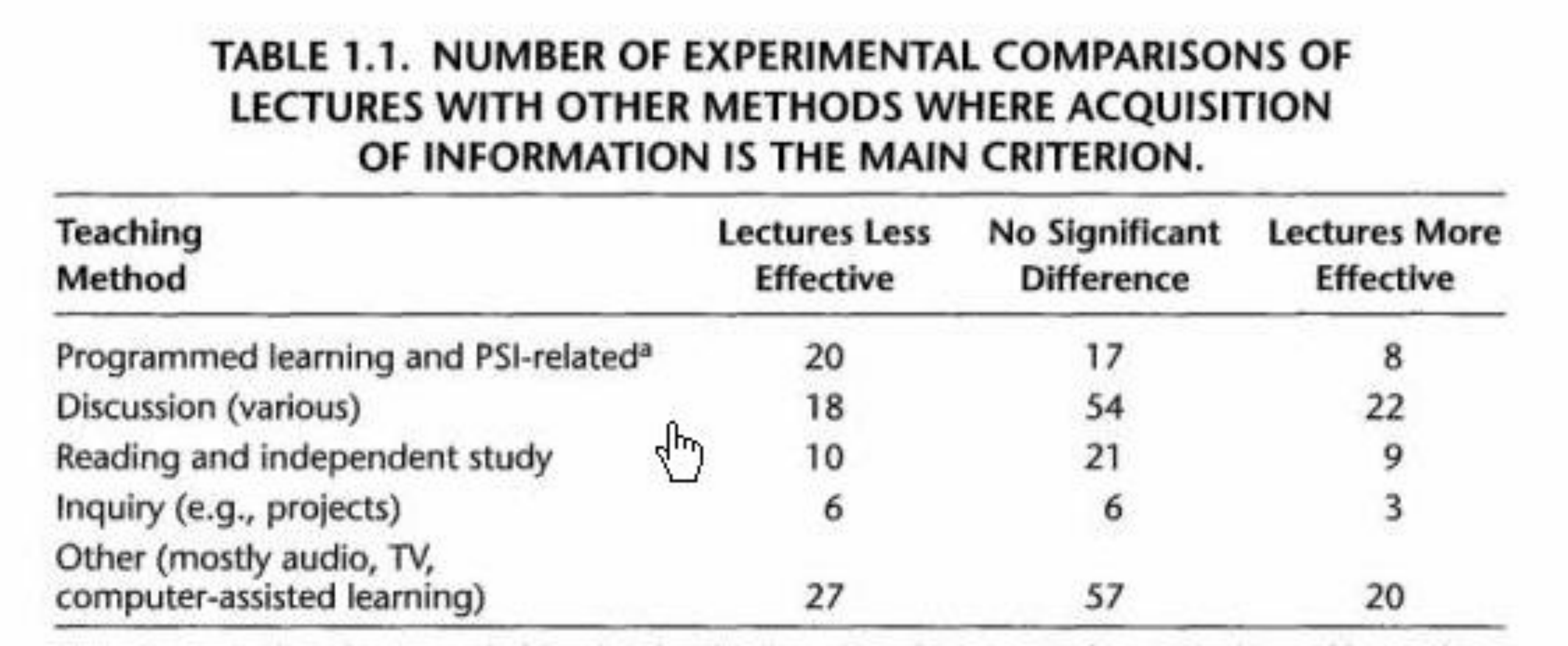


TABLE 1.1. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE ACQUISITION OF INFORMATION IS THE MAIN CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Programmed learning and PSI-related[a]	20	17	8
Discussion (various)	18	54	22
Reading and independent study	10	21	9
Inquiry (e.g., projects)	6	6	3
Other (mostly audio, TV, computer-assisted learning)	27	57	20

Programmed learning and PSI

- Small steps
- Self-paced active learning
- Early feedback on performance
- Individual support with personal contact
- Progress to next unit dependent on mastery of previous one

Getting rid of lectures

- Adopt a Blended learning approach : combination of with e-learning and distance learning with face-to-face teaching .

- Replace lectures with study packs supported by on-line assessment and feedback via Virtual Learning Environment (VLE)

- Use the lecture time for more workshops to improve student engagement and their problem solving skills

Blended Learning Module Format

- 22 lectures replaced by 22 study packs
- Study packs include learning activities and are provided as hard copies and on VLE.
- 1 workshop for each study pack.
- Each study pack supported by formative on-line assessment.
- Each workshop ended with summative MCQ quiz.

Map against Programmed learning

- Small steps – 20 short study packs. 2 study packs delivered each week.
- Self-paced active learning- A week to work through 2 study packs.
- Early feedback on performance – immediate feedback with on-line assessment.
- Individual support with personal contact – more personal contact due to 2 workshop sessions per week. Each workshop ended with summative MCQ quiz

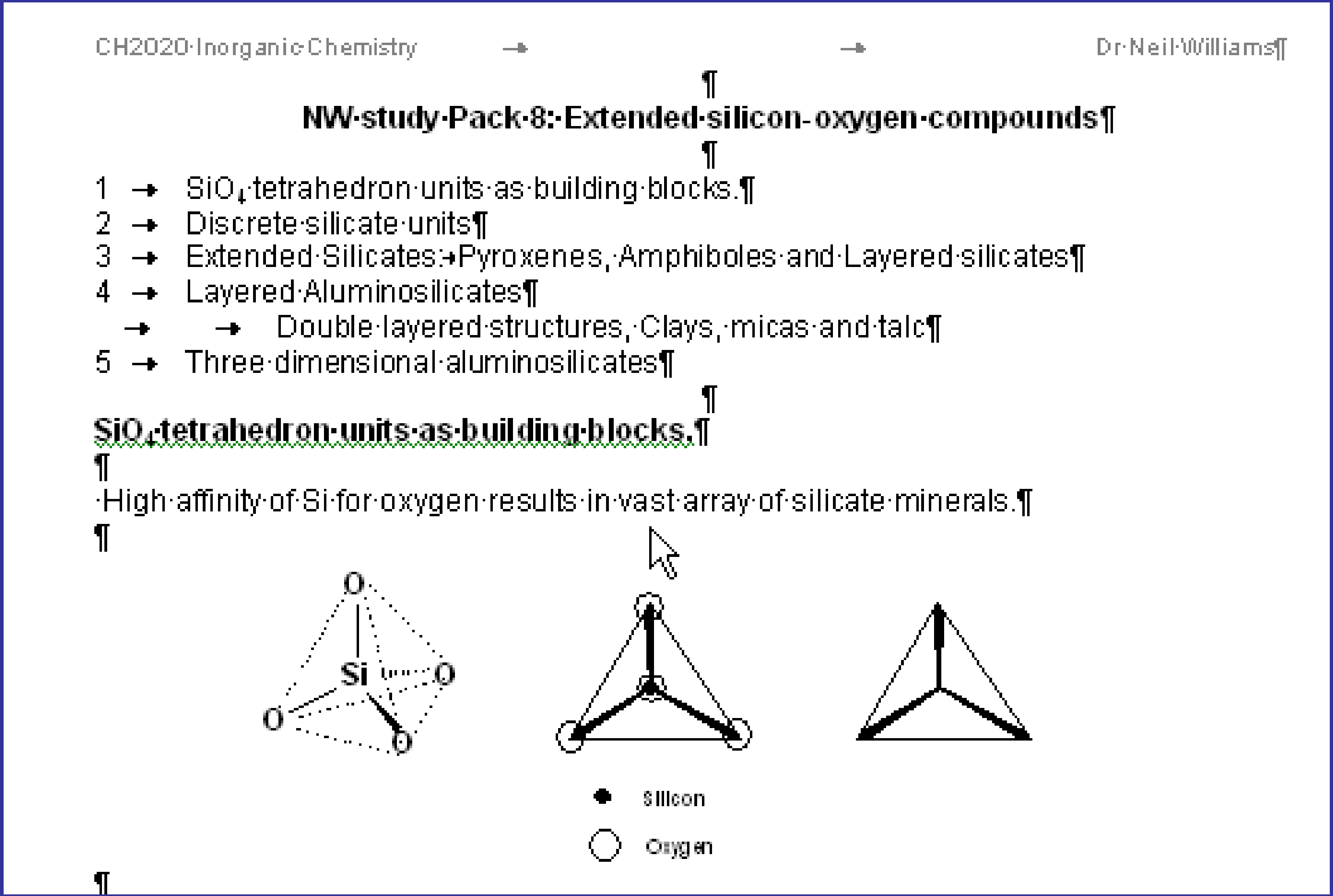
Getting students engaged

- Including learning activities in Study Packs.
- Summative On-line assessment for each study pack in advance of workshop.
- Monitor student activity via gradebook.
- More Workshop time.
- Workshop MCQ tests

Materials

- Study packs – with learning activities
- On-line assessments
- Weekly Workshops with tests
- On-line presentations

Study Pack -fragment



CH2020 Inorganic Chemistry Dr Neil Williams

NW study Pack 8: Extended silicon-oxygen compounds

1 SiO$_4$ tetrahedron units as building blocks.
2 Discrete silicate units
3 Extended Silicates: Pyroxenes, Amphiboles and Layered silicates
4 Layered Aluminosilicates
  Double layered structures, Clays, micas and talc
5 Three dimensional aluminosilicates

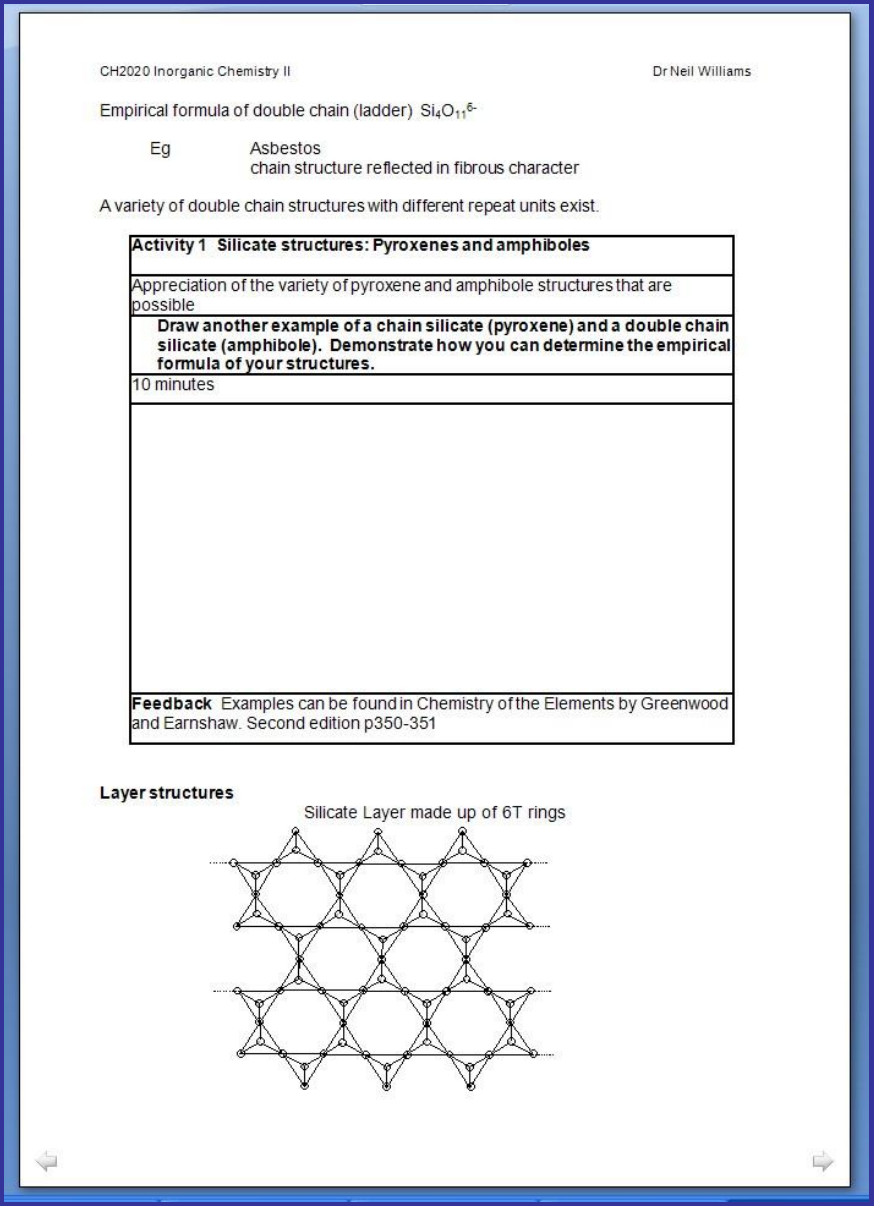
SiO$_4$ tetrahedron units as building blocks.

High affinity of Si for oxygen results in vast array of silicate minerals.

Encouraging active learning

- Learning effectiveness improved if learning activities were included in study packs.
- Tendency to ignore activities that are not assessed.
- The value of blank space.
- “Important to identify the benefits that activities offer as well as the costs that learners will incur.”
- Lockwood, F. (1992) *Activities in self instructional texts* London: Kogan Page

Study Packs



CH2020 Inorganic Chemistry II Dr Neil Williams

Empirical formula of double chain (ladder) $Si_4O_{11}^{6-}$

Eg Asbestos
chain structure reflected in fibrous character

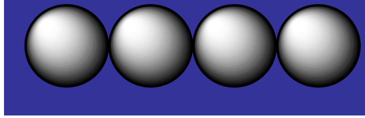
A variety of double chain structures with different repeat units exist.

Activity 1 Silicate structures: Pyroxenes and amphiboles
Appreciation of the variety of pyroxene and amphibole structures that are possible
Draw another example of a chain silicate (pyroxene) and a double chain silicate (amphibole). Demonstrate how you can determine the empirical formula of your structures.
10 minutes
Feedback Examples can be found in Chemistry of the Elements by Greenwood and Earnshaw. Second edition p350-351

Layer structures

Silicate Layer made up of 6T rings

Lockwood Format for Learning Activity

Activity 1: Linear combination of atomic orbitals	Title
This activity will help you derive molecular orbitals from the linear combination of atomic orbitals	Motivational rationale
Sketch the four MOs produced by the linear combination of four 1s atomic orbitals. Use the principles outlined in the study pack	Instructions
5 minutes	Time allocation
 zero nodes 3 bonding interactions Lowest enrgy MO	Answer space & example if needed.
Attempt the on-line assessment test for feedback on this topic	Feedback

Rapid Feedback: On-line tests

- Summative on-line tests delivered through VLE/Blackboard
- Needs to be done before workshop
- Test for each study pack.
- Feedback given on each question dependent on answer given

On-line tests

- Use of graphics
- Types of questions
  - Multiple choice
  - Multiple Response

    Rank order
  - Observation-conclusion
  - Analysis of Statements

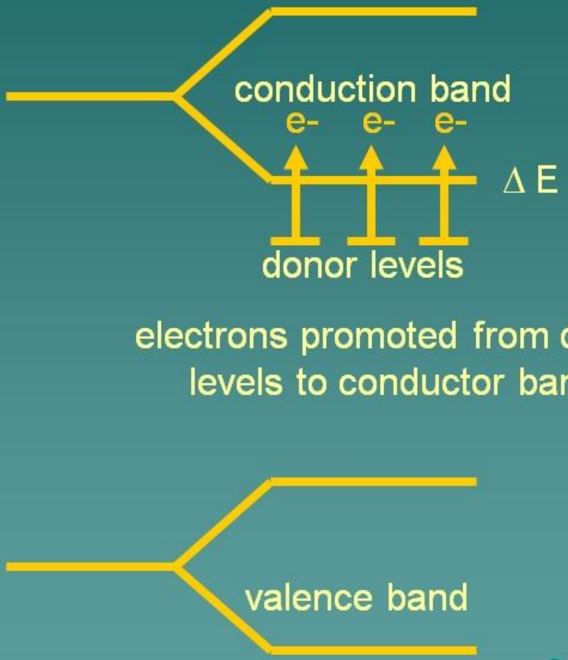
On-line presentations

- Power point presentations with audio commentary.
- Camstasia Screencasts

- Blackboard 9.1 Mobile App allows access on smart phones and IPads.

n-type semi-conductor cont.

- Electrons reside in discrete energy levels (donor levels) just below the conduction band.
- Low concentration of As means not enough levels to form a band
- Promotion into the conduction band means they can act as charge carriers.
- Electrons in donor levels cannot act as charge carriers as they do not reside in a band. (Not enough donor levels to form a continuous band)



conduction band

e- e- e-

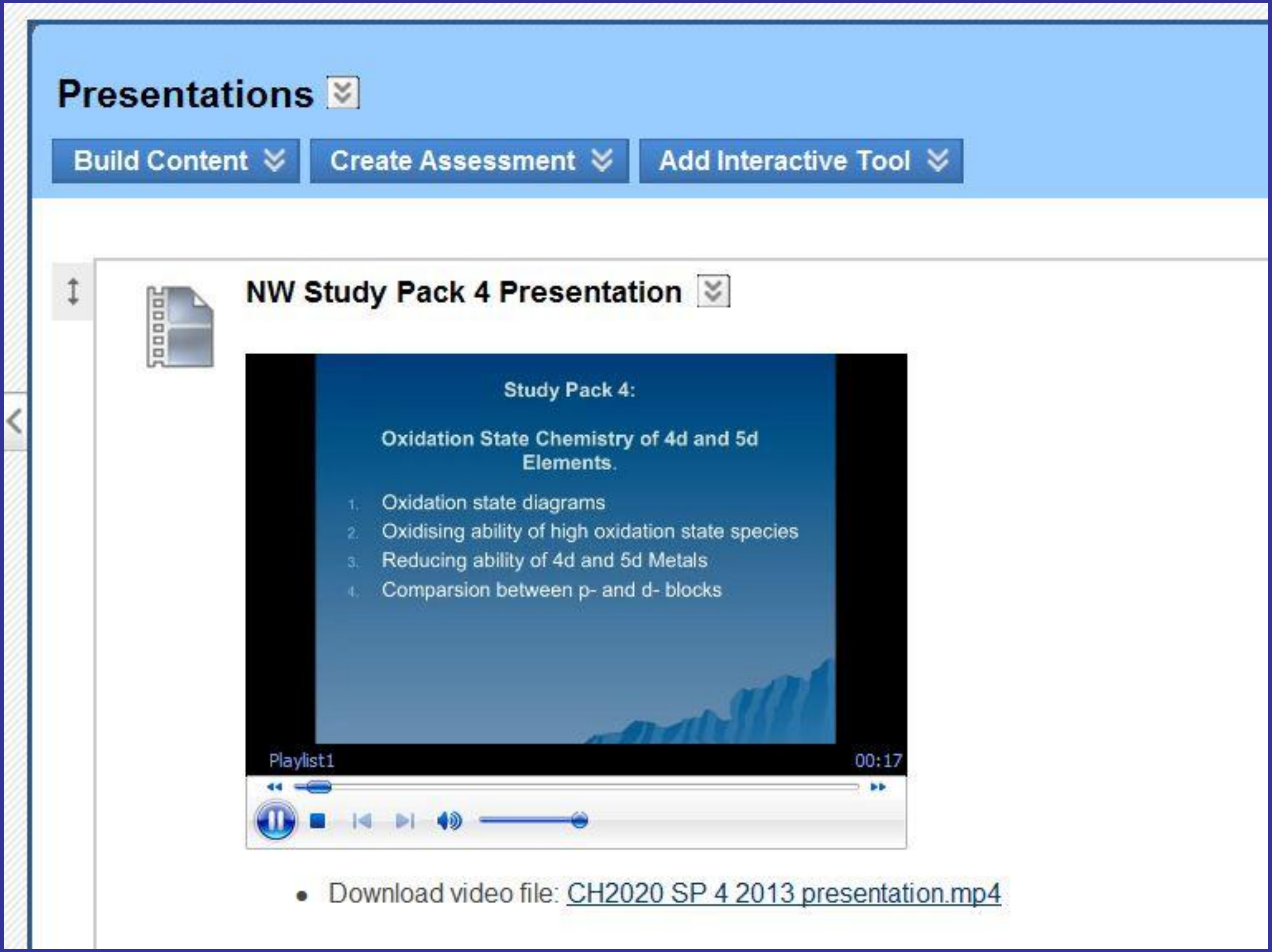
Δ E

donor levels

electrons promoted from donor levels to conductor band

valence band

n-type semi-conductor



Presentations

NW Study Pack 4 Presentation

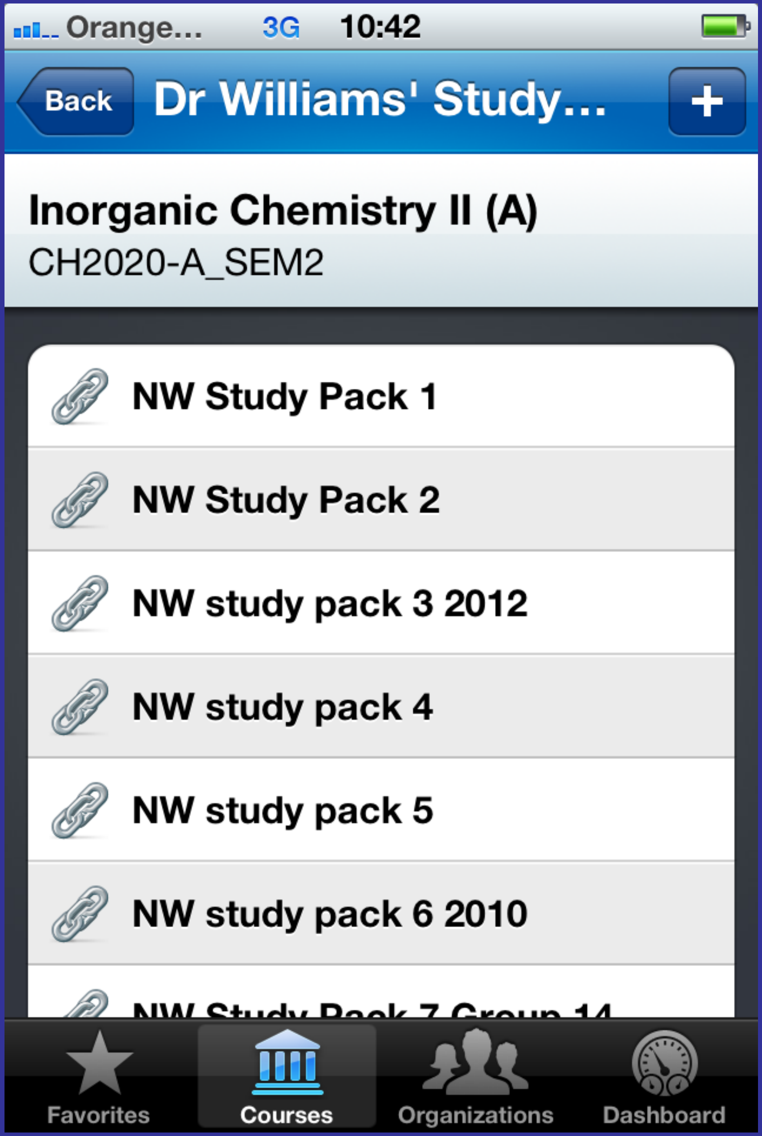
Study Pack 4:

Oxidation State Chemistry of 4d and 5d Elements.

1. Oxidation state diagrams
2. Oxidising ability of high oxidation state species
3. Reducing ability of 4d and 5d Metals
4. Comparsion between p- and d- blocks

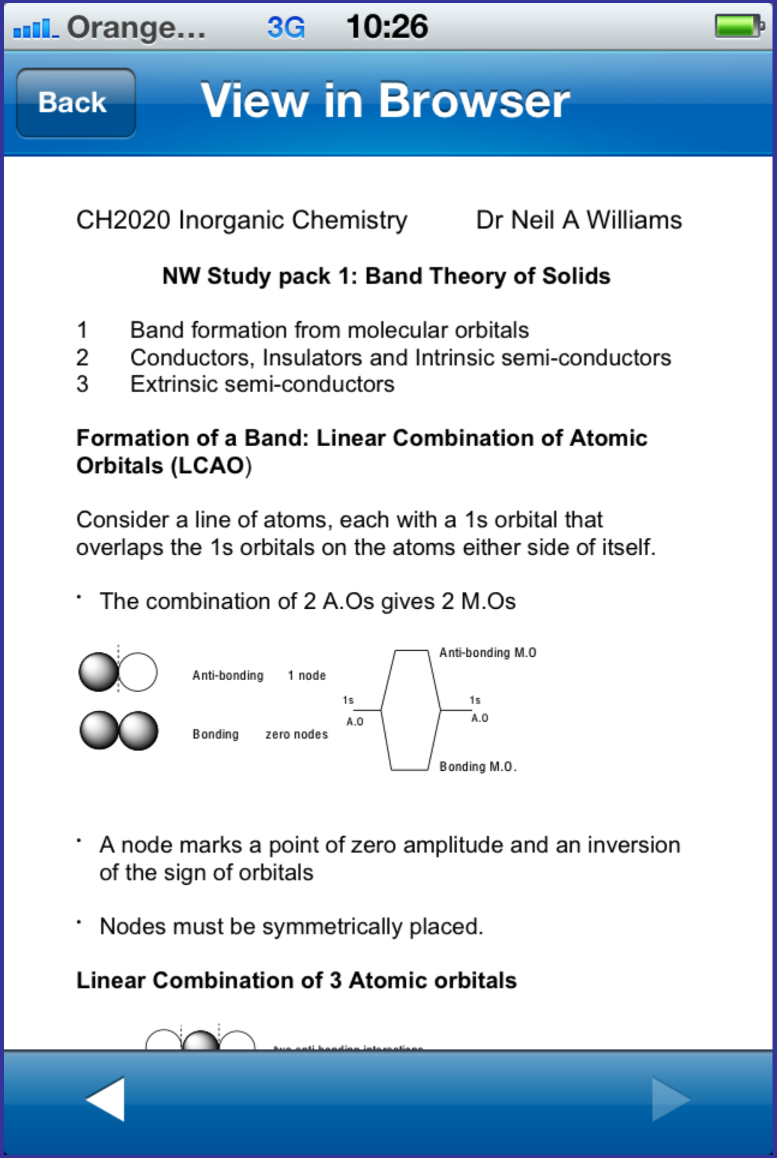
- Download video file: CH2020 SP 4 2013 presentation.mp4

Accessible via mobile App



Inorganic Chemistry II (A)
CH2020-A_SEM2

- NW Study Pack 1
- NW Study Pack 2
- NW study pack 3 2012
- NW study pack 4
- NW study pack 5
- NW study pack 6 2010



CH2020 Inorganic Chemistry Dr Neil A Williams

NW Study pack 1: Band Theory of Solids

1 Band formation from molecular orbitals
2 Conductors, Insulators and Intrinsic semi-conductors
3 Extrinsic semi-conductors

Formation of a Band: Linear Combination of Atomic Orbitals (LCAO)

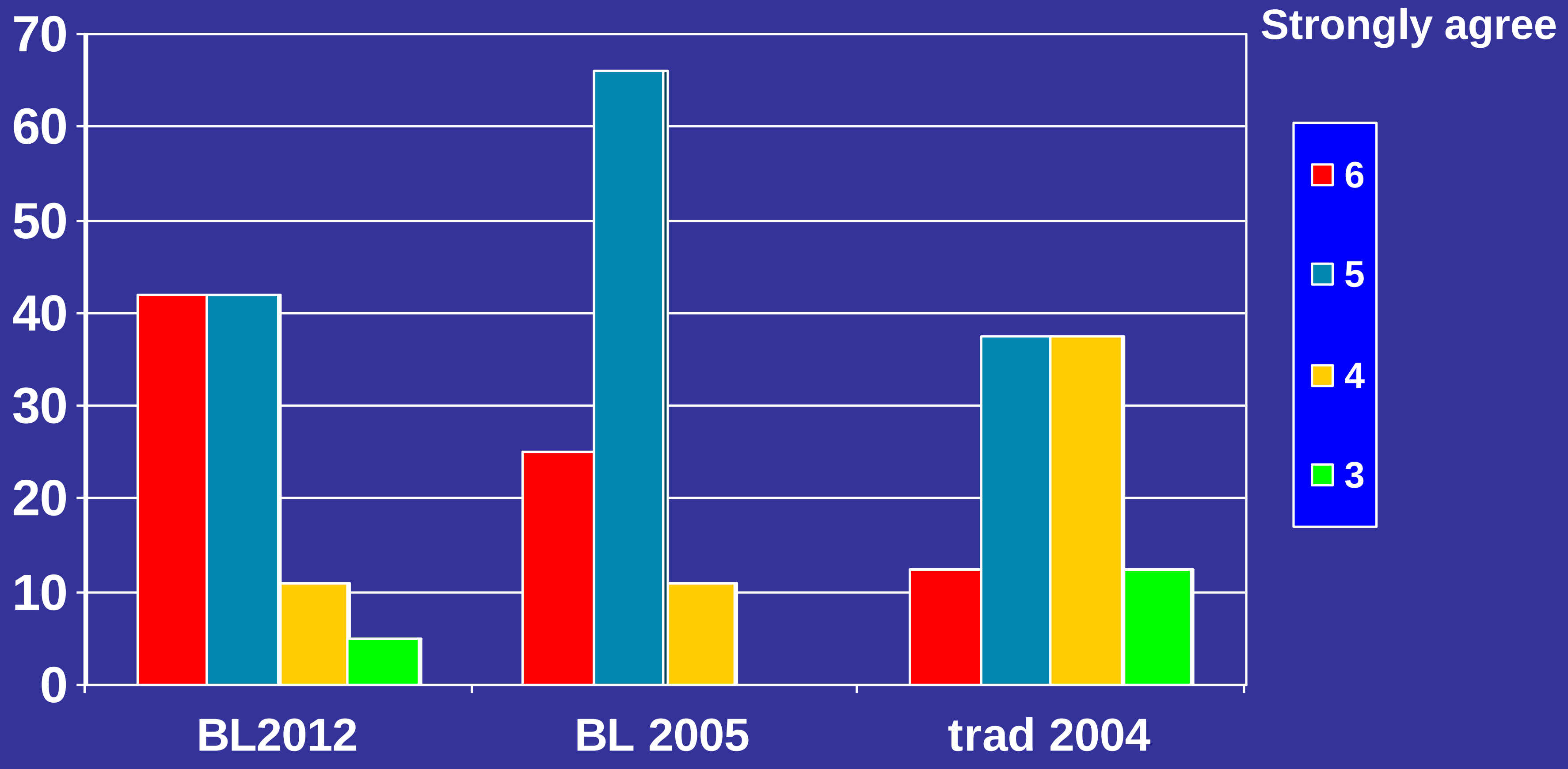
Consider a line of atoms, each with a 1s orbital that overlaps the 1s orbitals on the atoms either side of itself.

- The combination of 2 A.Os gives 2 M.Os

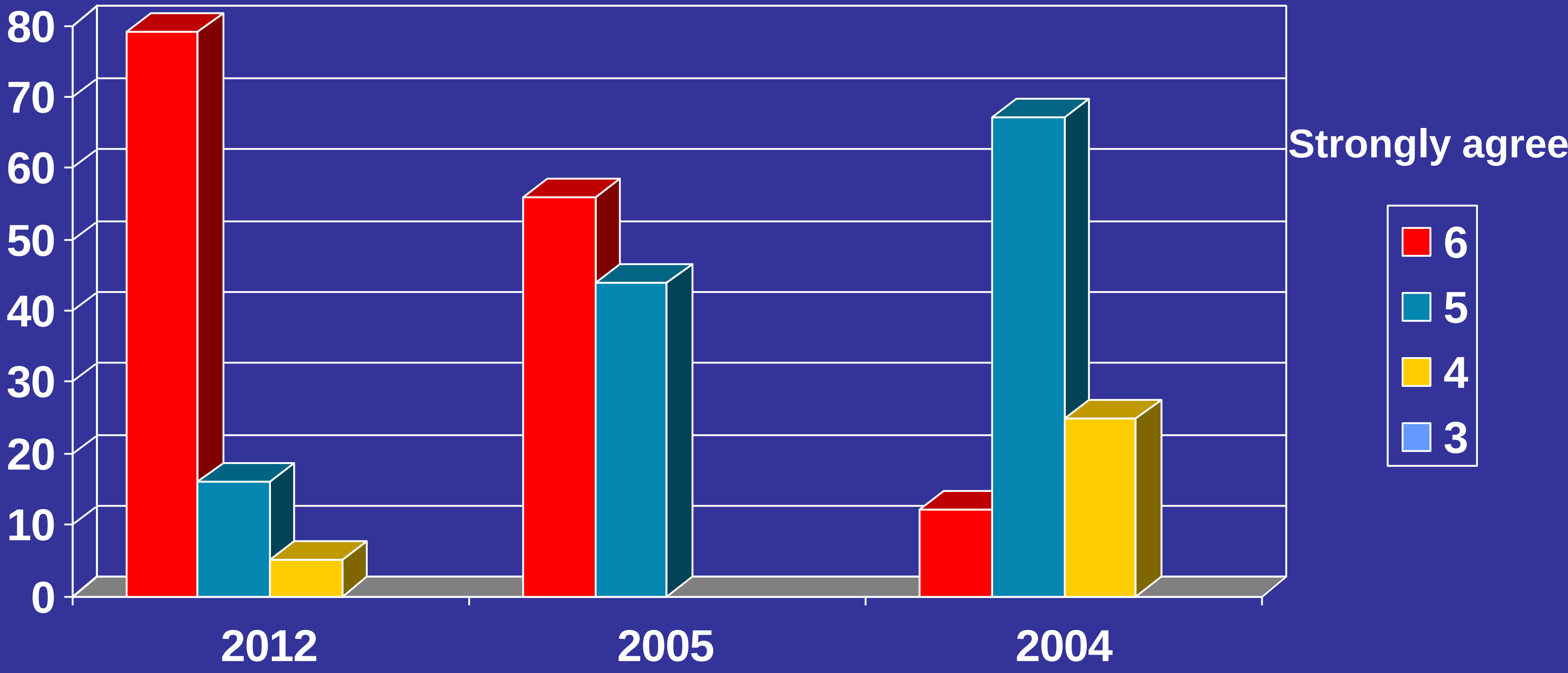
- A node marks a point of zero amplitude and an inversion of the sign of orbitals
- Nodes must be symmetrically placed.

Linear Combination of 3 Atomic orbitals

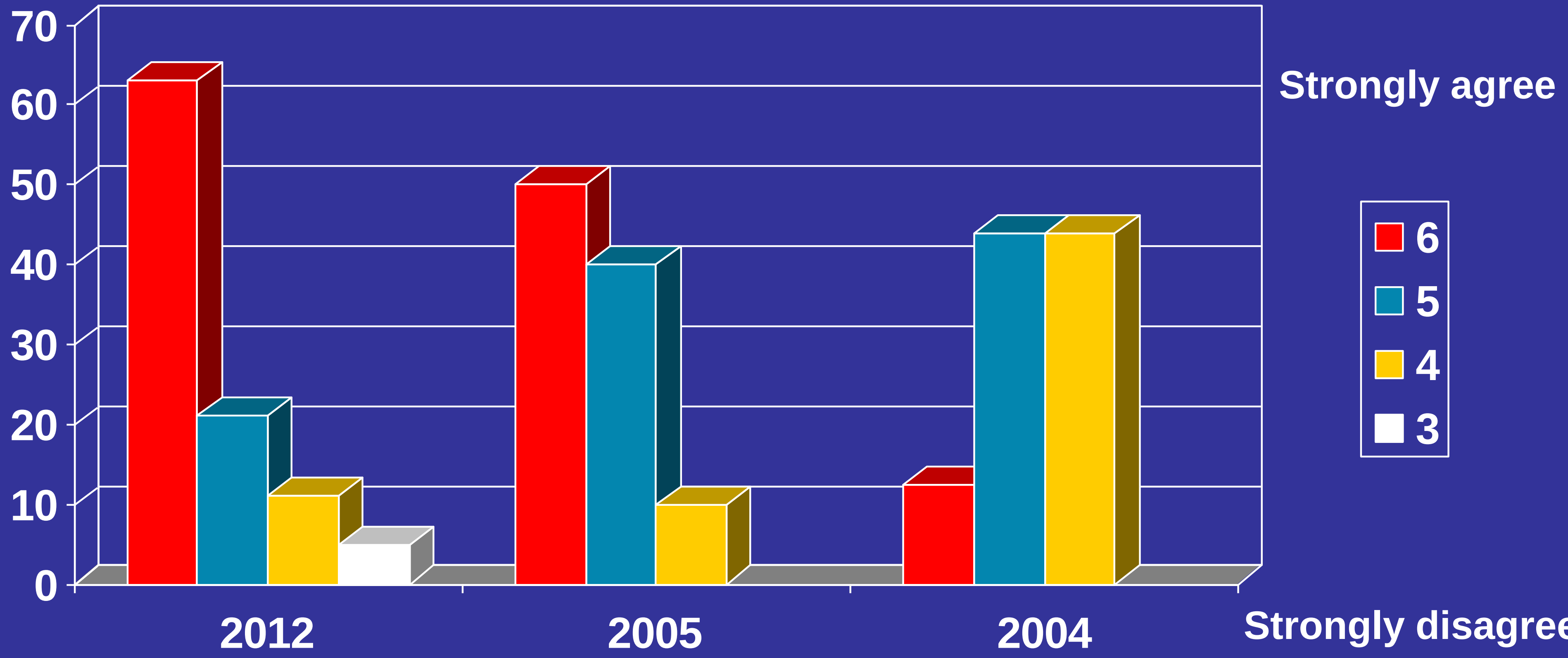
Student Evaluation :
Content stimulating and interesting



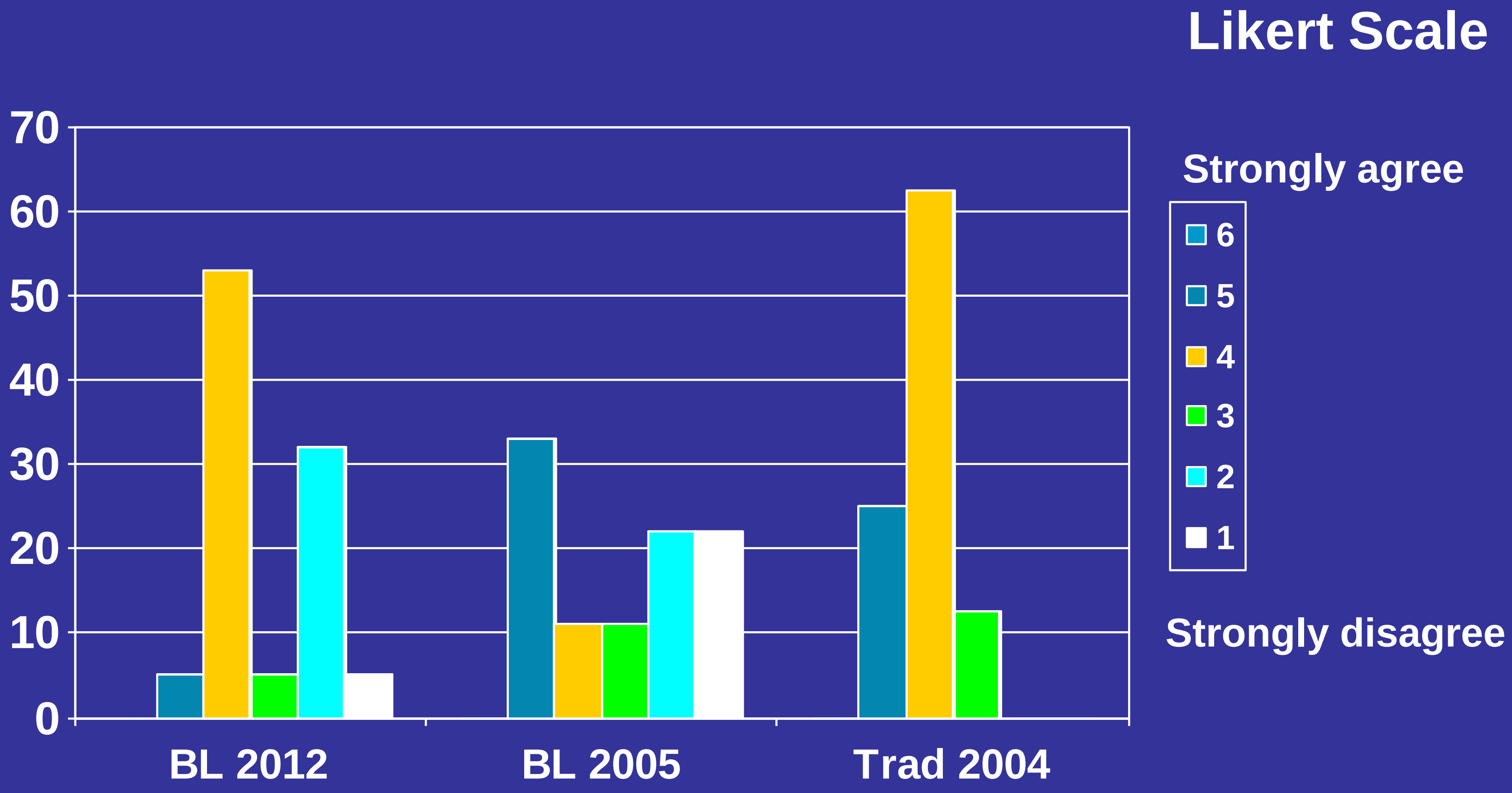
Student Evaluation:
Taught at appropriate pace



Student Evaluation:
Provided Helpful Feedback



Student Evaluation :
Found module difficult



Evaluation of implementation of Blended learning in CH2020

- *“ the way it was taught was better than any other module”*
- *“the study pack Blended learning format, with more time spent solving problems and addressing difficult concepts makes the module difficult to fail!”*
- *“ The blended learning teaching suited me perfectly, it would be good if the whole course was taught like that it was very Interesting 10/10”*

Module averages

Module Code	Module Name	12	11	10	9	8	7	6	5	av	4
CH2010	Inorganic I	58	48	46	50	51	49	46	49	**49**	44
CH2020	Inorganic II	62	42	58	48	52	53	52	50	**51**	48
CH2250	Physical		37	46	38	44	46	43	50	**43**	51
CH2260	Physical		39	41	44	45	46	44	47	**44**	45
CH2030	Organic		47	41	42	45	42	43	38	**43**	40
CH2040	Organic		42	37	37	48	46	44	43	**42**	51
annual average			**44**	**42**	**41**	**47**	**45**	**44**	**43**	**44**	**45**

Evaluation of implementation of Blended learning in CH2020

- Content and learning experience rated very highly by students.

- Attendance of workshops very good

- On-line tests with feedback, study packs and extra workshops deemed best features

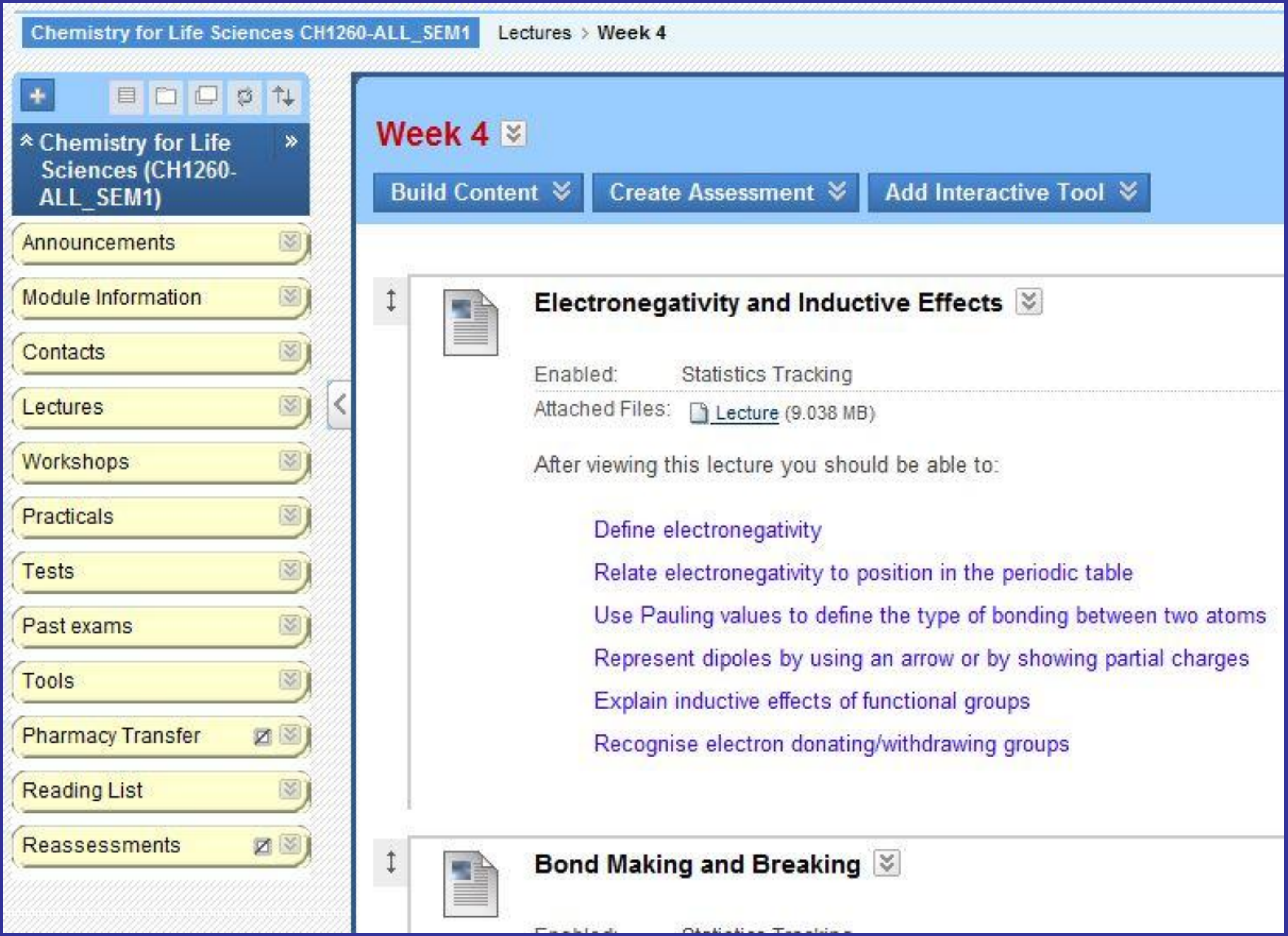
- Student Performance above average

Adoptions elsewhere

- Implemented in Chemistry for first year " Chemistry for Life Sciences" module (300+ students) in 2007 by Dr Simon Carrington.

- Adopted for half of Organic Chemistry 1 in 2010.

  I am so glad I made the effort to modify the teaching methods as the student performance on the module has been significantly better in the last two years."



Electronegativity and Inductive Effects

Enabled: Statistics Tracking

Attached Files: Lecture (9.038 MB)

After viewing this lecture you should be able to:

Define electronegativity

Relate electronegativity to position in the periodic table

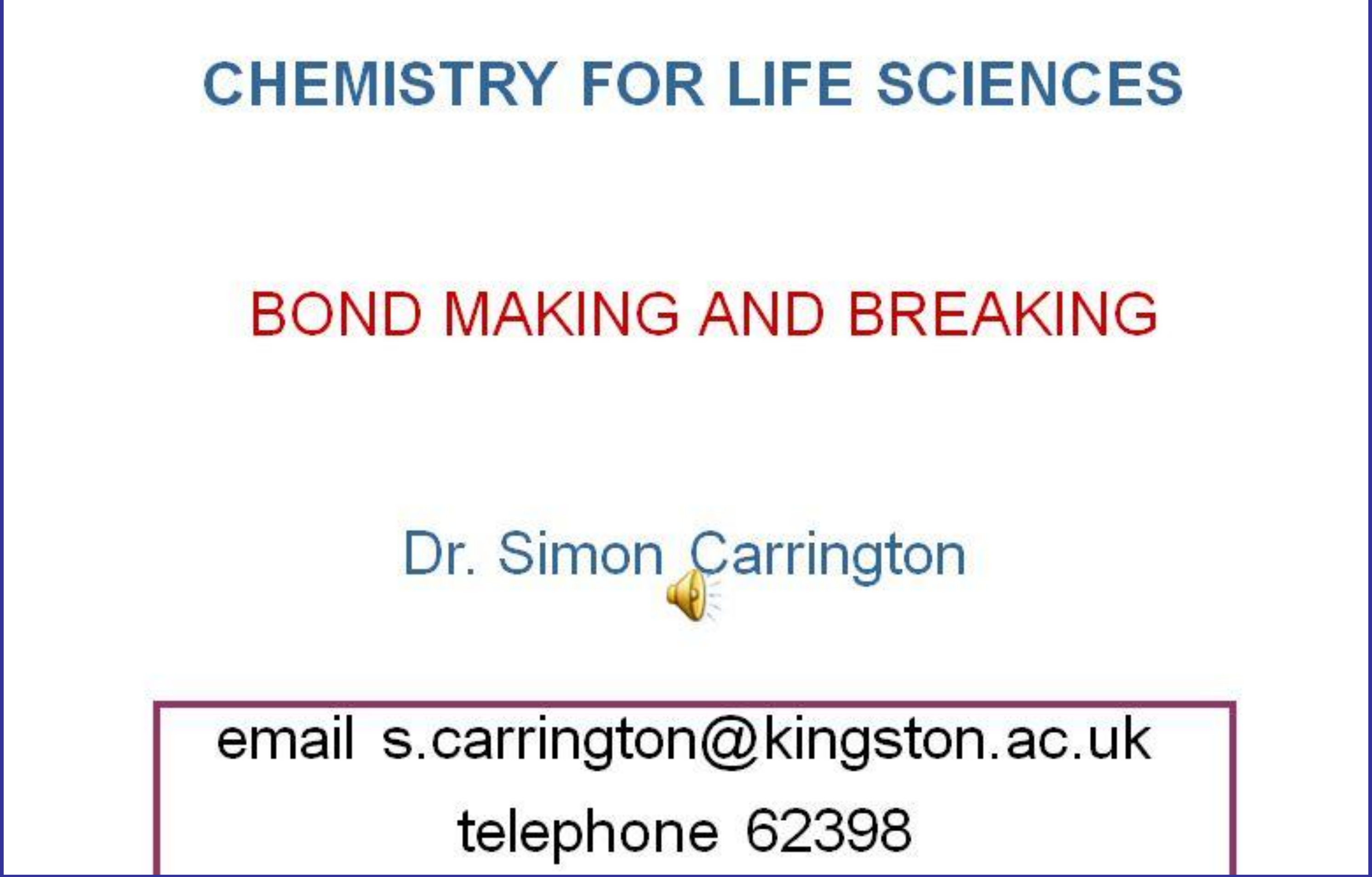
Use Pauling values to define the type of bonding between two atoms

Represent dipoles by using an arrow or by showing partial charges

Explain inductive effects of functional groups

Recognise electron donating/withdrawing groups

Bond Making and Breaking

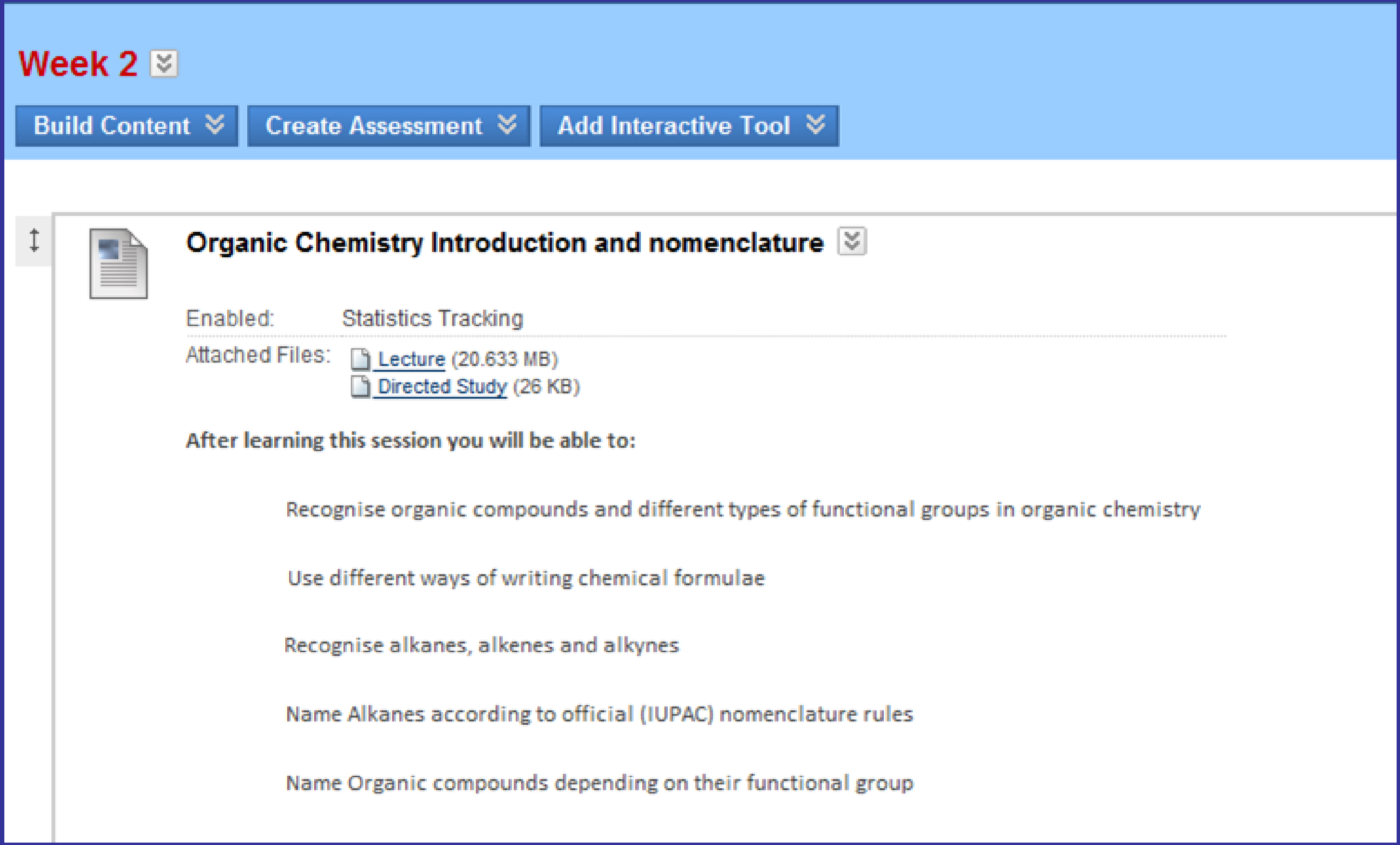


CHEMISTRY FOR LIFE SCIENCES

BOND MAKING AND BREAKING

Dr. Simon Carrington

email s.carrington@kingston.ac.uk
telephone 62398



Week 2

Organic Chemistry Introduction and nomenclature

Enabled: Statistics Tracking

Attached Files: Lecture (20.633 MB)
Directed Study (26 KB)

After learning this session you will be able to:

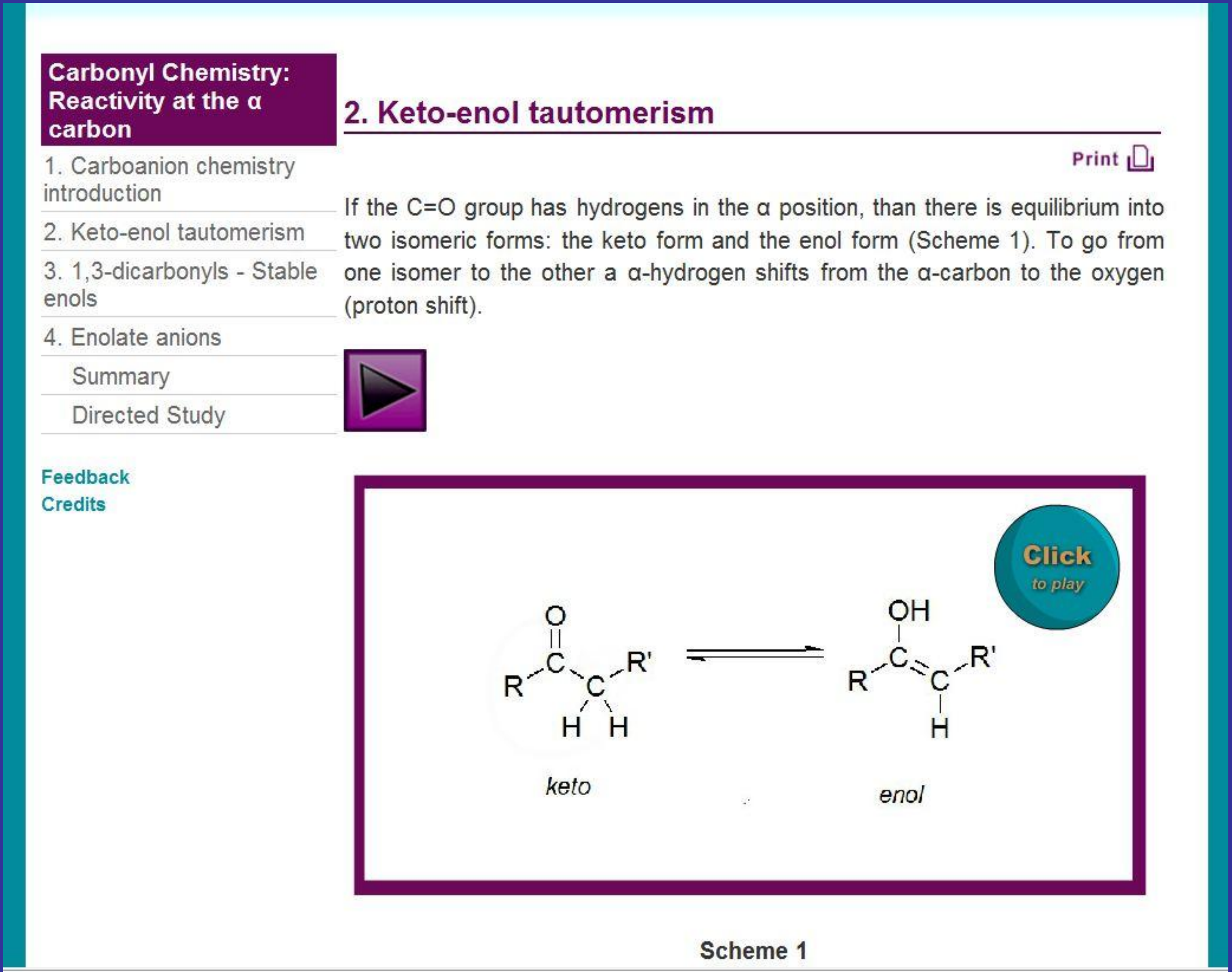
Recognise organic compounds and different types of functional groups in organic chemistry

Use different ways of writing chemical formulae

Recognise alkanes, alkenes and alkynes

Name Alkanes according to official (IUPAC) nomenclature rules

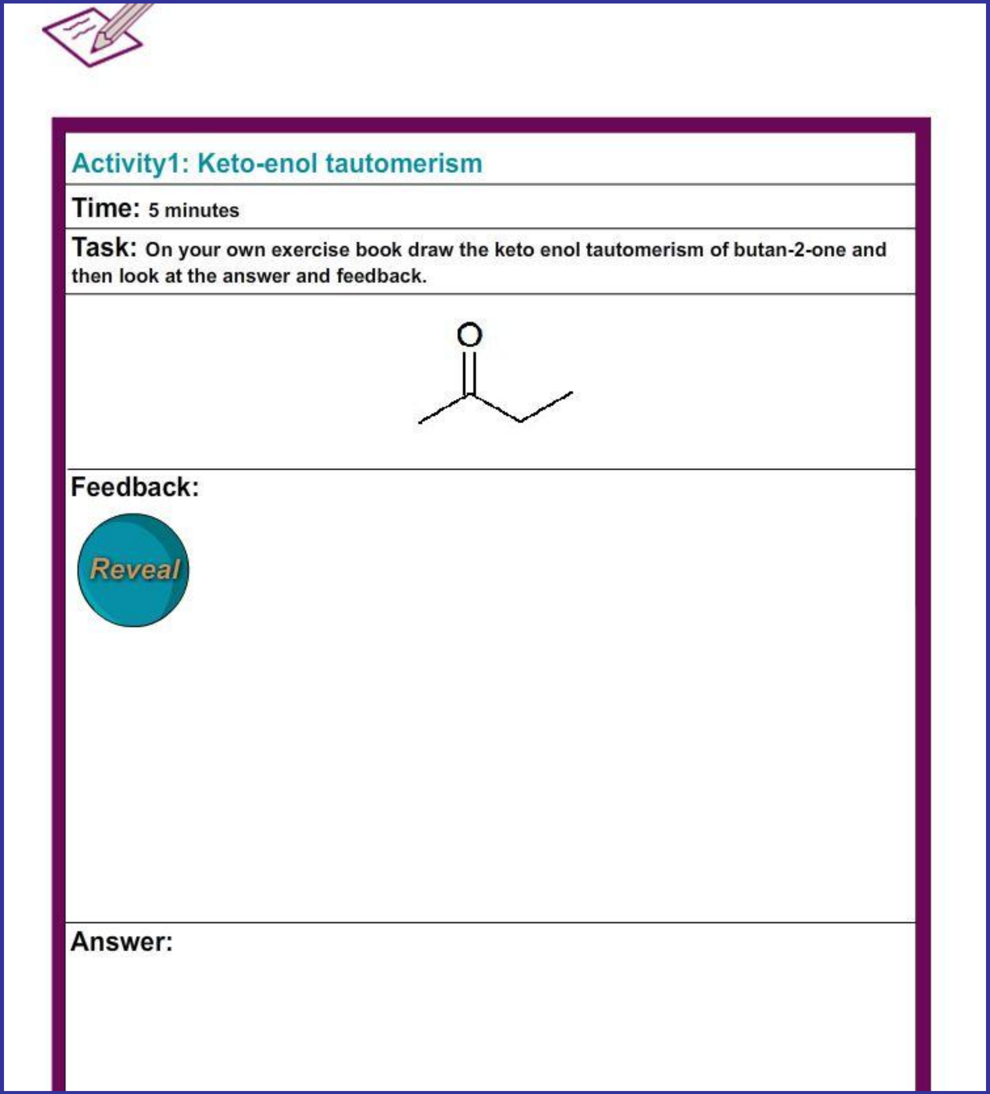
Name Organic compounds depending on their functional group



2. Keto-enol tautomerism

If the C=O group has hydrogens in the α position, than there is equilibrium into two isomeric forms: the keto form and the enol form (Scheme 1). To go from one isomer to the other a α-hydrogen shifts from the α-carbon to the oxygen (proton shift).

Scheme 1



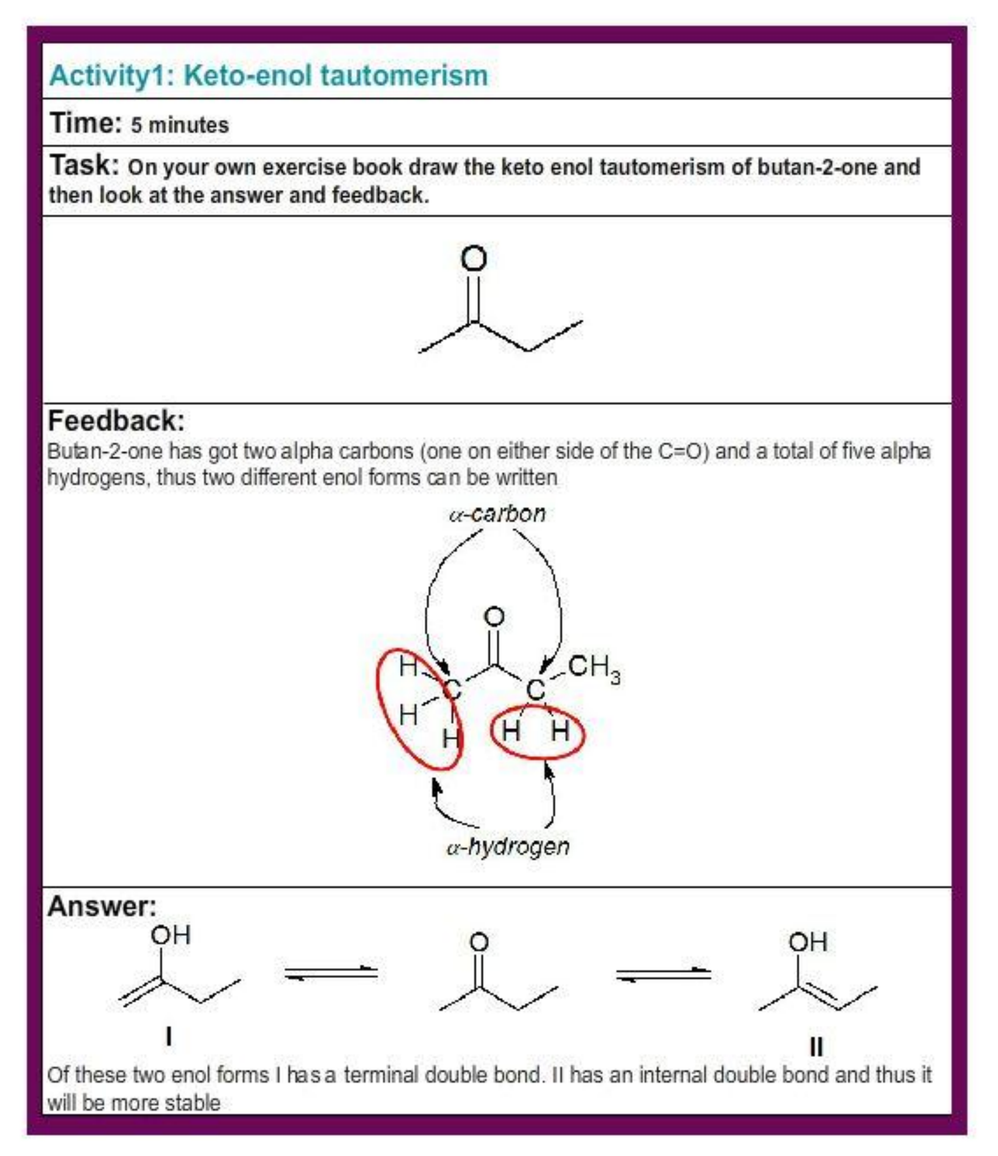
Activity1: Keto-enol tautomerism

Time: 5 minutes

Task: On your own exercise book draw the keto enol tautomerism of butan-2-one and then look at the answer and feedback.

Feedback:

Answer:



Activity1: Keto-enol tautomerism

Time: 5 minutes

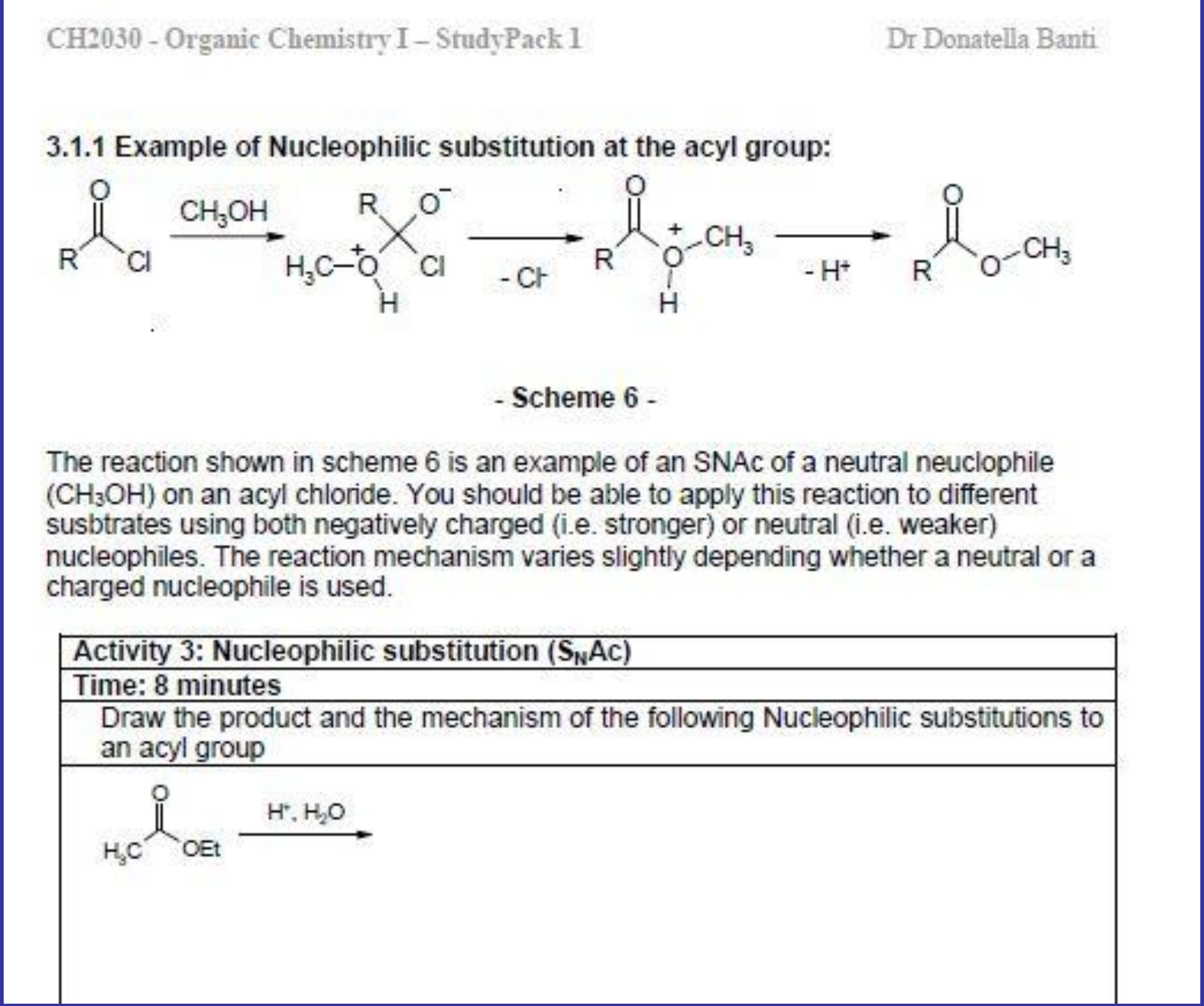
Task: On your own exercise book draw the keto enol tautomerism of butan-2-one and then look at the answer and feedback.

Feedback:

Butan-2-one has got two alpha carbons (one on either side of the C=O) and a total of five alpha hydrogens, thus two different enol forms can be written

Answer:

Of these two enol forms I has a terminal double bond. II has an internal double bond and thus it will be more stable



3.1.1 Example of Nucleophilic substitution at the acyl group:

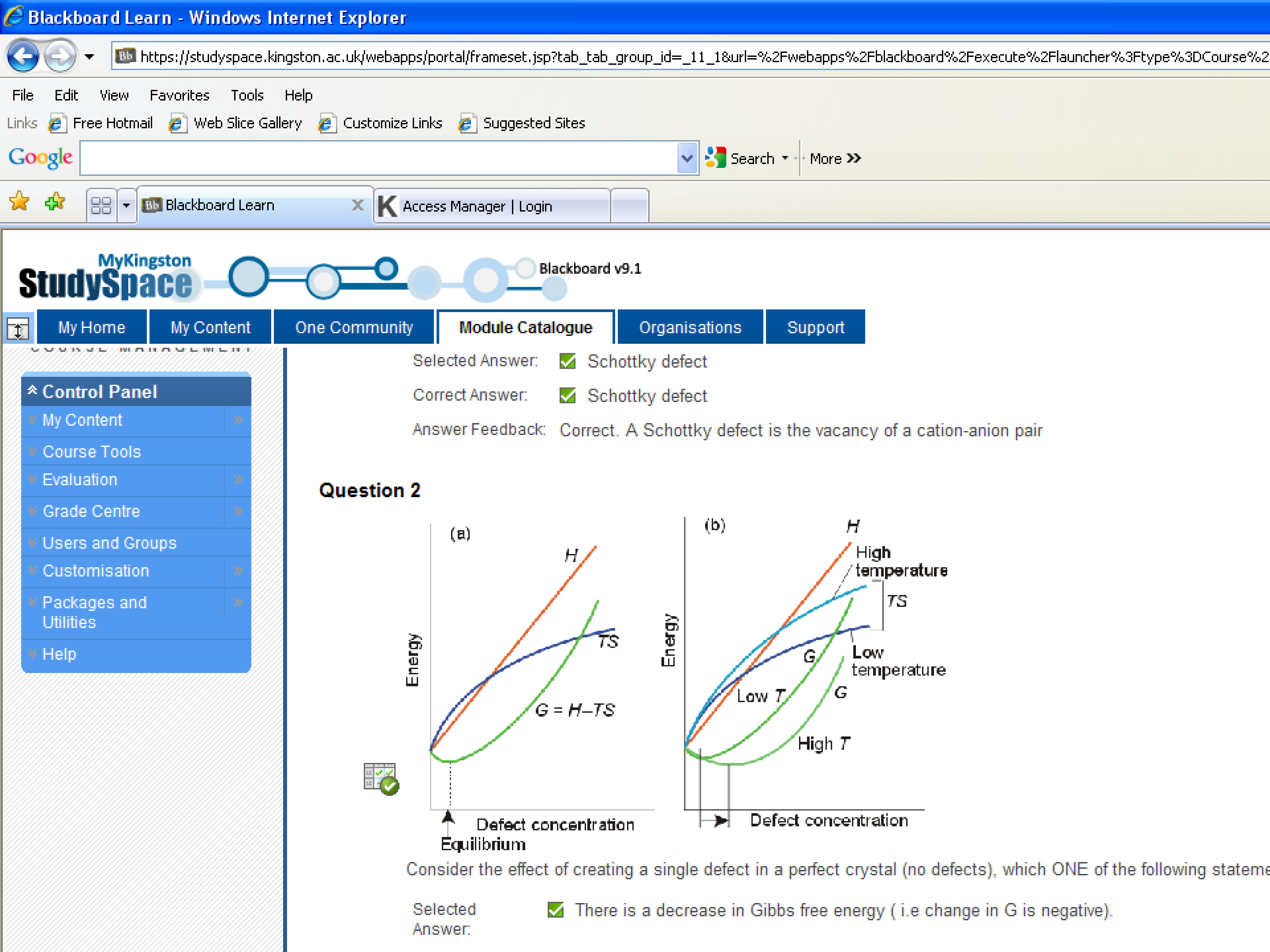
- **Scheme 6** -

The reaction shown in scheme 6 is an example of an SNAc of a neutral neuclophile (CH_3OH) on an acyl chloride. You should be able to apply this reaction to different susbtrates using both negatively charged (i.e. stronger) or neutral (i.e. weaker) nucleophiles. The reaction mechanism varies slightly depending whether a neutral or a charged nucleophile is used.

Activity 3: Nucleophilic substitution (S_NAc)
Time: 8 minutes
Draw the product and the mechanism of the following Nucleophilic substitutions to an acyl group

Conclusion

- Most popular with small groups
- Use small study packs
- Works with larger modules
- Improvements in results and satisfaction.
- Studypacks, on-line assessments and extra workshops increase student engagement.



Selected Answer: ☑ Schottky defect

Correct Answer: ☑ Schottky defect

Answer Feedback: Correct. A Schottky defect is the vacancy of a cation-anion pair

Question 2

Consider the effect of creating a single defect in a perfect crystal (no defects), which ONE of the following stateme

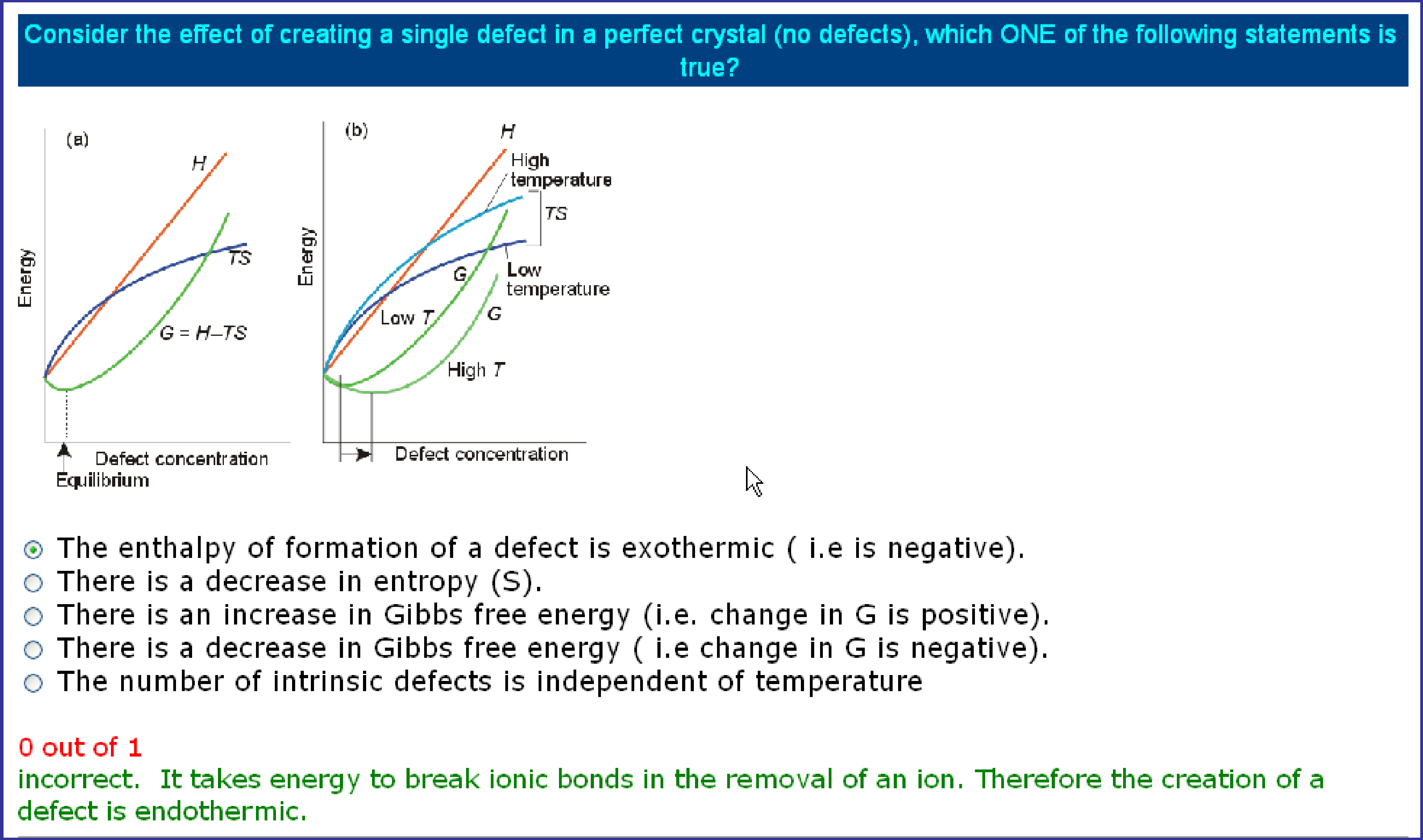
Selected Answer: ☑ There is a decrease in Gibbs free energy (i.e change in G is negative).

Evaluation

- Comparison of results with previous years

Year	No.	Pass %	Mod Av %	Exm Av %	CW Av %
2006	11	92	54	48	61
2005	14	85	55	5	57
2004	10	70	49	44	57
2003	20	95	56	53	59

MCQ question



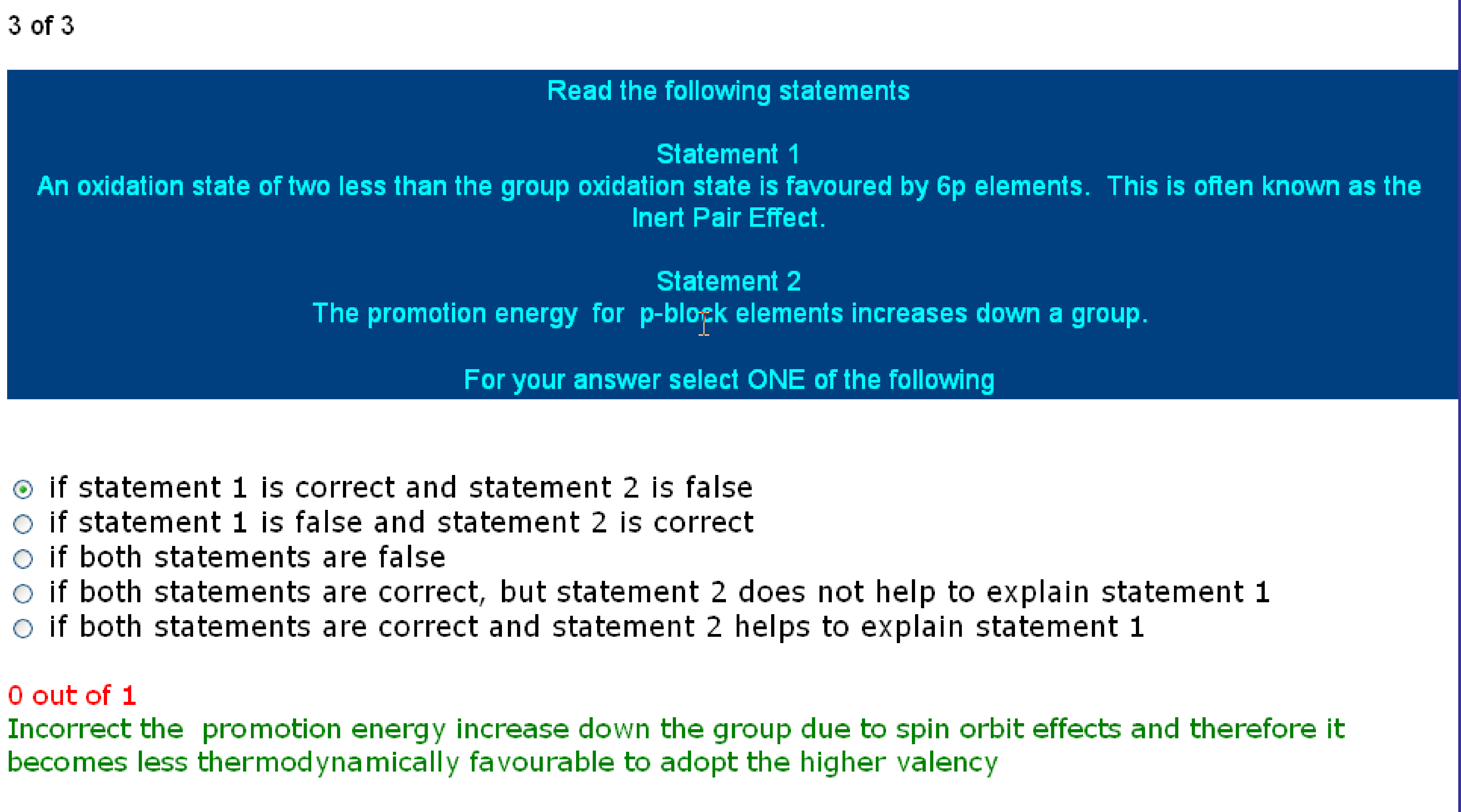
Consider the effect of creating a single defect in a perfect crystal (no defects), which ONE of the following statements is true?

- ● The enthalpy of formation of a defect is exothermic (i.e is negative).
- ○ There is a decrease in entropy (S).
- ○ There is an increase in Gibbs free energy (i.e. change in G is positive).
- ○ There is a decrease in Gibbs free energy (i.e change in G is negative).
- ○ The number of intrinsic defects is independent of temperature

0 out of 1

incorrect. It takes energy to break ionic bonds in the removal of an ion. Therefore the creation of a defect is endothermic.

Statements question



3 of 3

Read the following statements

Statement 1
An oxidation state of two less than the group oxidation state is favoured by 6p elements. This is often known as the Inert Pair Effect.

Statement 2
The promotion energy for p-block elements increases down a group.

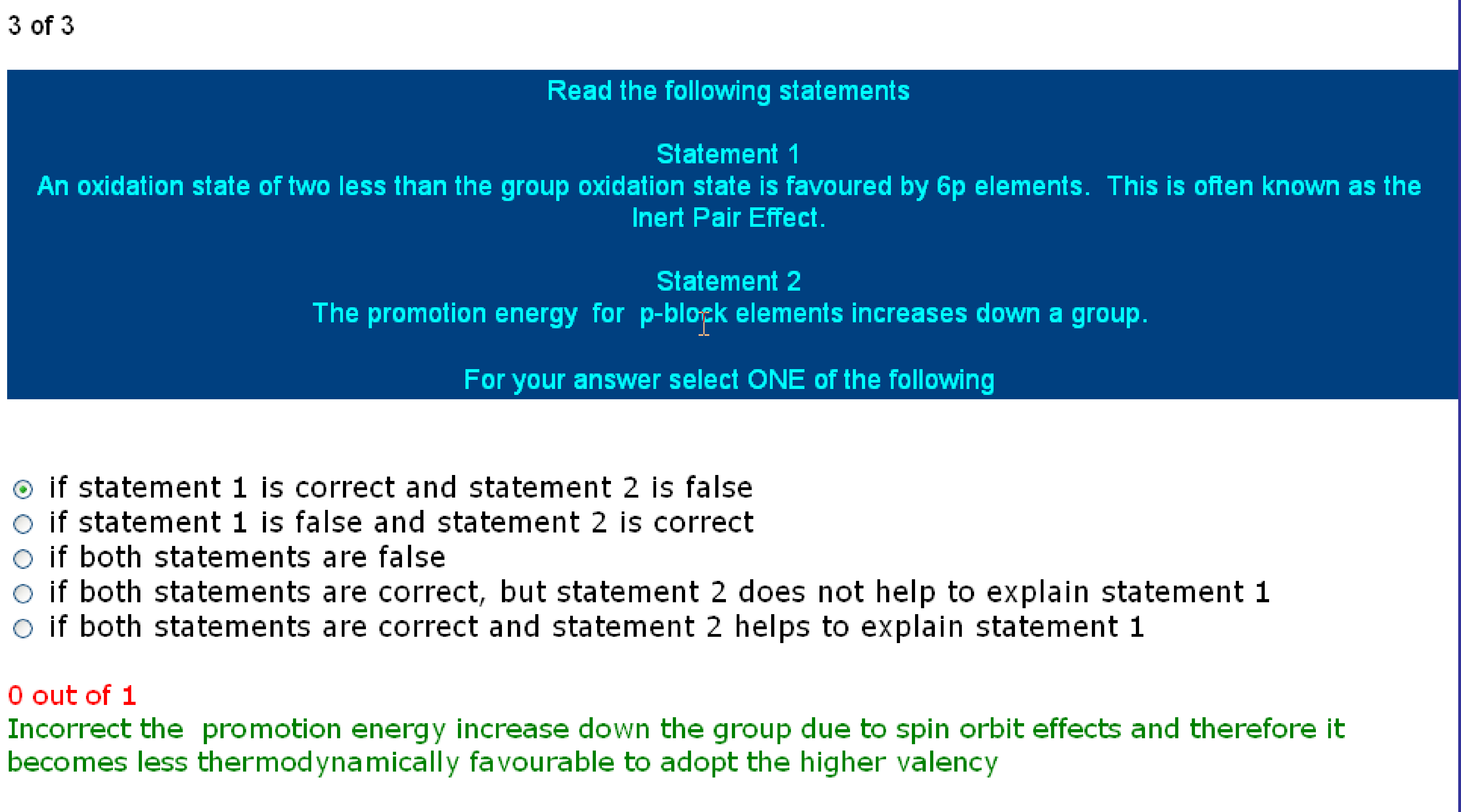
For your answer select ONE of the following

- ● if statement 1 is correct and statement 2 is false
- ○ if statement 1 is false and statement 2 is correct
- ○ if both statements are false
- ○ if both statements are correct, but statement 2 does not help to explain statement 1
- ○ if both statements are correct and statement 2 helps to explain statement 1

0 out of 1

Incorrect the promotion energy increase down the group due to spin orbit effects and therefore it becomes less thermodynamically favourable to adopt the higher valency

Statements question



3 of 3

Read the following statements

Statement 1

An oxidation state of two less than the group oxidation state is favoured by 6p elements. This is often known as the Inert Pair Effect.

Statement 2

The promotion energy for p-block elements increases down a group.

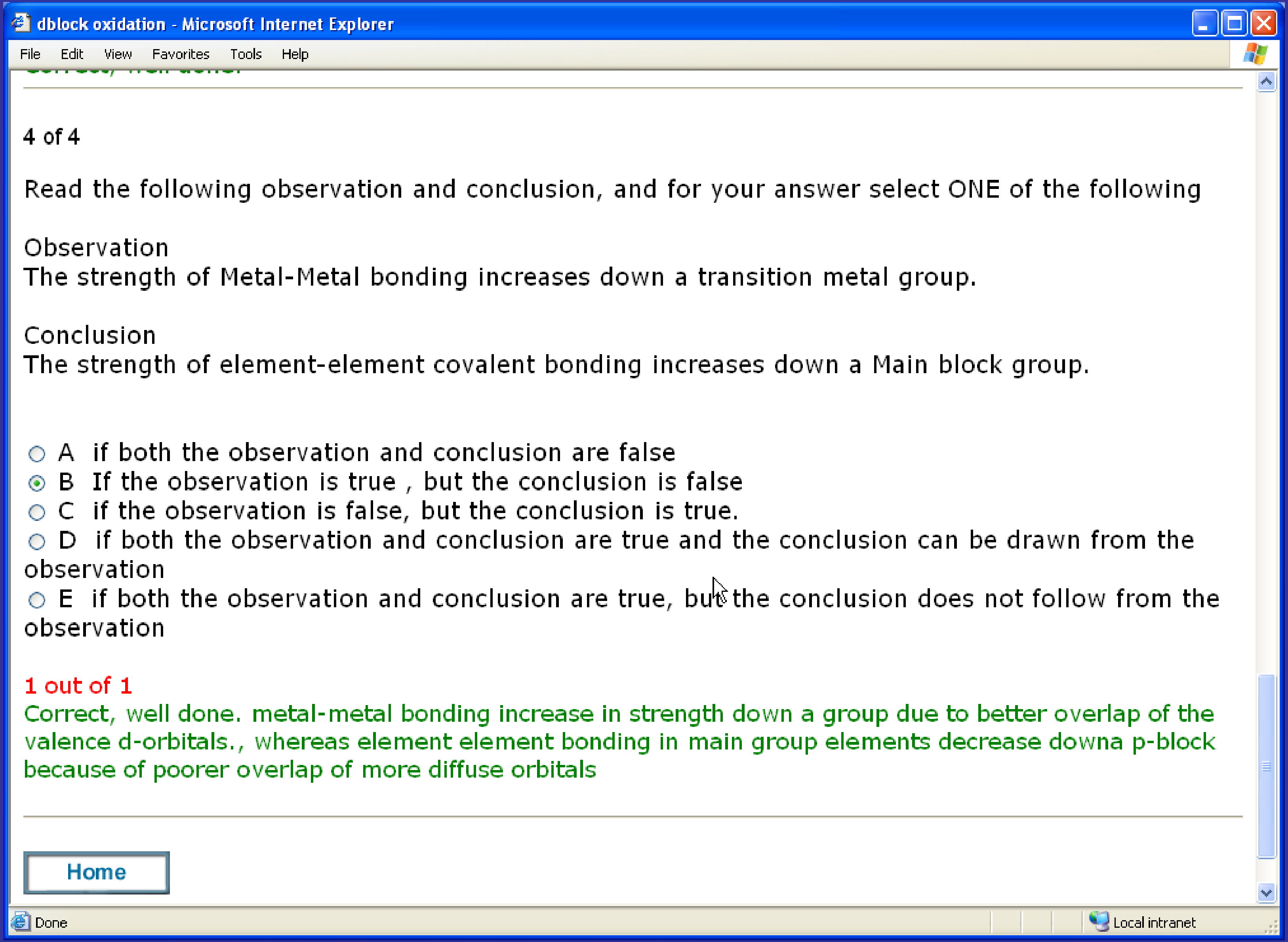
For your answer select ONE of the following

- ● if statement 1 is correct and statement 2 is false
- ○ if statement 1 is false and statement 2 is correct
- ○ if both statements are false
- ○ if both statements are correct, but statement 2 does not help to explain statement 1
- ○ if both statements are correct and statement 2 helps to explain statement 1

0 out of 1

Incorrect the promotion energy increase down the group due to spin orbit effects and therefore it becomes less thermodynamically favourable to adopt the higher valency

Observation-conclusion question



4 of 4

Read the following observation and conclusion, and for your answer select ONE of the following

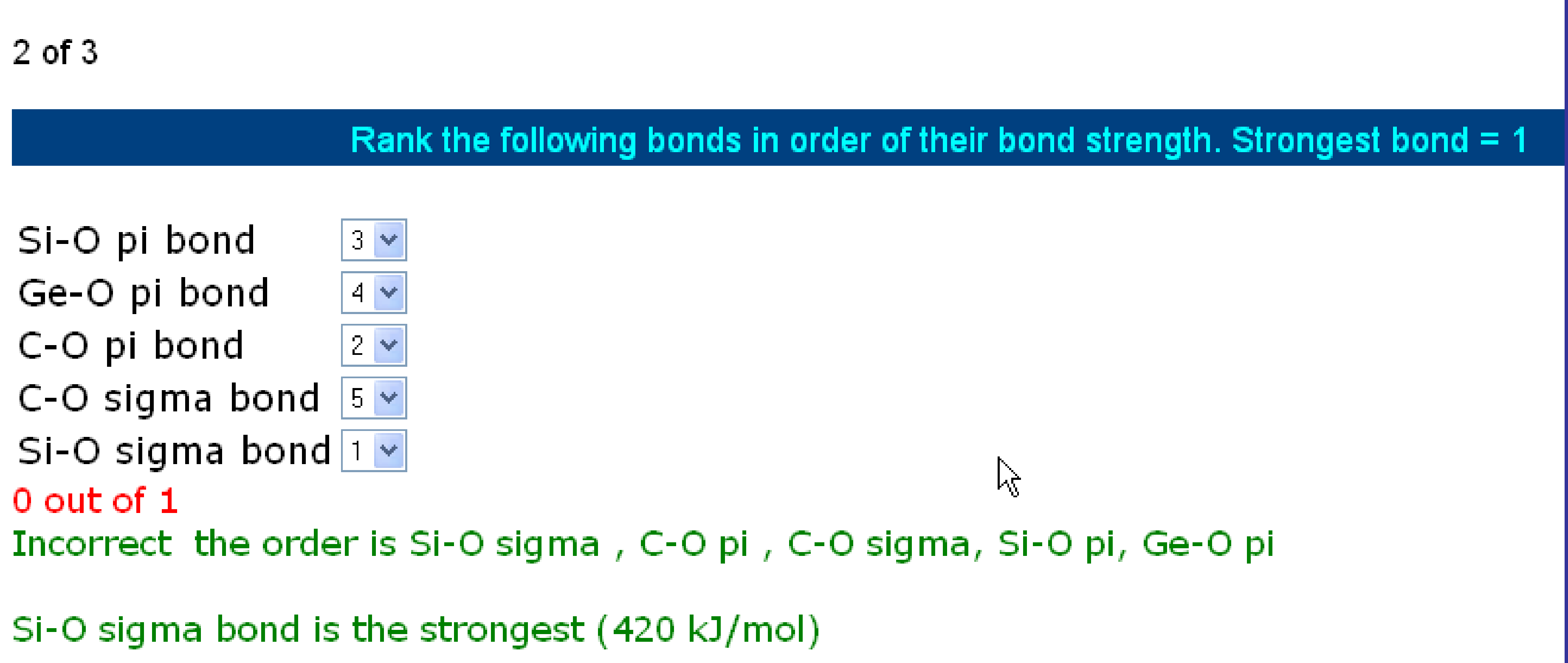
Observation
The strength of Metal-Metal bonding increases down a transition metal group.

Conclusion
The strength of element-element covalent bonding increases down a Main block group.

○ A if both the observation and conclusion are false
● B If the observation is true , but the conclusion is false
○ C if the observation is false, but the conclusion is true.
○ D if both the observation and conclusion are true and the conclusion can be drawn from the observation
○ E if both the observation and conclusion are true, but the conclusion does not follow from the observation

1 out of 1
Correct, well done. metal-metal bonding increase in strength down a group due to better overlap of the valence d-orbitals., whereas element element bonding in main group elements decrease downa p-block because of poorer overlap of more diffuse orbitals

Rank order question



2 of 3

Rank the following bonds in order of their bond strength. Strongest bond = 1

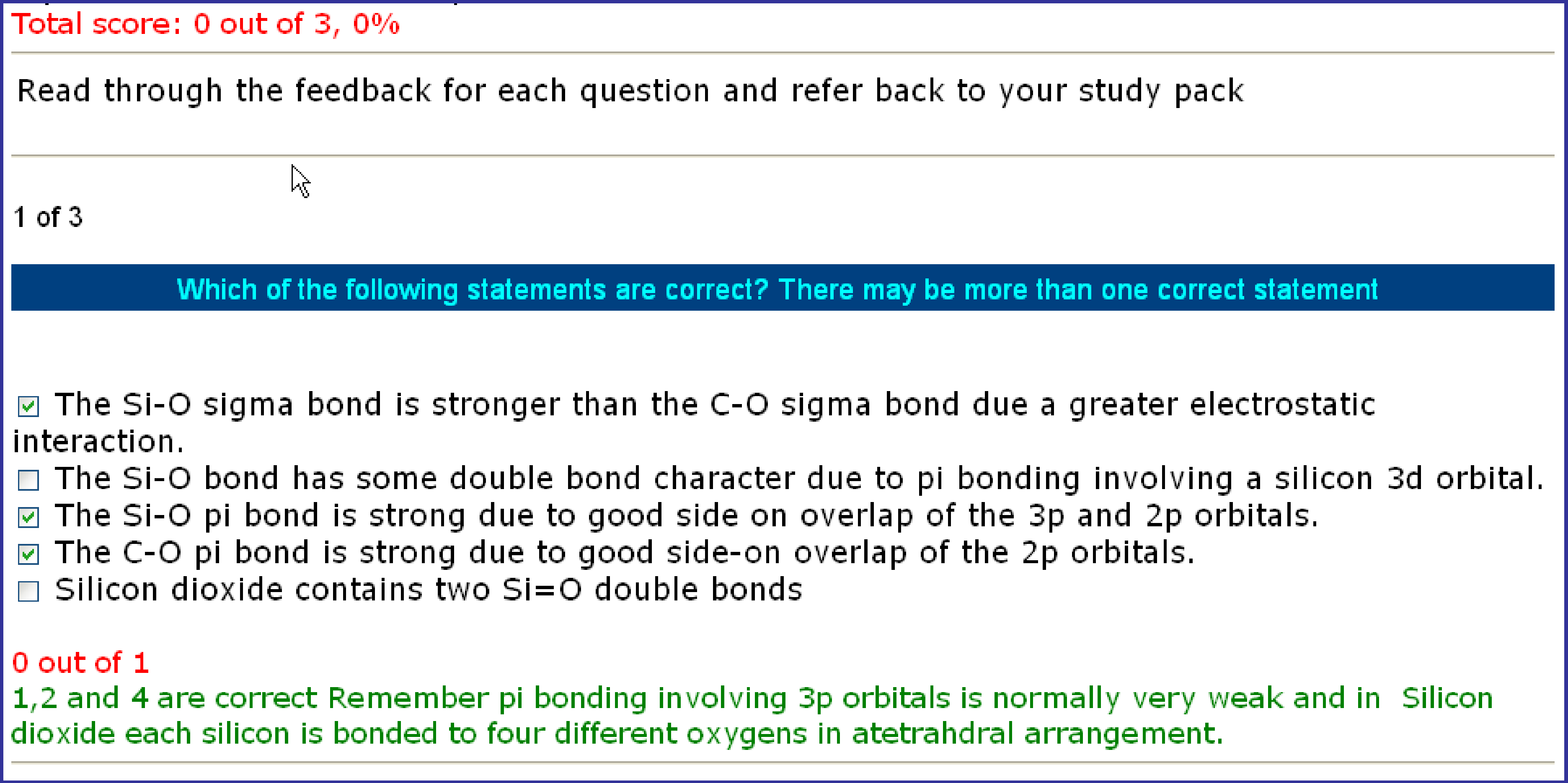
Si-O pi bond	3
Ge-O pi bond	4
C-O pi bond	2
C-O sigma bond	5
Si-O sigma bond	1

0 out of 1

Incorrect the order is Si-O sigma , C-O pi , C-O sigma, Si-O pi, Ge-O pi

Si-O sigma bond is the strongest (420 kJ/mol)

Multiple response question



Total score: 0 out of 3, 0%

Read through the feedback for each question and refer back to your study pack

1 of 3

Which of the following statements are correct? There may be more than one correct statement

☑ The Si-O sigma bond is stronger than the C-O sigma bond due a greater electrostatic interaction.
☐ The Si-O bond has some double bond character due to pi bonding involving a silicon 3d orbital.
☑ The Si-O pi bond is strong due to good side on overlap of the 3p and 2p orbitals.
☑ The C-O pi bond is strong due to good side-on overlap of the 2p orbitals.
☐ Silicon dioxide contains two Si=O double bonds

0 out of 1
1,2 and 4 are correct Remember pi bonding involving 3p orbitals is normally very weak and in Silicon dioxide each silicon is bonded to four different oxygens in atetrahdral arrangement.