LUI

First names

Family name

Attach your barcode ID label here

Thursday 2 June 2016

Question and response book

Chemistry

Year 11 — Supervised assessment

Time allowed

Perusal time: 10 minutes
Writing time: 90 minutes

Materials provided

1. Question and response book (this book)
2. Instrument-specific standards and fold out mark distribution (at the back of this book)
3. Periodic table.

Equipment

Equipment	Comments
pens (black ink only)	use black ink for all responses
pencils	pencils may be used for drafting (e.g. sketches or plots), but all drafts must then be finalised in black ink
rulers, highlighters, sharpener, eraser	ensure materials have no added text or handwriting
approved calculator	

Guidelines

- Read each question to ensure your answer meets the question's requirements, e.g. 'explain your reasoning', 'refer to electron shells'.
- All numerical answers should be given **exactly** or **correct to two decimal places**, unless otherwise stated in the question.
- Full marks are not necessarily awarded for a correct answer with no working. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. Therefore show all working where appropriate.
- Respond in the spaces provided in the response book. If you need more space to complete, rewrite or redraft a response, use the spare pages at the back of this book. Be sure to:
  - label the spare page with the question number that relates to your response
  - cancel your incorrect response by ruling a single, diagonal line through your work; if you fail to do this, your original response will be marked
  - note the page number of your additional response (e.g. see page 12).

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DO NOT WRITE ON THIS PAGE

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Question 1

[KCU C standard]

Atoms of a certain isotope of an element have 14 neutrons and a mass number of 27.

a) What is the atomic number of this element? *[1 mark]*

b) What is the name of this element? *[1 mark]*

c) Write the charge of the ion commonly formed by this element. *[1 mark]*

d) Using the ${}^{A}_{Z}M$ format, write the symbol for this element. *[1 mark]*

e) Write the complete electron configuration for this element.

[1 mark]

Question 2

[KCU C standard]

a) A 0.60 mole sample of an element has a mass of 47.40 g. Determine the identity of the element.

Show all working

[3 marks]

b) How many atoms would be found in 23.40 moles of this element?

Note: Avogadro's number = 6.02×10^{23}

Show all working

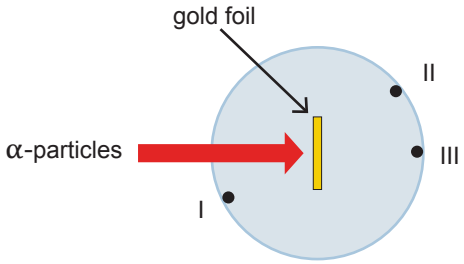
[2 marks]

Do not write outside this box.

Question 3

[KCU B standard]

The diagram below represents Rutherford's investigation into the structure of the atom. It shows α-particles (He nuclei) being fired at thin gold foil. Detectors reveal that most α-particles are detected at III, a much smaller number of α-particles are detected at II, and occasionally α-particles are detected at I.



Interpret the results of this experiment to show how they support Rutherford's model of the atom.

[4 marks]

Do not write outside this box.

Question 4

[KCU B standard]

Calculate the relative atomic mass of gallium given the following information.

Element	Relative isotopic mass	Percentage abundance
Gallium-69	68.93	60.11
Gallium-71	70.92	39.89

Show all working

[2 marks]

Question 5

[KCU B standard]

A solution containing 0.60 moles of sodium hydroxide is added to excess magnesium sulfate in solution. A white solid, magnesium hydroxide, is formed.

a) Write a balanced equation including the states of reactants and products.

[2 marks]

b) Write the name of the other product formed.

[1 mark]

c) Calculate the mass of magnesium hydroxide formed.

Show all working

[3 marks]

Do not write outside this box.

Question 6

[KCU B standard]

Use the information in the following table to answer a) and b) below.

Atom	Protons	Neutrons	Electrons
J	17	18	17
K	17	19	17
L	18	18	18
M	19	19	19

Compare the atoms, J, K, L and M.

a) Determine which atoms may be considered isotopes.

Explain your reasoning

[2 marks]

b) Determine which two atoms have the closest masses.

Explain your reasoning

[3 marks]

Do not write outside this box.

Question 7

[KCU A standard]

Caffeine has an **empirical formula** of $C_4H_5N_2O$ and a molar mass of approximately 200 g/mol. A 375 mL can of soft drink contains 36 mg of caffeine.

Determine the molarity (i.e. molar concentration) of caffeine in a can of this soft drink.

Show all working

[6 marks]

Do not write outside this box.

Question 8

[KCU A standard]

Information about the atomic and ionic radii of two elements is shown below.

	Atomic radius (nm)	Ionic radius (nm)
Sodium	0.186	0.097
Fluorine	0.071	0.133

This can be summarised by the statement:

> *Sodium atoms are larger than fluorine atoms, but sodium ions are smaller than fluoride ions.*

By comparing the electron configurations of both the atoms and ions, explain why the statement is correct.

[7 marks]

Question 9

[KCU B standard, EC A standard]

Information about the electronegativities of certain elements is shown below.

Element	Hydrogen	Carbon	Nitrogen	Oxygen
Pauling electronegativity value	2.1	2.5	3.0	3.5

Based on this information, a prediction was made:

> *Since the C–O bond is more polar than the N–H bond, CO_2 will have a higher boiling point than NH_3.*

Is this prediction correct? Justify your answer, referring to electronegativity differences, types and polarity of bonds, and the shapes of the molecules.

[4 marks KCU, 8 marks EC]

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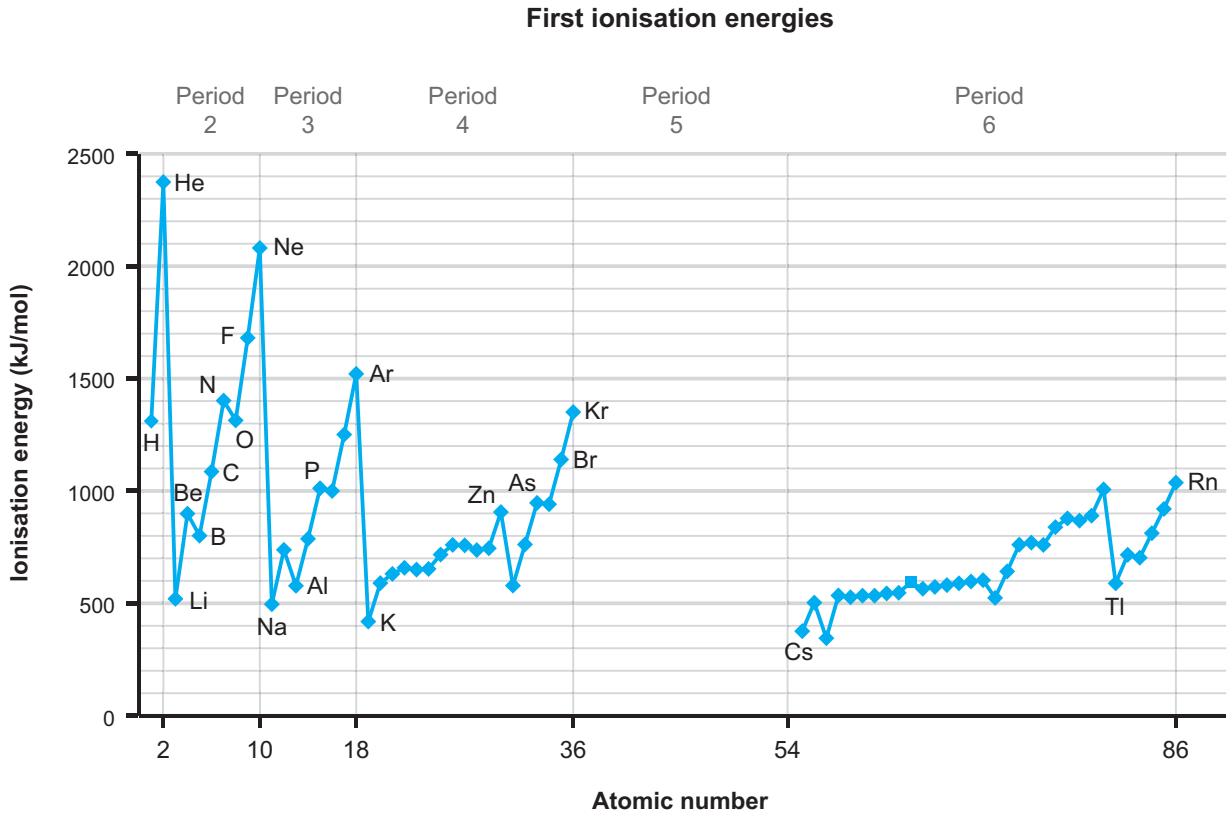
Refer to the diagram below to answer Questions 10 and 11.

The diagram shows the first ionisation energies of elements from periods 1, 2, 3, 4, and 6 of the period table. The data for period 5 have deliberately been omitted.



Question 10

[IP C standard]

Identify the overall trend in first ionisation energy for the period 2 elements, i.e. between Li and Ne. Identify any exceptions to this trend.

[4 marks]

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Question 11

[IP A standard]

Predict approximate values for the first ionisation energies of the period 5 elements Xenon and Indium. Give reasons for your predictions based on the trends visible in the *First ionisation energies* graph and the periodic table.

Element	Predicted first ionisation energy (kJ/mol)	Reason
Xe		
In		

[9 marks]

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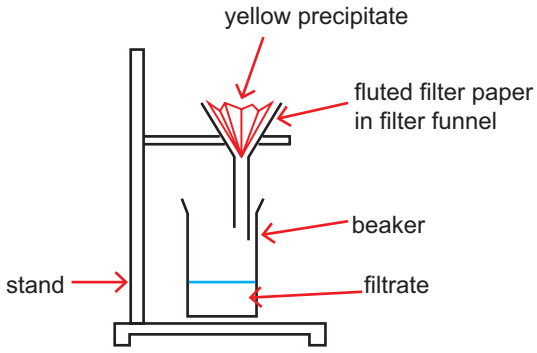
Question 12

[EC A standard]

An experiment was performed involving the reaction between potassium iodide and lead (II) nitrate. This reaction produces a bright yellow solid precipitate of lead (II) iodide. The method for the experiment was as follows.

1. A solution containing 0.01 mole of potassium iodide was prepared.
2. A solution containing excess lead (II) nitrate was prepared.
3. The lead (II) nitrate solution was added to the potassium iodide solution and stirred.
4. The mixture was then allowed to stand for 8–10 minutes to allow the reaction to go to completion.
5. The mass of the filter paper was recorded. The filter paper was then moistened and placed in a funnel.
6. The mixture was then filtered to remove the yellow precipitate as shown below.



7. The filter paper and precipitate were dried in a drying oven.
8. The filter paper and precipitate were weighed and the original mass of the filter paper subtracted from this to calculate the mass of the lead (II) iodide formed.

The table below shows theoretical yield for this experiment and the results from three different groups:

Theoretical yield (g)	Group 1 yield (g)	Group 2 yield (g)	Group 3 yield (g)
2.31	2.25	2.48	2.07

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a) Identify one source of error that would explain the higher yield in Group 2.

Justify your answer

[3 marks]

b) Identify two sources of error that would explain the lower yields in Groups 1 and 3.

Justify your answer

[6 marks]

END OF PAPER

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SPARE PAGE FOR ADDITIONAL RESPONSES

If you want this response marked don't forget to cancel your incorrect response.

Include the question number.

Do not write outside this box.

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Mark distribution

Q	Dimension	Objective	Marks
1	KCU	Application of algorithms, principles, theories and schema to find solutions in simple situations	5
2	KCU	Application of algorithms, principles, theories and schema to find solutions in simple situations	5
3	KCU	Reproduction and interpretation of complex concepts, theories and principles	4
4	KCU	Reproduction and interpretation of complex or challenging concepts, theories and principles Linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex or challenging situations	2
5	KCU	Linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex or challenging situations	6
6	KCU	Reproduction of concepts, theories and principles Comparison and explanation of concepts, processes and phenomena Linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex or challenging situations	5
7	KCU	Linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex and challenging situations	6
8	KCU	Reproduction and interpretation of complex or challenging concepts, theories and principles Comparison and explanation of complex concepts, processes and phenomena Application of algorithms, principles, theories and schema to find solutions in simple situations	7
9	KCU	Reproduction and interpretation of complex or challenging concepts, theories and principles Comparison and explanation of concepts, processes and phenomena Application of algorithms, principles, theories and schema to find solutions in simple situations	4
	EC	Analysis and evaluation of complex scientific interrelationships	8
10	IP	Analysis of secondary data to identify obvious trends and anomalies	4
11	IP	Systematic analysis of secondary data to identify relationships between trends and anomalies	9
12	EC	Exploration of scenarios and possible outcomes with justification of conclusions	9

FOLD OUT THIS PANEL

MARK DISTRIBUTION ON REVERSE

THIS PANEL WILL NOT BE MARKED

Chemistry instrument-specific standards

	Standard A	Standard B	Standard C	Standard D	Standard E
	The student work has the following characteristics:				
Knowledge and conceptual understanding (KCU)		• reproduction and interpretation of complex or challenging concepts, theories and principles	• reproduction of concepts, theories and principles	• reproduction of simple ideas and concepts	• reproduction of isolated facts
	• comparison and explanation of complex concepts, processes and phenomena	• comparison and explanation of concepts processes and phenomena	• explanation of simple processes and phenomena	• description of simple processes and phenomena	• recognition of isolated simple phenomena
	• linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex and challenging situations	• linking and application of algorithms, concepts, principles, theories and schema to find solutions in complex or challenging situations	• application of algorithms, principles, theories and schema to find solutions in simple situations	• application of algorithms, principles, theories and schema	• application of simple given algorithms
Investigative processes (IP)	• systematic analysis of secondary data to identify relationships between trends and anomalies.	• analysis of secondary data to identify trends and anomalies	• analysis of secondary data to identify obvious trends and anomalies	• identification of obvious patterns	• recording of data
Evaluating and concluding (EC)	• analysis and evaluation of complex scientific interrelationships	• analysis of complex scientific interrelationships	• description of scientific interrelationships	• identification of simple scientific interrelationships	• identification of obvious scientific interrelationships
	• exploration of scenarios and possible outcomes with justification of conclusions	• explanation of scenarios and possible outcomes with discussion of conclusions	• description of scenarios and possible outcomes with statements of conclusion	• identification of scenarios or possible outcomes	• statements about outcomes