OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL CHEMISTRY

(9620)

Unit 3: Inorganic 2 and Physical 2

Example responses with commentary

For teaching from September 2016 onwards
For A-level exams in May/June 2018 onwards

This guide includes some examples of student responses to a selection of questions from the summer 2018 CH03 unit.

The question parts are reproduced, along with the final mark scheme, student responses and a commentary from the Lead Examiner on each of the students' answers.

Both teachers and students are encouraged to look at the published mark schemes and examiners reports after each examination series.

'Command' words (eg calculate, state, describe, identify) appear at the start of a sentence so students are in no doubt what is required in answering each question. To help students the answer space is often structured to help them eg if they are asked to 'identify a reagent...' and 'state what you observe...', then there will be one answer line for them to write their reagent and then one line for each observation.

Students should be aware that the number of marks awarded indicates the number of points required in their response. If there are several marks available then the first marking point in the mark scheme is M1. Any ideas 'underlined' in the mark scheme are essential to gain credit (although on occasions students can express these ideas in 'their own words').

Students should be aware that any contradiction in their answer is treated using a '**list'** principle (refer to published mark scheme, page 3, section 3.1 Marking of lists). For example, if the student had stated that the effect is 'decrease' and had also written that the amount increases, then the examiner is likely to view this as one correct point and one incorrect, and is unable to award any marks.

Students should note that provided their answers are legible, they are awarded credit for correct chemistry. If a candidate wishes to change their first answer then this should be clearly crossed out. If they do not and write a different answer then the 'list principle' will be applied and zero marks will be scored. Do ensure that any working or alternative answers are clearly crossed out!

In calculations students should show what they are calculating in each step. Students should know how many significant figures they should use in their answer; three significant figures is standard practice. However, there are occasions when some other precision is required eg A_r and M_r must be stated to one decimal place, pH readings to two decimal places or when students are asked otherwise eg 'give' your answer to the nearest whole number.

Oxford AQA produced a webinar on 'Improving exam performance for AO1 and AO2' in science. During the presentation an emphasis was placed upon the large amount of content that students must learn. These are available for viewing on the Oxford International AQA Examinations website.

Chemistry is a practically based subject and as a minimum students should carry out the 10 required practicals (summarised on page 49 of the specification). Wherever possible students should be provided with practical opportunities to reinforce their learning eg reacting Mg with steam, relative solubility of Group 2 hydroxides and sulfates, etc.

When drawing covalent bonds in organic molecules care must be taken eg in alcohols students must show the bond from C to O of the –OH alcohol group (refer to mark scheme pages 7-9, section 3.12 Organic structures for further examples). Another frequent mistake made is that the bond between O-H is not shown when students are asked to draw a displayed formula.

QUESTION

01.1

0 1 One of the characteristics of transition metals is that they form complexes.

0 1 . 1 A solution contains aqueous copper(II) ions.
When an excess of chloride ions is added to this solution, a reaction occurs in which there is a change in the co-ordination number of the copper ion.

- Write an equation for the reaction.
- State the type of reaction occurring.
- State the name of the shape of the complex ion formed.
- Give a reason for the change in co-ordination number.

[4 marks]

Equation ____________________

Type of reaction ____________________

____

Name of the shape of the complex ion ____________________

Reason for change in co-ordination number ____________________

____

MARK SCHEME

Question	Marking guidance	Mark	Comments
01.1	$[Cu(H_2O)_6]^{2+} + 4\ Cl^- \rightleftharpoons [CuCl_4]^{2-} + 6\ H_2O$	1	Allow →
	ligand substitution/exchange	1	
	tetrahedral	1	
	chloride ions are bigger (than water molecules) OR chloride ions have a negative charge	1	

STUDENT A

0 1 One of the characteristics of transition metals is that they form complexes.

0 1 . 1 A solution contains aqueous copper(II) ions.
When an excess of chloride ions is added to this solution, a reaction occurs in which there is a change in the co-ordination number of the copper ion.

- Write an equation for the reaction.
- State the type of reaction occurring.
- State the name of the shape of the complex ion formed.
- Give a reason for the change in co-ordination number.

[4 marks]

Equation $[Cu(H_2O)_6]^{2+} + 4Cl^- \longrightarrow CuCl_4^{2-} + 6H_2O$

Type of reaction Ligand ~~exchange~~ Substitution

Name of the shape of the complex ion Tetrahedral

Reason for change in co-ordination number Cl^- ligand is bigger than H_2O ligand

EXAMINER COMMENTARY

This response was awarded 4 out of the 4 marks.
The majority of students were able to score over half marks on this item. The equation was often well written, although chlorine, rather than chloride ions was seen as a reactant and water was sometimes omitted as a product. The reaction type was normally correct as was the shape of the complex. Most students explained the change in coordination number using the relative sizes of the ligands.

STUDENT B

0 1 One of the characteristics of transition metals is that they form complexes.

0 1 . 1 A solution contains aqueous copper(II) ions.

When an excess of chloride ions is added to this solution, a reaction occurs in which there is a change in the co-ordination number of the copper ion.

- Write an equation for the reaction.
- State the type of reaction occurring.
- State the name of the shape of the complex ion formed.
- Give a reason for the change in co-ordination number.

[4 marks]

Equation $[Cu(H_2O)_6]^{2+} + 2Cl_2 \rightarrow [Cu(Cl)_4]^{2-} + 6H_2O$

Type of reaction Displacement reaction

Name of the shape of the complex ion tetrahedral

Reason for change in co-ordination number Chloride ions are bigger than water molecules ~~so only~~

EXAMINER COMMENTARY

This response was awarded 2 out of the 4 marks.
This student has used chlorine as a reagent, rather than chloride ions. The reaction type is ligand substitution/exchange.

QUESTION

01.2

0 1 . 2 Explain why transition metal complexes are coloured.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
01.2	spilt of d-orbitals **OR** d electrons move from ground to excited state visible light is absorbed remaining wavelengths are transmitted/reflected.	1 1 1	must have reference to d-electrons or electrons in the (3)d sub shell. do not allow emission of light

STUDENT A

0 1 . 2 Explain why transition metal complexes are coloured.

[3 marks]

Due to ~~incomplete d subshell,~~ electronic transition between ~~d sub~~ incomplete d subshell. Electrons are promoted to a higher electron state from ground state. ~~which is in visible in spe region and the rest~~ Energy is absorbed by visible spectrum region ~~away~~ and ~~that~~ remaining is reflected as a complementary colour.

EXAMINER COMMENTARY

This response was awarded 3 out of the 3 marks.

STUDENT B

0 1 . 2 Explain why transition metal complexes are coloured.

[3 marks]

Transition metal complexes are coloured because when a wavelength of light is shone through, electrons are raised to a higher energy level. Some wavelengths of light are absorbed by the solution and some wavelength shine through and are picked up by the human eye. The wavelengths of light that are not absorbed are the ones that we perceive and hence the colour.
Some wavelengths are reflected.

EXAMINER COMMENTARY

This response was awarded 1 out of the 3 marks.
While many students stated that the light energy not absorbed was transmitted, few stated the light being absorbed was from the visible part of the electromagnetic spectrum. Many answers suggested that electrons moved to a higher energy level rather than moved from ground to excited state within the d sub-shell.

QUESTION

02.2

0 2 . 2 Explain, in terms of structure and bonding, why sodium oxide has a high melting point.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.2			CE = 0/3 if mention of atoms / molecules / metallic
	It is an ionic lattice / giant ionic	1	Allow giant lattice if ions mentioned in answer
	Contains oppositely charged ions/ + and - ions	1	
	with strong forces of attraction between the ions	1	
			Allow a lot of energy to separate oppositely charged ions.
			M3 dependent on M2
			Max 1/3 if mention of electronegativity ie M1 only

STUDENT A

0 2 . 2 Explain, in terms of structure and bonding, why sodium oxide has a high melting point.
[3 marks]

Sodium oxide ~~is a gia~~ has a giant ionic structure with electrostatic forces between the $2Na^+$ ~~ia~~ and O^{2-}. This requires a lot of energy to break apart ~~the forces~~ and dissociate

EXAMINER COMMENTARY

This response was awarded 3 out of the 3 marks.
Some excellent answers were seen. It was pleasing to note that most students referred to the attraction between oppositely charged ions.

STUDENT B

0 2 . 2 Explain, in terms of structure and bonding, why sodium oxide has a high melting point.
[3 marks]

Na_2O has ionic bonding present ~~so it~~ and is a bigger molecule so it has strong Van der Waal force. Ionic bonding stronger than covalent bonding

EXAMINER COMMENTARY

This response was awarded 0 out of the 3 marks.
The right hand column of the mark scheme stated that a chemical error is awarded (CE = 0/3) if students mention atoms, molecules or metallic (bonding).

QUESTION

03.4

Table 2 shows the enthalpy changes involved in the formation of potassium oxide.

Table 2

Enthalpy change	**ΔH/kJ mol^{-1}**
Enthalpy of atomisation of potassium	+90
Enthalpy of formation of potassium oxide	–362
Enthalpy of atomisation of oxygen	+248
First electron affinity of oxygen	–142
First ionisation energy of potassium	+418
Second electron affinity of oxygen	+844

0 3 . 4 Use the data in **Table 2** to calculate the enthalpy of lattice dissociation of potassium oxide.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
03.4	(M1 expression in words or symbols) $\Delta_f H = \Delta_a H$(oxygen) + 2 x $\Delta_a H$(K) + 2 x $\Delta_{IE1} H + \Delta_{1EA} H + \Delta_{2EA} H$ – X OR X = $\Delta_a H$(oxygen) + 2 x $\Delta_a H$(K) + 2 x $\Delta_{IE1} H + \Delta_{1EA} H + \Delta_{2EA} H - \Delta_f H$	1	2328 scores 3 marks Allow answers given to 3 significant figures
	(M2 expression with correct numbers) -362 = 248 + (2 x 90) + (2 x 418) + -142 + 844 + -X OR X = 248 + (2 x 90) + (2 x 418) + -142 + 844 + 362	1	
	enthalpy of lattice dissociation = (+)2328 kJ mol^{-1}	1	

STUDENT A

0 3 . 4 Use the data in **Table 2** to calculate the enthalpy of lattice dissociation of potassium oxide.

[3 marks]

$248 + (2 \times 90) + (2 \times 418) - 142 + 844 + x = -362$

$1966 + x = -362$

$x = -2328$

enthalpy of lattice dissociation = +2328 kJ mol^{-1}

EXAMINER COMMENTARY

This response was awarded 3 out of the 3 marks.
While there was a pleasing proportion of fully correct answers, very common errors were to not multiply the enthalpy of atomisation of potassium or the first ionisation energy of potassium by two.

STUDENT B

0 3 . 4 Use the data in **Table 2** to calculate the enthalpy of lattice dissociation of potassium oxide.

[3 marks]

$-362 = 248 + 2 \times 90 + 2 \times 418 - 412 + 844 + \Delta H_{LD}$

$\Delta H_{LD} = 2058$ kJ mol^{-1}

enthalpy of lattice dissociation = 2058 kJ mol^{-1}

EXAMINER COMMENTARY

This response was awarded 2 out of the 3 marks.
In Table 2 the first electron affinity of oxygen is –142; this student has made a transcription error and used –412.
The examiner has followed the working through and awarded 2 marks; this is treated as an arithmetical error, AE (ie one mark is deducted).

QUESTION

04.3

0 4 . 3 At a given temperature a sealed flask contains an equilibrium mixture of 0.10 mol of methane, 0.18 mol of ethyne and 0.52 mol of hydrogen. The pressure in the flask at equilibrium is 500 kPa

Calculate the value of K_p under these conditions.
Give your answer to three significant figures.

State the units of K_p

[4 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
04.3	mole fractions of all three gases CH_4 = 0.125; C_2H_2 = 0.225; H_2 = 0.65(0)	1	
	partial pressures of all three gases CH_4 = 62.5 kPa; C_2H_2 = 112.5 kPa; H_2 = 325 kPa	1	
	(answer to 3 significant figures) 9.89×10^5	1	
	(units =) kPa^2	1	

STUDENT A

0 4 . 3 At a given temperature a sealed flask contains an equilibrium mixture of 0.10 mol of methane, 0.18 mol of ethyne and 0.52 mol of hydrogen. The pressure in the flask at equilibrium is 500 kPa

Calculate the value of K_p under these conditions.
Give your answer to three significant figures.

State the units of K_p

[4 marks]

$0.18 + 0.52 + 0.1 = 0.8$

pp of $CH_4 = \frac{0.1}{0.8} \times 500 = 62.5$

pp of $C_2H_2 = \frac{0.18}{0.8} \times 500 = 112.5$

pp of $H_2 = \frac{0.52}{0.8} \times 500 = 325$

$K_p = \frac{325^3 \times 112.5}{62.5^2} = 988650$

$= 9.89 \times 10^5$

$\frac{\cancel{kpa} \times \cancel{kpa} \times kpa \times kpa}{\cancel{kpa} \times \cancel{kpa}} = kpa^2$

K_p ~~988~~ 9.89×10^5 Units ~~kpa~~ kpa^2

EXAMINER COMMENTARY

This response was awarded 4 out of the 4 marks.
A number of fully correct and very well set out answers were seen. A common error was **not** to give the final answer to three significant figures as instructed in the question. Some students opted to show minimal working, this made it impossible to follow what they had done and so award any consequential marks as result of a transcription error.

STUDENT B

0 4 . 3 At a given temperature a sealed flask contains an equilibrium mixture of 0.10 mol of methane, 0.18 mol of ethyne and 0.52 mol of hydrogen. The pressure in the flask at equilibrium is 500 kPa

Calculate the value of K_p under these conditions.
Give your answer to three significant figures.

State the units of K_p

[4 marks]

$$K_p = \frac{P_{C_2H_2} \times P^3_{H_2}}{P^2_{CH_4}}$$

$$= \frac{0.18 \times (0.52)^3}{(0.16)^2}$$

$$= \frac{0.18 \times 0.141}{0.01}$$

$$= 2.538$$

K_p 2.54 Units kPa^2

EXAMINER COMMENTS

This response was awarded 1 out of the 4 marks.
This student has failed to find the total number of moles and then the mole fraction of each species (CH_4 = 0.125; C_2H_2 = 0.225; H_2 = 0.65). These are then multiplied by the total pressure to give each partial pressure (CH_4 = 62.5 kPa; C_2H_2 = 112.5 kPa; H_2 = 325 kPa). The units are correct (M4).

QUESTION

06.4

Methane reacts with steam according to the equation

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3H_2(g) \qquad \Delta H = +206 \text{ kJ mol}^{-1}$$

The entropy change, ΔS, for the reaction is +216 J K^{-1} mol^{-1}

Some entropy values are shown in **Table 3**.

Table 3

Substance	**CH_4(g)**	**H_2O(g)**	**CO(g)**
Entropy/J K^{-1} mol^{-1}	186	189	198

0 6 . 4 Calculate the Gibbs free-energy change, ΔG, for the reaction of methane with steam at 150 °C

Give units for your answer.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.4	$\Delta G = \Delta H - T\Delta S$	1	
	$\Delta G = 206 - 423(216/1000)$	1	If no conversion of T or ΔS then can score M1 only
	$\Delta G = 115$ kJ mol^{-1}	1	Allow unrounded value of 114.632 must have correct units allow answers in J mol^{-1}

STUDENT A

0 6 . 4 Calculate the Gibbs free-energy change, ΔG, for the reaction of methane with steam at 150 °C

Give units for your answer.

[3 marks]

$\Delta G = \Delta H - T\Delta S$

$150 + 273 = 423\text{ K}$

$\Delta G = 206 - 423 \times \frac{216}{1000} = 114.632$

ΔG 114.6 units kJ mol^{-1}

EXAMINER COMMENTARY

This response was awarded 3 out of the 3 marks.

STUDENT B

0 6 . 4 Calculate the Gibbs free-energy change, ΔG, for the reaction of methane with steam at 150 °C

Give units for your answer.

[3 marks]

$\Delta G = \Delta H - T\Delta S$

$150 + 273 = 423$

$+206 - (423 \times 216) = -91162$

ΔG −91162 units

EXAMINER COMMENTARY

This response was awarded 1 out of the 3 marks.
While this calculation was completed successfully by the majority of students, a common error was to not convert the entropy change from (move below formula up here) J K^{-1} mol^{-1} to kJ K^{-1} mol^{-1}
Mark scheme (right hand column) states that if no conversion of T or ΔS (as in this response) then can score M1 only ($\Delta G = \Delta H - T\Delta S$).

QUESTION

07.1

0 7 Hydrated ammonium iron(III) sulfate has the formula $NH_4Fe(SO_4)_2.xH_2O$

0 7 . 1 Describe **two** simple test-tube reactions that could be used to identify the three ions contained in a solution of ammonium iron(III) sulfate.

Give the expected observations.

[5 marks]

Test tube reaction 1 ______________________________

Observation(s) ______________________________

____

____

Test tube reaction 2 ______________________________

Observation(s) ______________________________

____

MARK SCHEME

Question	Marking guidance	Mark	Comments
07.1	(test 1) add (hydrochloric acid and) barium chloride (solution)	1	
	(observation) white precipitate	1	
	(test 2) add aqueous sodium hydroxide	1	allow use of aqueous ammonia or a named soluble carbonate
	(observations) brown precipitate	1	
	result gas which turns damp red litmus blue formed	1	Allow reference to pungent gas do not award this mark if aqueous ammonia or named soluble carbonate is used.

STUDENT A

0 7 . 1 Describe **two** simple test-tube reactions that could be used to identify the three ions contained in a solution of ammonium iron(III) sulfate.

Give the expected observations.

[5 marks]

Test tube reaction 1 $BaCl_2$

Observation(s) A white precipitate of $BaSO_4$ is formed. This is to identify the sulfate ion.

Test tube reaction 2 Heat with NaOH

Observation(s) A brown precipitate of $[Fe(H_2O)_3(OH)_3]$ will form and the gas evolved will turn red litmus paper blue.

EXAMINER COMMENTS

This response was awarded 5 out of the 5 marks.
While most students were able to give a test and positive result for sulfate ions and iron(III) ions, correct identification tests for the ammonium ion were a rarity. It was more common for answers to state that ammonium ions were alkaline rather give a correct test; there was clearly confusion between ammonium and ammonia.

STUDENT B

0 7 . 1 Describe **two** simple test-tube reactions that could be used to identify the three ions contained in a solution of ammonium iron(III) sulfate.

Give the expected observations.

[5 marks]

Test tube reaction 1 $BaCl_2$

Observation(s) white precipitate formed

Test tube reaction 2 CO_3^{2-}

Observation(s) If 2+ Fe ion green solution, if 3+ ion Fe ion brown precipitate

EXAMINER COMMENTARY

This response was awarded 3 out of the 5 marks.
This student has stated an ion, rather than a reagent for test tube reaction 2. In this case no credit is gained for the reagent but the examiner has ‘marked on’ and awarded M4 for brown precipitate.

QUESTION

07.4

A sample of hydrated ammonium iron(III) sulfate was analysed to determine the value of *x* in the formula.

Step 1
4.82 g of hydrated ammonium iron(III) sulfate were dissolved in 100 cm^3 of water.
An excess of zinc was added to the solution.
The iron(III) ions were reduced according to the equation

$$2Fe^{3+}(aq) + Zn(s) \rightarrow 2Fe^{2+}(aq) + Zn^{2+}(aq)$$

Step 2
The excess zinc was removed from the solution and the volume made up to 250 cm^3 with distilled water.

Step 3
25.0 cm^3 of the solution were acidified and titrated with 0.0151 mol dm^{-3} potassium manganate(VII) solution.
13.25 cm^3 of the potassium manganate(VII) solution were needed to oxidise the iron(II) ions.
The equation for the reaction that occurred is

$$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$$

0 7 . 4 Calculate the relative formula mass of $NH_4Fe(SO_4)_2.xH_2O$ and the value of *x*.

[5 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
07.4	moles MnO_4^- (= 0.0151 x 13.25/1000) = 2.00(075) x 10^{-4}	1	
	moles Fe^{2+} (= 5 x 2.00075 x 10^{-4}) = 1.00(0375) x 10^{-3}	1	
	moles Fe^{2+} or Fe^{3+} in full 250 cm^3 = 1.00(0375)x 10^{-2}	1	
	M_r = 4.82 / 1.00(1) x 10^{-2} = 481(.819) OR 482	1	
	x = (482 – 266)/18 = 12	1	

STUDENT A

0 7 . 4 Calculate the relative formula mass of $NH_4Fe(SO_4)_2.xH_2O$ and the value of x.

[5 marks]

Moles of $MnO_4^- = 0.0151 \times \frac{13.25}{1000} = 2 \times 10^{-4}$ moles

moles of $Fe^{2+} = 2 \times 10^{-4} \times 5 = 1 \times 10^{-3}$ moles

Total moles of $Fe^{2+} = 1 \times 10^{-3} \times 10 = 1 \times 10^{-2}$

$\therefore$ moles of $Fe^{3+} = 1 \times 10^{-2}$

~~mass~~ $Mr = \frac{4.82}{1 \times 10^{-2}} = 481.8$

$266 + 18x = 481.8$

$x = 11.98$

$= 12$

relative formula mass 481.85

value of x 12

EXAMINER COMMENTARY

This response was awarded 5 out of the 5 marks.
While some answers were well set out and fully correct answers were seen, the majority of students found this calculation too demanding. The most commonly awarded marks were for the moles of manganite (VII) and the moles of iron(II) in the aliquot. However, it was almost impossible to follow the working produced by some students – the inclusion of a few words (such as moles MnO_4^- = …) helps the examiner to follow the working enormously and enables errors from transcription errors to be carried forward.

STUDENT B

0 7 . 4 Calculate the relative formula mass of $NH_4Fe(SO_4)_2.xH_2O$ and the value of x.

[5 marks]

moles $(MnO_4^-) = 0.0151 \times 0.01325$
$= 2.0 \times 10^{-4}$

moles [Fe] $= 2.0 \times 10^{-4} \times 5$
$= \dfrac{1.0 \times 10^{-3}}{0.10}$

mass = m ×

$= 0.0100$

mass [Fe] $= 0.0100 \times 55.8$
$= 0.5582$

EXAMINER COMMENTARY

This response was awarded 2 out of the 5 marks.
This student has shown clear working out and has credit for moles MnO_4^- (M1) and moles Fe^{2+} (M2). However, they have not made the 'link' between the volumetric flask and aliquot used in the titration.

QUESTION

08.5

The effect of temperature on the value of the rate constant for a different reaction was investigated. The data obtained are shown in **Table 5**.

Table 5

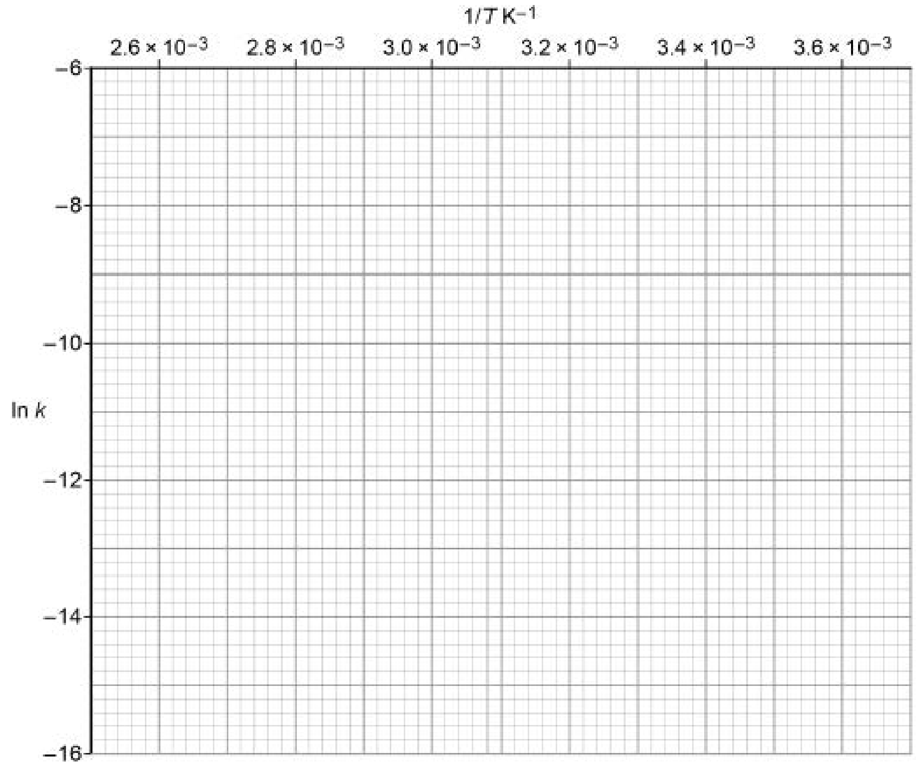
Experiment	Temperature, T / K	Rate constant, k / $mol^{-2}\ dm^{6}\ s^{-1}$	$1 / T$ / K^{-1}	ln k
1	293	1.00×10^{-6}	3.41×10^{-3}	−13.8
2	313	4.40×10^{-6}	3.19×10^{-3}	−12.3
3	335	1.92×10^{-5}	2.99×10^{-3}	−10.9
4	350	6.20×10^{-5}	2.86×10^{-3}	−9.69
5	370	2.20×10^{-4}	2.70×10^{-3}	−8.42

0 8 . 5 Plot a graph of ln k against $1/T$ using the axes provided.

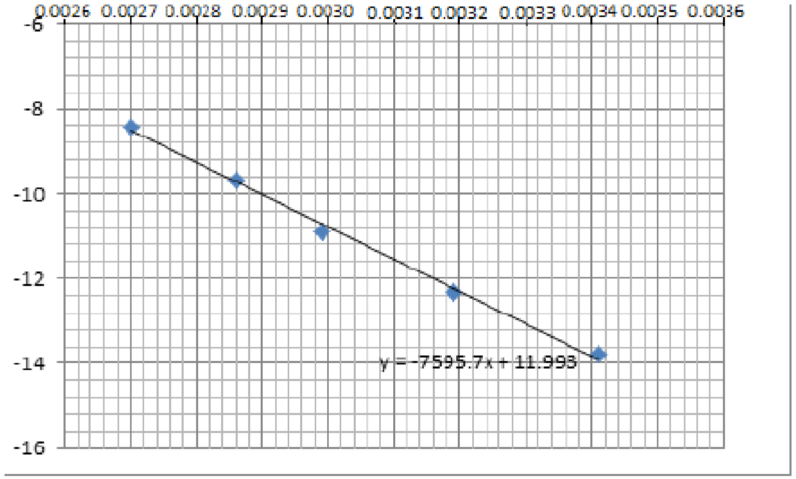
Draw a line of best fit and determine its gradient.

[3 marks]

Figure 5



MARK SCHEME

Question	Marking guidance	Mark	Comments
08.5	all five points plotted correctly	1	
	straight line of best fit drawn	1	
	gradient of line drawn calculated correctly – this must have a negative sign.	1	correct gradient is –7596.
			

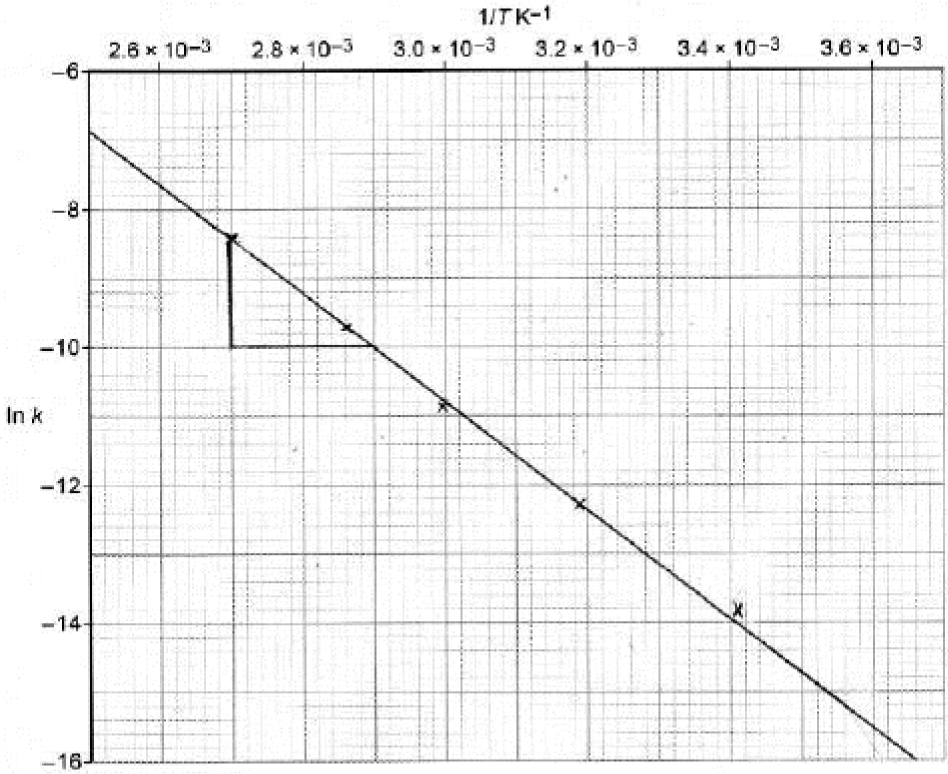
STUDENT A

0 8 . 5 Plot a graph of ln k against $1/T$ using the axes provided.

Draw a line of best fit and determine its gradient.

[3 marks]

Figure 5



$$\frac{-8.42 - -10}{2.7\times10^{-3} - 2.9\times10^{-3}} = -7900$$

Gradient = −7900 K

EXAMINER COMMENTARY

This response was awarded 3 out of the 3 marks.
There were very few errors in plotting and most students made a good attempt at the best fit straight line. However, the mark for calculation of the gradient was awarded far less often than the other two marks. Apart from basic mathematical errors, some students worked out the gradient over such a small length of their lines that the percentage error in the Δy and Δx values was very large, resulting in a gradient often well outside the accepted range. Students should try and calculate over almost the full length of the line, preferably making use of major gridlines where possible; this will minimise the percentage errors in the Δy and Δx values.

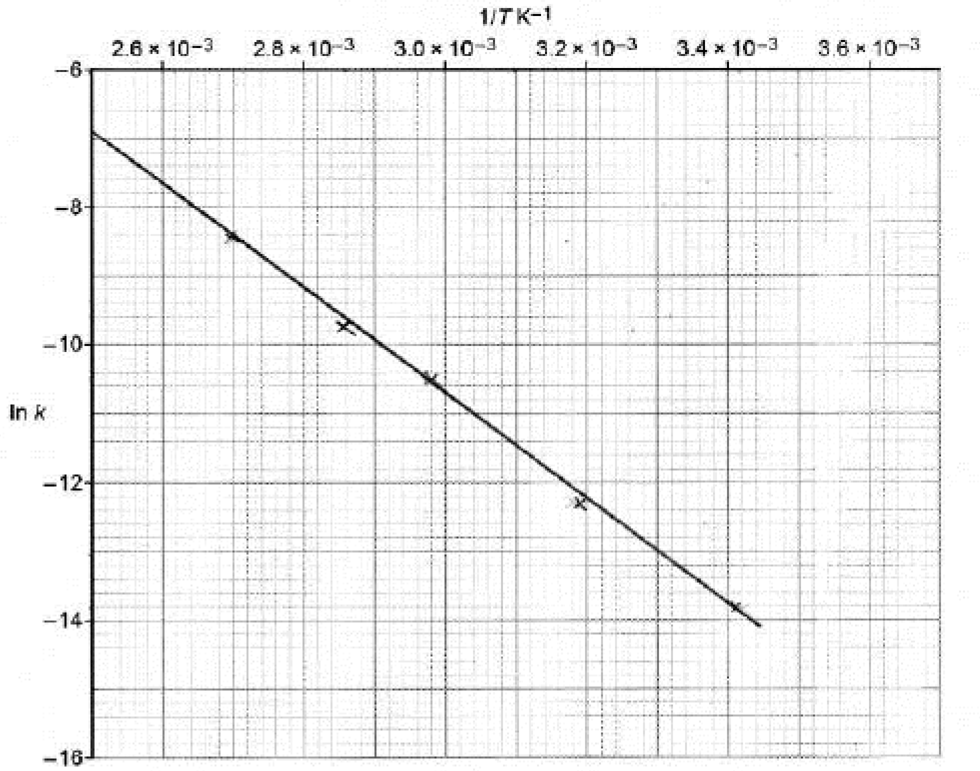
STUDENT B

0 8 . 5 Plot a graph of ln *k* against 1/*T* using the axes provided.

Draw a line of best fit and determine its gradient.

[3 marks]

Figure 5



$$\frac{y_2-y_1}{x_2-x_1} = \frac{-13.8+8.42}{3.41\times10^{-3}-2.7\times10^{-3}} = -6450.7$$

Gradient = −6450.7 K

EXAMINER COMMENTARY

This response was awarded 1 out of the 3 marks.
There is an error plotting one of the points (M1). A mark has been awarded for a straight line (M2). The gradient is incorrect (M3).

FURTHER GUIDANCE AND CONTACTS

You can contact the subject team directly at science@oxfordaqaexams.org.uk

Please note: We aim to respond to all email enquiries within two working days.

Our UK office hours are Monday to Friday, 8am – 5pm local time.

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