SPECIMEN MATERIAL v1.1

A-LEVEL
Chemistry

Paper 1: Inorganic and Physical Chemistry
Mark scheme

7405/1
Specimen Paper (set 2)

Version 1.1

Keep secure

Please be aware that centres may want to use these specimen papers as mock exams for their students. Help us to maintain the security of these papers by ensuring they are not distributed on social media or other platforms.

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

Important - please note

This mark scheme has not been through the full standardisation process. As such, many of the phases described above have not been completed. The Instructions for examiners are also included as a guide to how the mark scheme will function as an operational document. The layout has been kept consistent so that future operational mark schemes do not appear different to the specimen materials.

AS and A-level Chemistry

Mark scheme instructions for examiners

Introduction to marking

Before beginning the standardisation process, you must:

- access the online tutorial
- access all relevant documents on your Examiner Extranet page
- mark a minimum of 10 training clips of each item.

When standardising online, you must review the marking of the standardisation clips and all comments and annotations made by the Lead Examiner, which exemplify the marking standard. You must discuss the results of your marking of the standardisation clips with your Team Leader before you will be cleared to mark live clips.

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information in the 'Comments' column is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

You should mark according to the contents of the mark scheme. If you are in any doubt about applying the mark scheme to a particular response, consult your Team Leader.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

The use of M1, M2, M3 etc refers to the marking points in the order in which they appear in the mark scheme. So, M1 refers to the first marking point, M2 the second marking point etc.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **OR**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (often prefaced by 'Ignore' in the mark scheme) are not penalised.

3.2 Marking procedure for calculations

Full marks should be awarded for a correct numerical answer, without any working shown, unless the question states 'Show your working' or 'justify your answer'.

If an answer to a calculation is incorrect and working is shown, process mark(s) can usually be gained by correct substitution / working. This is usually shown in the 'Comments' column or by each stage of a longer calculation.

3.3 Equations

In questions requiring students to write equations, state symbols are generally ignored unless otherwise stated in the 'Comments' column.

Examiners should also credit correct equations using multiples and fractions unless otherwise stated in the 'Comments' column.

Equations are not correct unless they are balanced.

3.4 Organic structures

Where students are asked to draw organic structures, these may be given as displayed, structural or skeletal formulas unless a specific type of structure is required in the question and stated in the mark scheme.

3.5 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.6 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ECF or consequential in the marking scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the marking scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.7 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term or if the question requires correct IUPAC nomenclature.

3.8 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.9 Ignore / Insufficient / Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

3.10 Marking crossed out work

Crossed out work that **has not been** replaced should be marked as if it were not crossed out, if possible. Where crossed out work **has been** replaced, mark the replacement work and not the crossed out work.

3.11 Extended responses

For questions marked using a 'Levels of Response' mark scheme:

Level of response mark schemes are broken down into three levels, each of which has a descriptor. Each descriptor contains two statements. The first statement is the Chemistry content statement and the second statement is the communication statement.

Determining a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the Chemistry content descriptor for that level. The descriptor for the level indicates the qualities that might be seen in the student's answer for that level. If it meets the lowest level, then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Once the level has been decided, the mark within the level is determined by the communication statement:

- If the answer completely matches the communication descriptor, award the higher mark within the level.
- If the answer does not completely match the communication descriptor, award the lower mark within the level.

The exemplar materials used during standardisation will help you to determine the appropriate level. There will be an exemplar in the standardising materials which will correspond with each level of the mark scheme and for each mark within each level. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the exemplar to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the exemplar.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other chemically valid points. Students may not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme. The mark scheme will state how much chemical content is required for the highest level.

An answer which contains nothing of relevance to the question must be awarded no marks.

For other extended response answers:

Where a mark scheme includes linkage words (such as 'therefore', 'so', 'because' etc), these are optional. However, a student's marks for the question may be limited if they do not demonstrate the ability to construct and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. In particular answers in the form of bullet pointed lists may not be awarded full marks if there is no indication of logical flow between each point or if points are in an illogical order.

The mark schemes for some questions state that the maximum mark available for an extended response answer is limited if the answer is not coherent, relevant, substantiated and logically structured. During the standardisation process, the Lead Examiner will provide marked exemplar material to demonstrate answers which have not met these criteria. You should use these exemplars as a comparison when marking student answers.

Question	Marking Guidance	Mark	Comments
01.1	$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$ 8–12	1 1	
01.2	Decrease	1	
01.3	$BaCl_2$ $Ba^{2+} + SO_4^{2-} \longrightarrow BaSO_4$	1 1	Allow $Ba(NO_3)_2$ or other soluble barium salt Allow equation if state symbols missing but penalise if state symbols are incorrect
01.4	Strong attraction Between positive and negative ions	1 1	

Question	Marking Guidance	Mark	Comments
02.1	**A** Silver bromide /AgBr **B** Iron(II) carbonate / $FeCO_3$ **C** Iron(II) sulphate/ $FeSO_4$ **D** Carbon dioxide /CO_2 **Y** Iron(II) bromide/ $FeBr_2$	1 1 1 1 1	
02.2	$Ag^+ + Br^- \longrightarrow AgBr$	1	Allow equation if state symbols missing but penalise if state symbols are incorrect
02.3	$2H^+ + CO_3^{2-} \longrightarrow H_2O + CO_2$	1	Allow $FeCO_3 + 2H^+ \longrightarrow Fe^{2+} + CO_2 + H_2O$

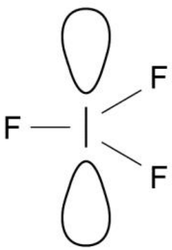
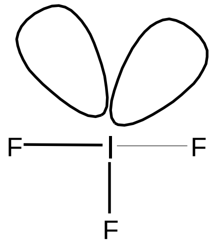
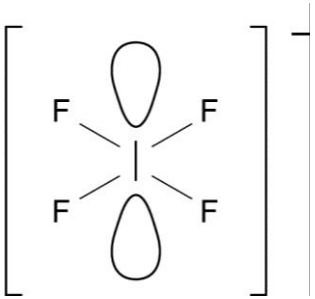
<table>
<tr><th>Question</th><th colspan="2">Marking Guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>03.1</td><td colspan="2">[Kr] $5s^2 4d^{10} 5p^5$</td><td>1</td><td></td></tr>
<tr><td rowspan="3">03.2</td><td colspan="2">This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.</td><td rowspan="3">6</td><td rowspan="3">Indicative chemistry content
Stage 1
I_2 is molecular.
HI is molecular.
Stage 2
IMF hold the molecules together.
There are weak IMF forces hence the melting point is low in both substances.
I_2 bigger molecule than HI so I_2 has more electrons.
Stage 3
Therefore stronger van der Waals between molecules in I_2 that need more energy to break causing the melting point to be higher.
HI also shows permanent dipole-dipole attraction</td></tr>
<tr><td>Level 3
5–6 marks</td><td>All stages are covered and the explanation of each stage is correct and complete.

Answer communicates the whole explanation coherently and shows a logical progression from stage 1 to stage 2 and then stage 3.</td></tr>
<tr><td>Level 2
3–4 marks</td><td>All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete.

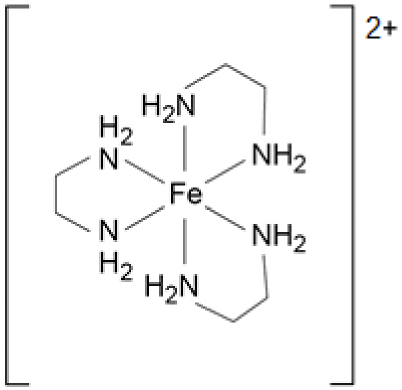
Answer is mainly coherent and shows a progression through the stages. Some steps in each stage may be out of order and incomplete.</td></tr>
</table>

	Level 1 1–2 marks	Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes some isolated statements, but these are not presented in a logical order or show confused reasoning.		between molecules but these forces are less than the vdW forces in iodine.
	Level 0 0 marks	Insufficient correct chemistry to warrant a mark.		

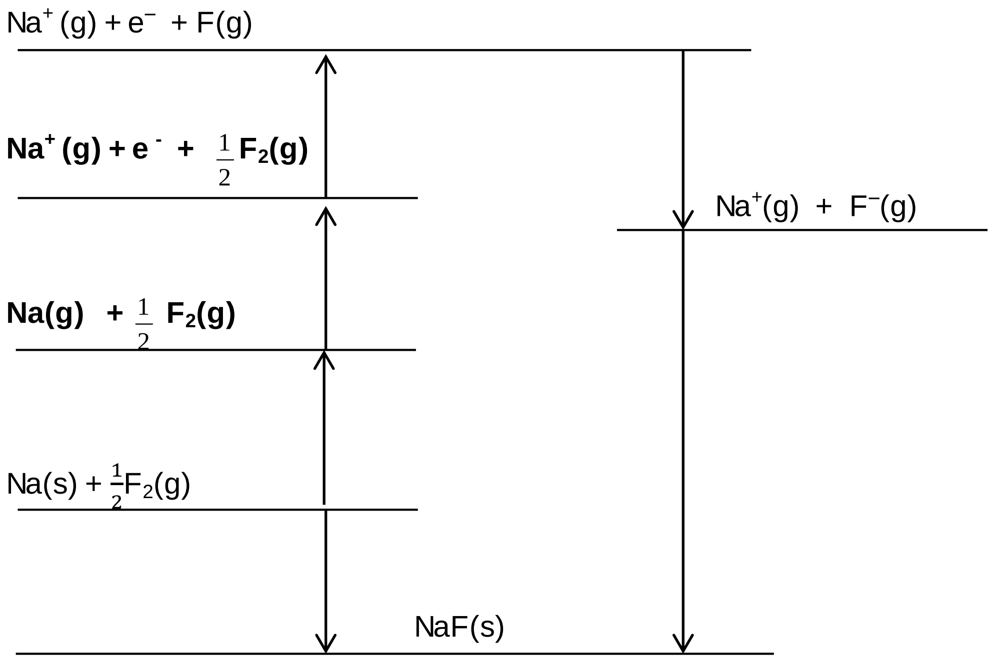
03.3	No delocalised electrons or ions	1	
03.4	$\frac{1}{2}H_2 + \frac{1}{2}I_2 \longrightarrow HI$	1	Allow multiples
03.5	NH_4I_3	1	

03.6	 or 	1	Allow any shape with 3 bond pairs and 2 lone pairs
		1	Allow any shape with 4 bond pairs and 2 lone pairs (eg lone pairs in equatorial positions)

03.7	+5	1	
	+7	1	

Question	Marking Guidance	Mark	Comments
04.1	$[Fe(H_2O)_6]^{3+} + 4Cl^- \longrightarrow FeCl_4^- + 6H_2O$	1	
04.2	Cl^- is a bigger ligand So only $4Cl^-$ can fit around the metal	1 1	 Allow fewer Cl^- can fit around the metal
04.3		1 1	M1 for structure of complex M2 for correct charge
04.4	Change in entropy is positive	1	
04.5	$5Fe^{2+} + MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$	1	

04.6	Amount of manganate (VII) = 6.50×10^{-4} mol Amount of iron(II) = 3.25×10^{-3} mol Mass of iron = 0.181g = 181 mg Percentage Fe = 181/1980 × 100 = 9.14(%) 3 sf	1 1 1 1	 ie M1 × 5 Allow M2 × 55.8
04.7	Colourless to pale pink	1	

Question	Marking Guidance	Mark	Comments
05.1		2	or M2 Na(g) + F(g) M1 Na(s) + F(g) or M2 = Na(g) + F(g) M1 = Na(g) + $0.5F_2(g)$
05.2	LE = –109 – 494 – 158/2 + 348 – 569 = –903 (kJ mol^{-1})	1 1	
05.3	NaCl enthalpy of lattice formation will be less negative OR less exothermic Cl^- ion bigger (than F^-) So attraction of halide ion to Na^+ is weaker	1 1 1	 Allow so ionic bonding is stronger

05.4	Amount of NaF = 1/42 = 2.38×10^{-2} mol Amount of F_2 = $(2.38 \times 10^{-2})/2 = 1.19 \times 10^{-2}$ mol $V = nRT/p = (1.19 \times 10^{-2} \times 8.31 \times 298)/100000$ $V = 2.95 \times 10^{-4}$ m^3 = 295 cm^3	1 1 1 1	

Question	Marking Guidance	Mark	Comments
06.1	Cl_2	1	
06.2	$Pt\|H_2\|H^+\|\|Sn^{2+}\|Sn$	2	Award 1 mark for species and 1 mark for correct order including Pt Ignore state symbols
06.3	0.94 V $Sn \longrightarrow Sn^{2+} + 2e^-$	1 1	
06.4	$Ag^+ + Fe^{2+} \longrightarrow Ag + Fe^{3+}$	1	

Question	Marking Guidance	Mark	Comments
07.1	Decrease Increasing pressure moves equilibrium to the side of least moles ie backward reaction To oppose the increase in pressure or to decrease the pressure	1 1 1	
07.2	A catalyst speeds up the rate of the forward and backward reaction By the same amount	1 1	
07.3	ΔH = –111 – (–75 – 242) 206 (kJ mol^{-1})	1 1	
07.4	$\Delta S = 3 \times 131 + 198 - (186 + 189) = 216\ J\ K^{-1}\ mol^{-1}$ $\Delta G = \Delta H - T\Delta S$ $0 = 206 - T\frac{216}{1000}$ T = 953.7 or 954 K T = 681 (°C)	1 1 1 1 1	If the value given in the question is used then the answer is 283 (°C)

Question	Marking Guidance	Mark	Comments
08.1	Proton donor	1	
08.2	Completely ionises to give H^+ ions in water	1	
08.3	0.058 mol dm^{-3} 1.24	1 1	
08.4	Amount of NaOH = 5.25×10^{-3} Since 1:1 reaction amount of OH^- ions in excess = $5.25 \times 10^{-3} - 1.45 \times 10^{-3}$ mol = 3.80×10^{-3} moles OH^- $[OH^-] = 3.80 \times 10^{-3} \times 1000/60 = 0.0633$ $K_w = [H^+][OH^-]$ so $H^+ = \frac{10^{-14}}{0.0633} = 1.58 \times 10^{-13}$ pH = 12.80	1 1 1 1 1	

08.5	Amount of OH^- added 1.5 / 40 = 0.0375 mol Use of 1:1 ratio to calculate amount of A^- formed = 0.0375 mol Amount of weak acid initially = 1 × 0.15 = 0.150 mol so amount of weak acid after addition of NaOH = 0.150 – 0.0375 = 0.1125 $[H^+] = K_a [HA]/[A^-]$ or $[H^+] = 1.79 \times 10^{-5} \times 0.1125/0.0375$ $= 5.37 \times 10^{-5}$ pH = 4.27	1 1 1 1 1 1	If M3 incorrect can only score max of 3 marks

Question	Marking Guidance	Mark	Comments
09.1	Formula of any strong acid (eg HCl) Formula of a weak alkali (eg NH_3)	1 1	
09.2	Place a fixed volume of alkali in a flask or beaker Add acid in small portions from a burette Stir and use a pH meter to record the pH after each addition of acid	1 1 1	
09.3	Repeat the experiment with each indicator Select the indicator that changes colour rapidly when the pH changes from about 7 to 4	1 1	

Question	Marking Guidance	Mark	Comments
10.1	$\frac{[Y][H_2O]^2}{[X][CH_3OH]^2}$	1	
10.2	0.06 0.32 0.52	1 1 1	
10.3	$\frac{0.26 \times 0.52^2}{0.06 \times 0.32^2}$ = (11.44) = 11 (2 sf) No units	1 1 1	
10.4	Increase	1	

Question	Marking Guidance	Mark	Comments
11.1	$\frac{(82 \times 5) + (83 \times 3) + (84 \times 26) + (86 \times 7)}{41} = \frac{3445}{41}$	1	
	84.0	1	
	Kr	1	
11.2	$82/(1.243 \times 10^{-5})^2 = 86 / t^2$		
	So $t^2 = 86 / 82 \times (1.243 \times 10^{-5})^2$	1	
	$t^2 = 1.6204 \times 10^{-10}$	1	
	$t = 1.273 \times 10^{-5}$ (s)	1	