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CHEMISTRY

9202/2

Paper 2

Mark scheme

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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 Examiner.

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 oxfordaqaexams.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different 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. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

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 and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example 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 example.

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 valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

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

Information to Examiners

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
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information 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.

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.

2. Emboldening and underlining

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.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

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 (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 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.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 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.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

'Ignore' 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.

3.10 Do <u>not</u> accept

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

Question 1

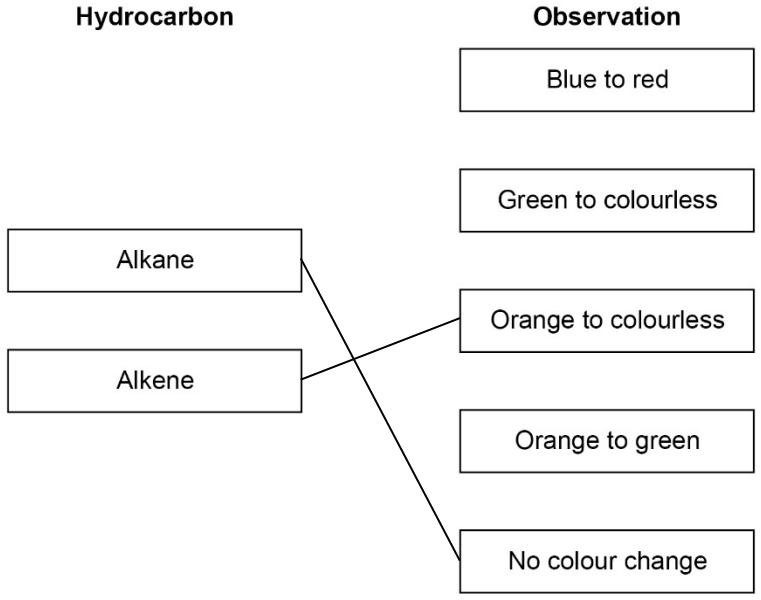
Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.1	C_3H_8		1	AO2 3.10.1.2b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.2	propane		1	AO1 3.10.1.2b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.3	C_nH_{2n}		1	AO1 3.10.1.3b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.4	measuring cylinder		1	AO4 3.10.1.3d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.5	(no flames) (hydrocarbons are) flammable (fume cupboard) (bromine is) toxic / harmful / poisonous		1 1	AO4 3.10.1.3d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
01.6	 an extra line from the hydrocarbon box negates the mark		1 1	AO1 3.10.1.3d

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.1	protons = 22 neutrons = 26		1 1	AO2 3.1.2f,h

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.2	isotopes		1	AO1 3.1.2g

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.3	alloy		1	AO1 3.3.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.4	(density =) $\frac{27}{6.0}$ = 4.5 (g/cm^3)		1 1	AO2 3.7.2b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
02.5	(mass of Ti =) $5.0 \times 10^5 \times \frac{1.2}{100}$ = 6000 (g)		1 1	AO2 3.3.1.1c

Total Question 2		8

Question 3

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.1	any **three** from: • immerse thermometer bulb in solution • use same mass of metal • stir solution • use a lid / extra insulation • repeat experiment **and** calculate a mean		3	AO4 3.3.1.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.2	type of metal		1	AO4 3.3.1.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.3	from 0.05 (g) to 0.40 (g)	allow 0.40 (g) to 0.05 (g)	1	AO2 3.3.1.1b

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.4	temperature increase increases (as mass of magnesium increases)		1	AO3 3.3.1.1b
	increase (in temperature increase) is lower when more magnesium is added	allow (temperature increase) increases at a decreasing rate	1	
	(temperature increase) stops increasing above 0.35 g	allow (temperature increase) stops increasing above 17.5 °C	1	
	alternative approach: highest temperature increases (as mass of magnesium increases) (1)	do **not** accept temperature increases (as mass of magnesium increases)		
	increase is lower when more magnesium is added (1)	allow (highest temperature) increases at a decreasing rate		
	(temperature) stops increasing above 0.35 g (1)	allow (temperature) stops increasing above 17.5 °C		

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
03.5	reaction has finished		1	AO3 3.3.1.1b
	(because) all copper sulfate has reacted (with masses above 0.35 g)	allow (because) magnesium is in excess	1	

Total Question 3		**10**

Question 4

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.1	HNO_3		1	AO1 3.5.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.2	H^+		1	AO1 3.5.1f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.3	zinc chloride	allow $ZnCl_2$	1	AO2 3.5.1c

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
04.4	$2\,H_3PO_4 + 3\,MgCO_3 \rightarrow Mg_3(PO_4)_2 + 3\,H_2O + 3\,CO_2$	allow **1** mark for $H_2O + CO_2$	2	AO2 3.3.1.2b 3.6.1a

Question	Answers	Mark	AO/ Spec. Ref.
04.5	**Level 3:** The plan would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO4 3.5.2a 3.5.2b
	Level 2: The plan would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use copper oxide and sulfuric acid • add a measured volume of sulfuric acid to a beaker • warm sulfuric acid • add copper oxide • stir • continue adding until copper oxide is in excess • filter • using a filter paper and funnel • to remove excess copper oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		

Total Question 4		**11**

Question 5

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.1	endothermic		1	AO1 3.9.1d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.2	**W**		1	AO1 3.9.2d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.3	**Y**		1	AO1 3.9.2d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.4	the higher the pressure the higher the yield		1	AO2
	(because) there are fewer moles / molecules (of gas) on the right (of the equation)	allow (because) four moles / molecules produce two moles / molecules (of gas) allow (because as pressure increases) equilibrium position moves to the right	1	AO3 3.8.2d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.5	(temperature) 450 (°C)		1	AO3 3.8.1c
	(pressure) 220 (atm)	allow a tolerance of ± ½ a small square allow **1** mark for an answer of 350 (°C) **and** 85 (atm) allow **1** mark for an answer of 400 (°C) **and** 140 (atm)	1	3.8.2e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
05.6	mixture is cooled ammonia liquefies / condenses (unreacted) nitrogen and hydrogen are recycled		1 1 1	AO1 3.8.3c

Total Question 5		**10**

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.1	(M_r) = (27 × 2) + (16 × 3) **or** (M_r) = 54 + 48 = 102		1 1	AO2 3.6.2a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.2	**A**		1	AO3 3.5.1f 3.10.1.2d

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.3	potassium atom loses one electron oxygen atom gains two electrons two potassium atoms react with one oxygen atom to form ions that have the electron arrangement of a noble gas	if neither of first two marks given then allow **1** mark for potassium loses and oxygen gains electron(s) allow to gain a full outer shell of electrons allow to form (two) K^+ ions and an O^{2-} ion	1 1 1 1	AO2 3.2.1c

Total Question 6		7

Question 7

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.1	(bonding) covalent		1	AO3 3.2.2d
	(structure) simple molecular	allow simple / small molecules	1	3.2.2e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.2	**J** has giant covalent structure	allow macromolecular	1	AO2
	(with) strong (covalent) bonds between atoms	allow (with) all atoms linked to other atoms (by covalent bonds)	1	AO2
	(so) a lot of energy needed to break bonds		1	AO3 3.2.2f

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
07.3	**H** contains ions	allow **H** is ionic	1	AO2 AO3 3.2.2b 3.2.2g
	(and ions are) free to move when liquid (so can conduct electricity)		1	
	(but ions are) fixed when solid (so cannot conduct electricity)		1	
	I contains delocalised electrons	ignore reference to graphite	1	
	(which) move through the substance (when solid and liquid)		1	

Total Question 7		**10**

Question 8

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.1	(molecules) randomly arranged		1	AO1 3.1.1a
	(molecules) far apart from each other		1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.2	forms closer to concentrated hydrochloric acid	allow forms closer to left hand side allow drawn on **Figure 10**	1	AO2 AO3 3.1.1b
	(when) molecules diffuse by diffusion		1	
	ammonia travels faster / further		1	
	(because) ammonia has a lower relative formula mass	allow (because) ammonia is a lighter molecule	1	

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.3	<table><tr><th></th><th>C</th><th>N</th><th>H</th></tr><tr><td>(moles =)</td><td>$\frac{3.6}{12}$</td><td>$\frac{4.2}{14}$</td><td>$\frac{1.5}{1}$</td></tr><tr><td></td><td>= 0.3</td><td>= 0.3</td><td>= 1.5</td></tr><tr><td></td><td>$\frac{0.3}{0.3} = 1$</td><td>$\frac{0.3}{0.3} = 1$</td><td>$\frac{1.5}{0.3} = 5$</td></tr></table> CNH_5	allow correct use of incorrect calculation of moles allow correct use of incorrectly calculated ratio of moles	1 1 1 1 1	AO2 3.6.2c 3.6.3a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
08.4	$\left(\frac{4.8}{24} =\right) 0.2$ (mol)		1	AO2 3.6.2c 3.6.3a
	$\left(M_r = \frac{8.4}{0.2} =\right) 42$	allow correct use of incorrect calculation of moles	1	3.6.4d
	$\left(\frac{42}{14} =\right) 3$	allow correct use of incorrect calculation of M_r	1	
	C_3H_6		1	
	alternative approach: $\left(\frac{24}{4.8} =\right) 5$		1	
	$(5 \times 8.4 =) 42$		1	
	$\left(\frac{42}{14} =\right) 3$		1	
	C_3H_6		1	

Total Question 8		14

Question 9

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.1	(test) lighted splint (result) makes a pop (sound)		 1 1	AO1 3.4.2a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.2	rate of reaction decreases (because) concentration of acid decreases **or** (because) surface area of magnesium decreases **or** (because) fewer collisions per unit time		1 1	AO3 3.8.1a

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.3	**K** curve **K** rate faster / slope steeper than **L** because higher temperature curve **K** has smaller final volume than **J** as there are fewer moles of hydrochloric acid	 allow curve **K** and **L** have the same final volume as they have the same concentration of hydrochloric acid	1 1 1	AO3 3.8.1a 3.8.1c 3.8.1e

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
09.4	volume = 0.025 (dm^3)		1	AO2 3.6.1d
	(mol = 0.025 × 1.5 =) 0.0375	allow correct use of incorrect / no conversion of volume	1	3.6.4a
	(mol Mg = $\frac{0.0375}{2}$ =) 0.01875	allow correct use of incorrect calculation of moles	1	
	(mass of Mg =) 0.01875 × 24	allow correct use of incorrect calculation of moles	1	
	= 0.45 (g)		1	

Total Question 9		12