GCE 2005
January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Chemistry

CHM2 Foundation Physical and Inorganic Chemistry

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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 to download from the AQA Website: www.aqa.org.uk

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Guidance on the award of the mark for Quality of Written Communication

Quality of Written Communication assessment requires candidates to:

- select and use a form and style of writing appropriate to purpose and complex subject matter;
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate; and
- ensure text is legible, and spelling, grammar and punctuation are accurate, so that meaning is clear.

For a candidate to be awarded 1 mark for quality of written communication on the question identified as assessing QWC in a unit test, the minimum acceptable standard of performance should be:

- the longer parts (worth 4 marks or more) should be structured in a reasonably logical way, appropriate and relevant to the question asked;
- ideas and concepts should be explained sufficiently clearly to be readily understood. Continuous prose should be used and sentences should be generally be complete and constructed grammatically. However, minor errors of punctuation or style should not disqualify;
- appropriate AS/A level terminology should be used. Candidates should not use such phrases as 'fighting disease', 'messages passing along nerves', 'enzymes being killed' etc, but a single lapse would not necessarily disqualify. Technical terms should be spelled correctly, especially where confusion might occur, e.g. mitosis/meiosis, glycogen/glucagon.

The Quality of Written Communication mark is intended as a recognition of competence in written English. Award of the mark should be based on overall impression of performance on the question identified on the paper as assessing QWC. Perfection is not required, and typical slips resulting from exam pressure such as 'of' for 'off' should not be penalised. Good performance in one area may outweigh poorer performance in another. Care should be taken not to disqualify candidates whose lack of knowledge relating to certain parts of a question hampers their ability to write a clear and coherent answer; in such cases positive achievement on other questions might still be creditworthy. No allowance should be made in the award of this mark for candidates who appear to suffer from dyslexia or for whom English is a second language. Other procedures will be used by the Board for such candidates.

Examiners should record 1 or 0 at the end of the paper in the Quality of Written Communication lozenge. This mark should then be transferred to the designated box on the cover of the script.

CHM2 Foundation Phyiscal and Inorganic Chemistry

Section A

Question 1

(a)		Increase	1
		Van der Waal's forces between molecules	1
		Increase with size (or M_r or surface area etc)	1
		More energy needed to break (overcome) these forces	1
		(Note max 2 from last three marks if no mention of molecules or 'molecular')	
(b)	(i)	Brown solution (or yellow or orange)	1
		$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$	1
	(ii)	cream precipitate	1
		$Br^- + Ag^+ \rightarrow AgBr$	1
		Precipitate dissolves	1
	(iii)	orange (brown) fumes (gas), White fumes (or misty fumes), choking gas (any 2)	2
(c)		$2H^+ + H_2SO_4 + 2Br^- \rightarrow SO_2 + Br_2 + 2H_2O$ (SO_2 and Br_2 (1), equation (1))	2
		Total	13

Question 2

(a)		Accepts electrons	1
(b)		Charge on the ion (or element or atom)	1
(c)		+4	1
		+5	1
		–3	1
(d)	(i)	$Cu \rightarrow Cu^{2+} + 2e^-$	1
	(ii)	$NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$	1
	(iii)	$3Cu + 2NO_3^- + 8H^+ \rightarrow 3Cu^{2+} + 2NO + 4H_2O$	1
		Total	8

Question 3

(a)		Gradient (or slope) (or draw a tangent)	1
(b)	(i)	Curve **X** is lower and starts at origin	1
		And levels out at same volume as original curve	1
	(ii)	Curve **Y** is steeper than original and starts at origin	1
		Then levels out at half the volume of the original	1
(c)	(i)	$2H_2O_2 \rightarrow 2H_2O + O_2$	1
	(ii)	Speeds up (alters the rate of) a chemical reaction	1
		Remains unchanged (or not used up)	1
	(iii)	Remains unchanged (or not used up or not in the overall reaction equation)	1
		Offers alternative reaction route (or acts as an intermediate)	1
		Total	10

Question 4

(a)	(i)	$C + CO_2 \rightarrow 2CO$ (or $2C + O_2 \rightarrow 2CO$, or carbon reduction of an iron oxide)	1
	(ii)	$3CO + Fe_2O_3 \rightarrow 3CO_2 + 2Fe$	1
	(iii)	CO is gaseous (or C is solid)	1
		CO has more <u>collisions</u> (or C has very few collisions)	1
(b)		Titanium carbide is stable.	1
(c)	(i)	Basic oxygen process (or BOS)	1
	(ii)	$Mg + S \rightarrow MgS$	1
	(iii)	React with oxygen	1
		Forms phosphorus oxide (or P_4O_{10})	1
		Removed as slag (or phosphate) (with CaO)	1
	(iv)	*Any two from the following*: saves energy, removes scrap from environment, uses fewer raw materials, fewer green house gases released, less CO released, less SO2 released, less mining, has greater % of iron, correct economic argument etc	2
(d)		<u>Cost</u> of chlorine or sodium (or Mg) or argon or batch process (cost is QL mark)	1
		Mention of another of these	1
		Total	14

SECTION B

Question 5

(a) (i) enthalpy change when 1 mol of a substance (or compound) (QL mark) 1
is (completely) burned in oxygen (or reacted in excess oxygen) 1
at 298 K and 100 kPa (or under standard conditions) 1

(ii) heat produced = mass of water × Sp heat capacity × ΔT (or $mc\Delta T$) 1
= 150 × 4.18 × 64 (note if mass = 2.12 lose first 2 marks then conseq)
= 40100 J or = 40.1 kJ (allow 39.9 – 40.2 must have correct units) 1
moles methanol = mass/M_r = 2.12/32 (1) 1
= 0.0663
ΔH = – 40.1/0.0663 = – 605 kJ (mol^{-1}) (allow –602 to –608 or answer in J) 1
(note allow conseq marking after all mistakes but note use of 2.12 g loses 2 marks

Total 7

(b) (i) equilibrium shifts to left at high pressure 1
because position of equilibrium moves to favour fewer moles (of gas) 1

(ii) at high temperature reaction yield is low (or at low *T* yield is high) 1
at low temperature reaction is slow (or at high *T* reaction is fast) 1
therefore use a balance (or compromise) between rate and yield 1

Total 5

(c) $\Delta H = \Sigma\Delta H_c^{\ominus}$(reactants) – $\Sigma\Delta H_c^{\ominus}$(products) (or correct cycle) 1

$\Delta H_c^{\ominus}$ (CH_3OH) = $\Delta H_c^{\ominus}$ (CO) + 2 × $\Delta H_c^{\ominus}$ (H_2) – ΔH 1
= (–283) + (2 × –286) – (–91) (*mark for previous equation or this*)
= –764 (kJ mol^{-1}) (*units not essential but lose mark if units wrong*) (*note +764 scores 1/3*) 1

Total 3