UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper for the guidance of teachers

9701 CHEMISTRY

9701/43

Paper 4 (A2 Structured Questions), maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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- 1 (a) (i) the enthalpy change/released when 1 mole is formed
 - of ionic lattice from the gas phase ions

[1]

[1]

(ii)
$$Mg^{2+} + O^{2-} \longrightarrow MgO$$

[1] [3]

- (b) measurements needed:
 - volume/mass/weight of water (in calorimeter)initial + final temperature/temperature change/temperature rise (of the water)[1]

mass of Mg (used)/mass MgO

Not volume/moles/mass of oxygen used

[3]

[1]

(c)
$$\Delta H = 148 + 736 + 1450 + 496/2 - 141 + 798 - 3791$$

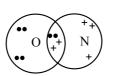
= -552 kJ mol⁻¹

[3]

(d)
$$Na_2O(s) + H_2O(aq/l) \longrightarrow 2NaOH(aq)$$
 [1]
 $MgO(s) + H_2O(aq/l) \longrightarrow Mg(OH)_2(s) \text{ or } Mg(OH)_2(aq)$ [1]
 $pH 12.5-14 [NaOH] \text{ AND } 8-10.5 [Mg(OH)_2] \text{ respectively}$ [1]

[Total: 12]

2. (a) (i)



[1]

(ii)
$$-180 \text{ kJ mol}^{-1}$$
 [1]

(iii) (formation of NO is endothermic) so high T and equilibrium pushed over to NO side. or high T and needed to break N-N bond in N_2 [1]

(iv) -180 = 2 E(NO) - 994 - 496 [1] $E(NO) = +655 \text{ kJ mol}^{-1}$ [1]

[5]

(b) (i) (from 1 and 2:) as p(NO) halves, rate decreases to $\frac{1}{4}$, so order = 2 [1] (from 1 and 3:) as p(H₂) halves, so does rate, so order = 1 [1]

(ii) rate = $k p_{NO}^2 p_{H2}$ [1] units (of k) are atm⁻² s⁻¹

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	(iii)	NO +	NO + out a	+ H ₂ + all spe + H ₂ +	cies comr	non to both s	$+ \Theta + H_2O + N_2$	_			[1] [1]
	(iv)	O for or:	med f <i>step</i>	rom N	ce it invol						[1] [1] <i>[1]</i> <i>[1]</i>
(c)	(i)	NO									[1]
	(ii)	(allov	3Fe ²⁺ v Fe ²⁺	+ 4H + H	+ + NO ₃ + + + HNO ₂	$0 \longrightarrow 3Fe$ $0 \longrightarrow Fe^{3}$	e ³⁺ + NO + 2H ₂ (+ + NO + H ₂ O))			[1]
	(iii)	dativ	e/coo	rdinat	e bonding)					[1]
	(iv)	[Fe(F	1 ₂ O) _{6-n}	n(NO)r] ²⁺ (n	= 1-6)					[1] [4]
										[Tota	l:17]
3. (a)	(i)	C ₁₆ H	₁₀ N ₂ O ₂	2							[1]
	(ii)	ketor	ne, alk	ene, a	amine, ary	/l (benzene/a	rene/phenyl)			(any 3)	[2] [3]
(b)	(i)	redu	ction c	o <i>r</i> redo	ЭX						[1]
	(ii)	NaBl	H₄ or L	_iA <i>î</i> H₄	(NOT H	₂ + Ni)					[1] [2]
(c)	1.	2,4-0	NPH	[1]		red/yellow-c	orange/orange pp	t. [1]	no	reaction	
	2.	Na m	etal	[1]		no reaction			gas given o	off/fizzing	[1]
		PCl₅/S PCl₃ +				no reaction			steamy fume misty/whi	_	[1]
	2 x	"no re	action	າ"			must be	linke	ed to "correct	reagent"	[1] [5]

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(d) (i)

[1]

(ii)
$$M_r = 262$$
, so 2.5 g = 2.5/262 = 9.54 × 10⁻³ mol (1 mol indigo absorbs 9 mol of H₂) so volume of H₂ = 9 × 24 – 9.54 × 10⁻³ = **2.06 dm³** (2060 cm³)

[1]

[1] **[3]**

(e)

2 x Br **on C=C** [1]

a Br on each ring [1]

TWO non-adjacent Br on each ring [1]

[3]

[Total: 16]

4 (a) (i) volatilities decrease down the group

[1]

[1]

due to greater van der Waals (VDW) forces (intermolecular is not sufficient)

due to larger no of electrons [1]

(ii) CC14 does not react with water [1]

CC14 unreactive due to no **d**-orbitals [1]

GeCl₄ and PbCl₄ hydrolyse/react [1]

 $MCl_4 + 2H_2O \longrightarrow MO_2 + 4HCl (M = Ge or Pb)$ [1]

[7]

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(b) (i) **B** is $PbSO_4$ and **C** is $PbCl_2$ [1]

(ii)
$$SnO_2 + 2H_2SO_4 \longrightarrow Sn(SO_4)_2 + 2H_2O$$
 [1]

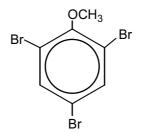
$$PbO_2 + H_2SO_4 \longrightarrow PbSO_4 + H_2O + \frac{1}{2}O_2$$
 [1]

$$PbO_2 + 6HCl \longrightarrow H_2PbCl_6 + 2H_2O$$
 [1]

$$H_2PbCl_6 \longrightarrow PbCl_2 + 2HCl + Cl_2$$
 [1] [5 max 4]

[Total: 11]

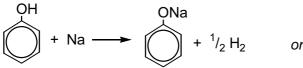
5 (a) (i)



[1]

(ii) Na metal or Fizzes/gas given off with phenol or $C_6H_5OH + Na \rightarrow C_6H_5ONa + \frac{1}{2}H_2$ or

NaOH [1] phenol dissolves (anisole doesn't) [1] $C_6H_5OH + OH^- \rightarrow C_6H_5O^- + H_2O$ [1]



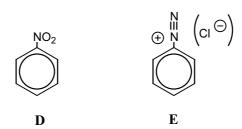
OH ONa + H₂O

(neutral) iron(III) chloride Solution goes purple/violet $3C_6H_5OH + FeCl_3 \rightarrow Fe(OC_6H_5)_3 + 3HCl$

[1] [1] **[4]**

[1]

(b) (i)



[1] + [1]

(ii) step 2: Sn + HC
$$l$$
 NOT LiA l H₄, NaBH₄ [1] conc. + reflux (warm is insufficient) [1]

step 4 is conditional of structure E

step 4: warm + in H_2O [1] [5 max 4]

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F must be an amide

(ii) reaction 1: H_2 + Ni or LiAlH $_4$ [1] reaction 2: heat + aqueous HCl [1] [6]

[Total: 14]

[4]

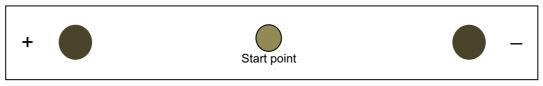
- 6 (a) (i) Condensation [1]
 - (ii) ala-ala, gly-gly, ala-gly [2]
 - (b) (i) Correct sugar-phosphate backbones (with two sugars and one phosphate attached) [1]
 - C G pair correct **or** A T pair correct [1]
 - deoxyribose label **and** all bases coming from sugars [1]
 - (ii) Replication would be slower/difficult because the DNA/strands could not be separated [1]
 - (c) (i) Some amino acids have more than one (triplet) code [1]
 - (ii) loss/disruption of ionic bonding/hydrogen bonding [1]
 - (iii) There would be a potential loss of all tertiary structure
 or
 frameshift deletion of a base changes protein structure
 [1]

[Total: 10]

[3]

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7 (a)



Glutamic acid Glycine Lysine

- (b) (i) Ratio of the <u>concentration</u> of a solute in each of two solvents or equilibrium constant representing the distribution of a solute between two solvents. [1]
 - (ii) illustration of some method of getting into our body via the food chain [1]

(c) (i)
$$156 = C_3H_6^{35}Cl^{79}Br^+$$
 [1] $158 = C_3H_6^{37}Cl^{79}Br^+$ [1] $158 = C_3H_6^{35}Cl^{81}Br^+$ [1] $160 = C_3H_6^{37}Cl^{81}Br^+$ [1]

(ii)
$$m/e = 15$$
 Species = CH_3^+ [1] [5 max 4]

[Total: 10]

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8 (a)





LDPE HDPE

minimum of 2 chains suitable sketches [1]

(The close packing of unbranched side chains means)

LDPE more space between the chains/polymers or HDPE less empty space between the chains [1]

[2]

(b) van der Waals' (VDW) forces are weaker

[1] [1] [2]

(c)

Addition OR	condensation
requires C=C/double bond	does not need C=C/double bond
uses the same functional group	needs two different functional groups
same general (empirical) formula as monomer	different formula
no loss of small molecule/H ₂ O/HCl	small molecule /H ₂ O/HCl is formed

Any two differences [1]

[2]

(d) (i) (through its long chain of) delocalised electrons/mobile electrons free electrons is not sufficient

[1]

[1]

the π bonds/p-orbitals overlap (with each other)

[1]

[2]

(iii) C₈H₆ C_4H_3

(ii) planar

[5 max 4]

[Total: 10]