

As part of CIE’s continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature, The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner’s Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner’s Reports.

<b>Question Paper</b>	<b>Mark Scheme</b>	<b>Principal Examiner’s Report</b>
Introduction	Introduction	Introduction
First variant Question Paper	First variant Mark Scheme	First variant Principal Examiner’s Report
Second variant Question Paper	Second variant Mark Scheme	Second variant Principal Examiner’s Report

**Who can I contact for further information on these changes?**

Please direct any questions about this to CIE’s Customer Services team at: [international@cie.org.uk](mailto:international@cie.org.uk)

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

**MARK SCHEME for the May/June 2009 question paper  
for the guidance of teachers**

**0620 CHEMISTRY**

**0620/31**

Paper 3 (Extended Theory), maximum raw mark 80

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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	IGCSE – May/June 2009	0620	31

- 1 (a) (i) basic set up – container and chromatography paper [1]
- sample clearly above level of solvent [1]  
(original mark must be shown and not just the line)
- indication that more than one “spot” either on diagram **or** as comment [1]
- Allow MAX [2] for round filter paper with green spot at centre  
two or more rings
- (ii) run chromatogram of pure chlorophyll can be implied [1]  
same position of green spot **or** same R<sub>f</sub> [1]  
**NOT** just a green spot
- (b) catalyst  
photosynthesis **or** chloroplasts  
photochemical reaction **or** needs light  
carbon dioxide + water form  
glucose **or** starch **or** oxygen **NOT** sugar  
Any **THREE** correct points ignore incorrect answers [3]
- [Total: 8]**
- 2 molten potassium iodide **NOT** aqueous [1]
- hydrogen [1]  
oxygen [1]  
water used up **or** solution becomes more concentrated **or** sodium chloride remains  
**NOT** no change [1]  
If products are given as hydrogen, chlorine and sodium hydroxide then 2/3
- copper [1]  
oxygen (and water) [1]  
sulfuric acid accept hydrogen sulfate [1]
- aqueous **or** dilute **or** concentrated potassium bromide [1]  
**accept** correct formulae
- [Total: 8]**
- 3 (a) (i) D [1]
- (ii) E [1]
- (iii) B or F [1]
- (iv) B [1]
- (v) A [1]

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- (b) (i)  $\text{CF}_2$  or  $\text{CaI}_2$  [1]  
**COND** next two marks conditional on correct formula  
 $\text{C}^{2+}$  and  $\text{F}^-$  or  $\text{Ca}^{2+}$  and  $\text{I}^-$  [1]  
 7× and 10 round F/I [1]  
**NOTE** covalent = 0  
 Ignore electrons around Ca  
**accept** arrow notation arrow from electron on calcium atom to iodine

- (ii) high melting point or boiling point  
 conducts when molten or in solution  
 soluble in water  
 brittle  
 correct chemical properties  
 hard  
 Any **TWO** [2]  
**NOT** crystalline solid **NOT** does not conduct as a solid

[Total: 10]

- 4 (i) Cu and Pd [2]  
 (ii) Ba and La [2]  
 (iii) +2 or 2+ or  $\text{Ba}^{2+}$  [1]  
 (iv) Ba or La [1]  
 (v) it is a transition metal or a d block element [1]

[Total: 7]

- 5 (a) (i)  $\text{Ca}^{2+} + 2\text{F}^- \rightarrow \text{CaF}_2$  [2]  
 Not balanced **ONLY** [1]  
 Both species must be correct for first mark. Second mark is for correct balancing.
- (ii) Mole ratio  $\text{Ca}^{2+}$ :  $\text{F}^-$  is 1:2 [1]  
 Answer must mention moles  
**accept** argument based on charges or number of ions  
**accept** 2 moles of NaF react with 1 mole of  $\text{CaCl}_2$   
**NOT** just "2" in equation  
 If fluorine must specify atoms or ions
- (iii) to remove traces of solutions or to remove soluble impurities or to remove a named salt sodium chloride or sodium fluoride or calcium chloride [1]  
 To remove impurities is not enough
- (iv) to dry (precipitate) or to remove water or to evaporate water [1]  
**NOT** to evaporate some of water **NOT** to crystallise salt

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- (b)  $T_3(PO_4)_2$  allow correct example [1]  
 explain why  $8\text{ cm}^3$  react fully [1]  
 comment about mole ratio [1]

[Total: 8]

- 6 (a) (i) air (liquid) [1]  
 petroleum **or** crude oil **or** alkanes **or** methane **or** water **or** steam **or** steam reforming **or**  
 suitable aqueous solution e.g. brine or sea water [1]  
**NOTE:** cannot crack methane
- (ii) iron [1]
- (iii) (as a) fertiliser **or** to make fertilisers **or** to make nitric acid [1]
- (b) (i) concentrations/macrosopic properties do not change [1]  
**accept** amounts stay the same  
**NOT** no change  
rate of forward and back reactions equal [1]
- (ii) it decreases with increase temperature [1]  
**or** it increases with decrease temperature [1]
- (c) (i) shows an increase either a line **or** curve [1]  
 (any decrease = 0)
- (ii) increase pressure favours the side with lower volume or molecules or moles [1]  
 that is RHS **or** products side [1]  
 ignore any mention of rates

[Total: 10]

- 7 (a) (total endothermic change =  $436 + 242 = +$ )678 kJ [1]  
 (total exothermic change =  $2 \times 431 = -$ )862 kJ [1]  
**accept** correct sign/supplied/absorbed for endo etc.  
**accept** correct sign/evolved/produced for exo etc.  
 change for reaction =  $-184\text{ kJ}$  [1]
- not necessary to calculate  $-184$ , just show that exo change > than endo  
 ecf allowed provided negative  
 $-184\text{ kJ}$  scores all 3 marks
- (b) (i) because it accepts a proton [2]  
 accepts hydrogen ion **or**  $H^+$  **ONLY** [1]  
 proton and  $H^+$  [2]
- (ii) hydrogen chloride is a strong acid [1]  
 hydrogen fluoride is a weak acid [1]  
 weaker **or** stronger correctly applied for [2]

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- (iii) hydrogen chloride (aqueous) would have lower pH [1]  
**OR** hydrogen fluoride (aqueous) would have higher pH  
 If values suggested, not over 7

[Total: 8]

- 8 (a) biodegradable or breaks down naturally  
 made from a renewable source **or** does not use up petroleum
- reduce visual pollution **or** reduces need for landfill sites **or** less danger to wildlife  
 any **TWO** [2]  
 ignore mention of toxic gases
- (b) (i) ester [1]  
**accept** polyester **or** fat **or** lipid **or** vegetable oil **or** carboxylic acid
- (ii) acid **or** carboxylic acid **or** alkanoic acid [1]  
 alcohol **or** hydroxyl **or** alkanol [1]  
**NOT** formulae **NOT** hydroxide
- (iii) condensation [1]  
**COND** because water is formed in reaction [1]  
**or** monomer does not have C=C bond [1]
- (c) (i) lactic acid → acrylic acid + water [1]
- (ii) add bromine (water) or bromine in an organic solvent [1]  
 remains brown/orange/yellow [1]  
 goes colourless **NOT** clear [1]  
 If mark 1 near miss e.g. bromide allow marks 2 and 3  
 Colour of reagent must be shown somewhere for [3] otherwise max [2]
- OR** acidified potassium manganate(VII)  
 purple/pink to colourless
- OR** alkaline potassium manganate(VII)  
 purple/pink to green  
**or** purple/pink to brown precipitate

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- (iii) reagent [1]  
 observable result [1]

suitable named metal (**NOT** sodium, lead, any metal below magnesium etc.)  
 if un-named metal [0] result can score [1]  
 hydrogen evolved or bubbles/effervescence/fizzing

insoluble metal oxide  
 colour change or dissolves

any carbonate or bicarbonate  
 gas/carbon dioxide/bubbles/effervescence/fizzing

sodium hydroxide or alkali  
 temperature increase **or** accept indicator to show neutralisation  
 unspecified base scores [1] only  
**NOT** alcohol

[Total: 13]

- 9 (a)  $72/24 = 3$  and  $28/14 = 2$  [1]  
 $Mg_3N_2$  [1]  
**accept** just formula for [2] even with incorrect or no working  
**NOT** ecf

- (b)  $Al_4C_3 + 12H_2O = 4Al(OH)_3 + 3CH_4$  [2]  
 For  $Al_4C_3$  ONLY [1]

- (c) (i) silicon is limiting reagent [1]  
 0.07 moles of Si and  $25/160 = 0.156$  moles of  $Br_2$  [1]  
 because  $0.14 (2 \times 0.07) < 0.156$  [1]  
 If 80 used to find moles of  $Br_2$  the mark 1 and 3 still available  
 arguments based on masses can be used

- (ii) 0.07 [1]  
**NOT** ecf

[Total: 8]

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- sample clearly above level of solvent [1]  
(original mark must be shown and not just the line)
- indication that more than one “spot” either on diagram **or** as comment [1]
- Allow MAX [2] for round filter paper with green spot at centre  
two or more rings
- (ii) run chromatogram of pure chlorophyll can be implied [1]  
same position of green spot **or** same R<sub>f</sub> [1]  
**NOT** just a green spot
- (b) catalyst  
photosynthesis **or** chloroplasts  
photochemical reaction **or** needs light  
carbon dioxide + water form  
glucose **or** starch **or** oxygen **NOT** sugar  
Any **THREE** correct points ignore incorrect answers [3]
- [Total: 8]**
- 2 molten lithium chloride **NOT** aqueous [1]
- hydrogen [1]  
oxygen [1]  
water used up **or** solution becomes more concentrated **or** sodium chloride remains  
**NOT** no change [1]  
If products are given as hydrogen, chlorine and sodium hydroxide then 2/3
- copper [1]  
oxygen (and water) [1]  
sulfuric acid accept hydrogen sulfate [1]
- aqueous **or** dilute **or** concentrated potassium bromide [1]  
**accept** correct formulae
- [Total: 8]**
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- (b) (i) CA **or** CaO [1]  
**COND** C<sup>2+</sup> and A<sup>2-</sup> **or** Ca<sup>2+</sup> and O<sup>2-</sup> [1]  
 6× and 2o round anion [1]  
**NOTE** covalent = 0  
 Ignore electrons around Ca  
**accept** arrow notation arrow from electron on calcium atom to oxygen

- (ii) high melting point **or** boiling point  
 conducts when molten **or** in solution  
 soluble in water  
 brittle  
 basic(oxide) or basic property  
 hard  
 Any **TWO** [2]  
**NOT** crystalline solid **NOT** does not conduct as a solid

[Total: 10]

- 4 (i) Cu and Pd [2]  
 (ii) Ba and La [2]  
 (iii) +2 **or** 2+ **or** Ba<sup>2+</sup> [1]  
 (iv) Ba **or** La [1]  
 (v) it is a transition metal **or** a d block element [1]

[Total: 7]

- 5 (a) (i) Fe<sup>3+</sup> + 3F<sup>-</sup> → FeF<sub>3</sub> [2]  
 Not balanced **ONLY** [1]  
 Both species must be correct for first mark. Second mark is for correct balancing.
- (ii) Mole ratio Fe<sup>3+</sup>: F<sup>-</sup> is 1:3 [1]  
 Answer must mention moles  
**accept** argument based on charges or number of ions  
**accept** 1mole of FeF<sub>3</sub> reacts with 3 moles of NaF  
**NOT** just "3" in equation  
 If fluorine must specify atoms or ions
- (iii) to remove traces of solutions **or** to remove soluble impurities **or** to remove a named salt sodium chloride **or** sodium fluoride **or** iron(III) chloride [1]  
 To remove impurities is not enough
- (iv) to dry (precipitate) **or** to remove water **or** to evaporate water [1]  
**NOT** to evaporate some of water

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- (b)  $T_3PO_4$  allow correct example [1]  
 explain why 6 cm<sup>3</sup> react fully [1]  
 comment about mole ratio [1]

[Total: 8]

- 6 (a) (i) air (liquid) [1]  
 petroleum **or** crude oil **or** alkanes **or** methane **or** water **or** steam **or** steam reforming **or**  
 suitable aqueous solution e.g. brine or sea water [1]  
**NOTE:** cannot crack methane

- (ii) iron [1]

- (iii) (as a) fertiliser **or** to make fertilisers **or** to make nitric acid [1]

- (b) (i) concentrations/macroscopic properties do not change [1]  
**accept** amounts stay the same  
**NOT** no change

rate of forward and back reactions equal [1]

- (ii) it increases with increase pressure [1]  
**or** it decreases with decrease pressure

- (c) (i) shows a decrease either a line **or** curve [1]  
 (any increase = 0)

- (ii) increase temperature favours the endothermic change [1]  
 that is LHS **or** reactants side **or** so less ammonia at equilibrium [1]  
**accept** corresponding exothermic argument

[Total: 10]

- 7 (a) (total endothermic change = 436 + 158 = +)594 kJ [1]  
 (total exothermic change = 2 × 562 = -)1124 kJ [1]  
**accept** correct sign/supplied/absorbed for endo etc.  
**accept** correct sign/evolved/produced for exo etc.  
 change for reaction = -530 kJ [1]

not necessary to calculate -530, just show that exo change > than endo  
 ecf allowed provided negative  
 -530 kJ scores all 3 marks

- (b) (i) because it accepts a proton [2]  
 accepts hydrogen ion **or** H<sup>+</sup> **ONLY** [1]  
 proton and H<sup>+</sup> [2]

- (ii) hydrogen chloride is a strong acid [1]  
 hydrogen fluoride is a weak acid [1]  
 weaker **or** stronger correctly applied for [2]

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[Total: 8]

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 observable result [1]

suitable named metal (**NOT** sodium, lead etc.)  
 gas/hydrogen/bubbles/effervescence/fizzing  
 if un-named metal [0] result can score [1]

insoluble metal oxide  
 colour change or dissolves

any carbonate  
 gas/carbon dioxide/bubbles/effervescence/fizzing  
 accept bicarbonate

sodium hydroxide or alkali  
 (temperature increase **or** accept indicator to show neutralisation)  
 unspecified base scores [1] only  
**NOT** alcohol

[Total: 13]

- 9 (a)  $72/24 = 3$  and  $28/14 = 2$  [1]  
 $Mg_3N_2$  [1]  
**accept** just formula for [2] even with incorrect or no working  
**NOT** ecf

- (b)  $Al_4C_3 + 12H_2O = 4Al(OH)_3 + 3CH_4$  [2]  
 For  $Al_4C_3$  ONLY [1]

- (c) (i) silicon is limiting reagent [1]  
 0.08 moles of Si and  $7.2/38 = 0.189$  moles of  $F_2$  [1]  
 because  $0.16 (2 \times 0.08) < 0.189$  [1]  
 If 19 used to find moles of  $F_2$  marks 1 and 3 still available  
 arguments based on masses can be used

- (ii) 0.08 [1]  
**NOT** ecf

[Total: 8]