

Cambridge Chemistry Challenge Lower 6th

June 2018

Student Answer Booklet

In order to print your certificate, we need to store your name, school, and mark in a database: these details are only viewable by your school and our committee. Your participation in the competition indicates that you are happy for us to do this.

Student name _____

male female

School _____

Date of exam _____

School year (eg year 12) _____

Signature _____

	p2	p3	p4	p5	p6	p7	p8	Total
mark	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Mark
1(a) Percentage by mass of SiO_2 and Al_2O_3 in anorthosite:	[2]
1(b)	
(i) Maximum oxidation state of titanium:	[1]
(ii) Formulae of two oxides in ilmenite:	[2]
(iii) Equation for reaction between ilmenite and hydrogen:	[1]
(iv) Tonnes of moon rock needed for one tonne of oxygen gas:	[4]
1(c) Equation for the reaction between ilmenite and methane:	[1]

1(d)

(i) Equation for regeneration of methane:

[1]

(ii) The sign of the standard entropy change plus reason:

[2]

(iii) Standard enthalpy change at 298 K:

[2]

(iv) Standard entropy change at 298 K:

[1]**1(e)**

(i) Standard Gibbs energy for the reaction at 298.0 K:

[2]

1(e)
(ii) Minimum temperature at which products will be favoured:

[3]

1(f) Elements in order of first ionisation energy, easiest first:

[2]

1(g)
(i) Units of constant C:

[1]

1(g)
(ii) Percentage of oxygen atoms ionized:

[4]

	Mark
2(a)	
(i) Structure of propanoic acid:	[1]
(ii) 2-methyl butanoic acid:	[1]
2(b) General formula for a carboxylic acid:	[1]
2(c)	
(i) Percentage by mass of metal ion M in salt A :	[1]
(ii) Empirical formula of salt A using M for the metal ion:	[2]
(iii) Identify the metal that forms ion M :	[1]
2(d)	
(i) Empirical formula of salt B :	[2]

2(d)

(ii) Equation for formation of **salt B** from hydrated **salt A**:

[1]

(iii) The oxidation state of metal ion **M** in **salt B**:

[1]

(iv) The carboxylic acid whose anion is present in **salt B**:

[1]

2(e) Equation for the formation of **salt B**:

[1]

2(f)

(i) Structure of anion formed by removing one proton from **ketone C**:

[1]

(ii) Delocalisation of charge on the anion of **ketone C**:

[2]

2(g) Representations of the anion of **methyl 3-oxobutanoate**:

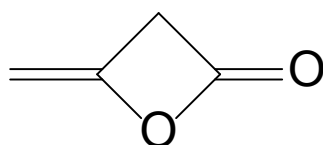
[2]

Representation I

Representation II

2(h) Circle the atom in **diketene** attacked by a nucleophile:

[1]



2(i) The role of **compound E** in the synthesis of **Sweetener D**:

electrophile

radical initiator

base

nucleophile

[1]

2(j) Structures:

Compound E

Compound F

[3]

Compound G

2(k)

(i & ii) Structure of **Compound H** with most acidic proton circled:

Compound H

[3]

(iii) Structure:

Sweetener D

[3]

	Mark
2(l) Concentration of Sweetener D in city water (ng dm^{-3}):	[1]
2(m) Concentration of Sweetener D in pool water (ng dm^{-3}):	[1]
2(n) Concentration of Sweetener D in urine (ng dm^{-3}):	[1]
2(o) Volume of urine in the pool (dm^3):	[4]