

Cambridge Chemistry Challenge Lower 6th

June 2021

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. If you wish to withdraw your consent, please contact your teacher who will be able to delete your data from our database.

Student name _____

School _____

Date of exam _____ Tick box if held online

School year (eg year 12) _____

Signature _____

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

1(a) (i) Dot-and-cross diagram of carbon disulfide & bond angle:

1



(ii) Equation for the reaction between ammonia and carbon disulfide:

1

(iii) Molecular formula for intermediate compound **A**:

1

1(b) (i) Structure of reactive species **X**:

1



(ii) Structure of intermediate compound **A**:

2



1(c) (i) Structure of isothiocyanic acid:

1

(ii) Structure of thiocyanic acid:

1

(iii) Bonds in order of INCREASING length

1

1(d) Structure of compound **C**:

1

1(e) (i) Equation for combustion of 1 mole of CS₂:

1

(ii) Standard enthalpy of combustion for CS₂:

2

(iii) Equation for the decomposition of mercury(II) thiocyanate:

1

1(f) Percentage mass loss for mercury(II) sulfide and carbon nitride and identity of compound removed between 245 and 370°C:

5

1(g) (i) Structure of CN_2^{2-} & bond angle.

1

(ii) Two possible Structures for cyanamide:

2

Structure 1	Structure 2

(iii) Structure of melamine:

2

1(h) (i) RMM of the molecule lost when melamine dimerises:

2

(ii) Molecule **M** lost when melamine dimerises:

1

(iii) Structure of melamine dimer:

2

1(j) Tick one box that best explains the presence of hydrogen in **g-CN**:

1

- Hydrogen gas is easily absorbed from the atmosphere inbetween layers of **g-CN**.
- Polymerisation reactions inevitably leave some hydrogen attached to N-atoms at the edges of the sheets of **g-CN**.
- g-CN** is very reactive and reacts with atmospheric moisture to attach hydrogen atoms.
- There are contaminants in the original melamine that contain hydrogen and these react with the **g-CN**.

1(k) Empirical formula of the carbon nitride ultimately formed on heating melamine:

2

2(a) (i) Percentage decrease in mass when copper(II) oxide is reduced to copper:

1

(ii) Two equations for the production of copper from copper(II) oxide and carbon:

2

(iii) Minimum theoretical mass of carbon needed to produce 100g copper:

2

2(b) Oxide formulae:

Xe:

Po:

Cl:

Nb:

Os:

Y:

3

2(c) (i) Molecular or ionic formulae:

Br:

Cr:

As:

Ge:

Tc:

Tl:

Ir:

Ru:

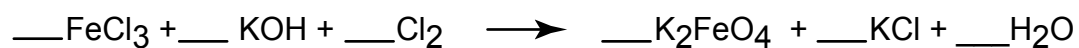
4

(ii) Formula of the non-tetrahedral molecule or ion:

1

2(d) (i) Balanced equation for the preparation of potassium ferrate:

2



(ii) Balanced equation for the decomposition of aqueous potassium ferrate:

2

(iii) Order of pH 4, pH 7 and pH 10 from slowest to fastest expected reaction:

1

2(e) (i) Mass of manganese(II) sulfate monohydrate in 750 ml sample:

3

(ii) Concentration of potassium ferrate stock solution:

2

2(f) (i) Molar ratio ferrate ions : Mn(II) ions:

1

(ii) Number of electrons formally transferred during the reaction:

1

(iii) Oxidation state for manganese in the product:

1

(iv) Equation for reaction between potassium ferrate and manganese(II) chloride:

2