Name:	Teacher:

Level 3 Chemistry

91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of thermochemical principles and the properties of particles and substances.	Demonstrate in-depth understanding of thermochemical principles and the properties of particles and substances.	Demonstrate comprehensive understanding of thermochemical principles and the properties of particles and substances

You should attempt ALL the questions in this booklet.

A periodic table is provided in the Resource Sheet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2 – 10 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

ASSESSOR'S USE ONLY

QUESTION ONE

(a) Complete the following table, using s, p, d notation.

Symbol	Electron configuration
Fe	
Cu	
Cr^{3+}	

(b) The following table shows the electronegativity values of the elements from lithium to fluorine.

	Li	Be	B	C	N	O	F
Electronegativity	1.0	1.5	2.0	2.5	3.0	3.5	4.0

(i) Define the term electronegativity.

Electronegativity: _____

_____

_____

_____

(ii) Justify the trend in electronegativity of the elements from lithium to fluorine.

_____

_____

_____

_____

_____

(c) Ionisation energies provide evidence for the arrangement of electrons in atoms.

(i) Define the term *first ionisation energy*.

(ii) The table shows the first ionisation energy of rubidium and some other elements in the same group.

Element	Sodium	Potassium	Rubidium
First ionisation energy / kJ mol^{-1}	494	418	402

Explain the factors influencing the trends in first ionisation energy down a group of the periodic table.

Question Two

Two molecules of BrF_3 react to form ions as shown by the following equation.

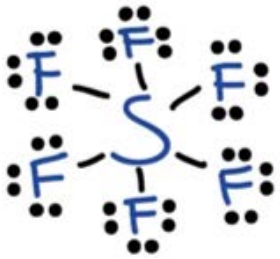
$$\mathbf{2BrF_3 \rightarrow BrF_2^+ + BrF_4^-}$$

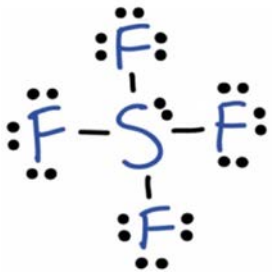
(a) Complete the following table.

	BrF_3	**BrF_4^-**
Lewis Diagram		
Name of shape		

Sulfur forms many molecular compounds with the halogens.

(b) The Lewis diagrams of SF_6 and SF_4 are shown below.





Compare and contrast the polarities and shapes of these two molecules.

_____

_____

_____

_____

(c) (i) Draw a diagram to show how two molecules of water are attracted to each other by intermolecular forces. Your diagram should include

- partial charges
- all lone pairs of electrons.

(ii) The table below shows the boiling points of some hydrogen compounds formed by Group 16 elements.

	H_2O	H_2S	H_2Se	H_2Te
Boiling point/K	373	212	232	271

Use the information above to explain the difference in the boiling points of water and hydrogen sulfide by comparing and contrasting the relative strengths of all the attractive forces between the molecules involved.

Question Three

(a) Define the term standard enthalpy of combustion.

(b) Explain why the value for the standard enthalpy of formation of carbon dioxide, $CO_2(g)$, which is -394 kJ mol^{-1}, has the same as the value for the standard enthalpy of combustion of carbon.

(c) (i) Use the standard enthalpies of formation in the table below and the equation to calculate a value for the standard enthalpy change, $\Delta_r H^o$ for the extraction of iron using carbon monoxide.

	$Fe_2O_3(s)$	$CO(g)$	$CO_2(s)$
$\Delta_f H^o$ / kJ mol^{-1}	-822	-111	-394

$$\mathbf{Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)}$$

(ii) The $\Delta_{fus}H$ for iron, Fe is 13.8 kJ $mol^{-1.}$ How would the enthalpy change you calculated in (c)(i) be different if the iron was formed as a liquid, rather than as a solid.

Circle the correct phrase and justify your answer. There is no need to do a calculation but you may wish to include one to justify your answer.

less negative / the same / more negative

(d) When sodium chloride, NaCl, dissolves in excess water, ΔH is +3.90 kJ mol^{-1}.

$$NaCl(s) + aq \rightarrow Na^{+}(aq) + Cl^{-}(aq)$$

(i) Explain the entropy changes of the system and surroundings for the dissolution of sodium chloride.

System: ΔS for the system is +305 J K^{-1} mol^{-1}.

Surroundings: ΔS for the surroundings is -13.1 J K^{-1} mol^{-1}.

(ii) Discuss why the NaCl dissolves readily in water despite ΔH = +3.90 kJ mol^{-1}.

Extra paper if required.

Write the question number(s) if applicable