Section A: Multiple Choice (1 mark each)

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

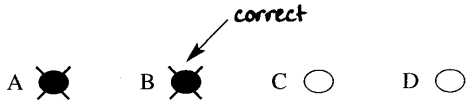
Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



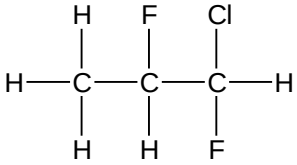
Write your answer on the response grid on page 2

1.Which statement is correct concerning the use of a catalyst in the Haber Process?

(A) The catalyst enables a lower reaction temperature to be used.
(B) The catalyst produces ammonia of greater purity.
(C) The catalyst speeds up the forward reaction and slows down the reverse reaction.
(D) The catalyst removes ammonia from the product mixture allowing the equilibrium to shift to the right.

Answer – (A)
Outcome – H8

2. What is the name of the compound below?



(A) 1-chloro-1,2-difluoropropane
(B) 3-chloro-2,3 – difluoropropane
(C) 1,2-difluoro-1-chloropropane
(D) 1-chloro-1,2-fluoropropane

Answer: A
Outcome(s): H9

3. Which conditions would Le Chatelier advise for the maximum production of ammonia

(A) low pressure and low temperature
(B) low pressure and high temperature
(C) high pressure and low temperature
(D) high pressure and high temperature

Answer – (C)
Outcome – H8

4. *Sydney Water* tests a sample of water at Warragamba Dam. The results are shown in the table…

Aluminium ($\mu g\ L^{-1}$)	*Total chlorine* ($mg\ L^{-1}$)	*Fluoride* ($mg\ L^{-1}$)	*Iron* ($\mu g\ L^{-1}$)	*Manganese* ($\mu g\ L^{-1}$)
< 10	1.52	1.11	< 20	6

Which chemical species could be efficiently assayed using AAS*?*

(A) Total chlorine
(B) Total chlorine and fluoride
(C) Aluminium, iron and manganese
(D) Aluminium, total chlorine, fluoride, iron and manganese

Answer – (C)
Outcome – H4

5. What is the purpose of adding chlorine to domestic water supplies?

(A) To reduce the pH of the water
(B) To remove the heavy metal ions like lead from the water.
(C) To clarify the water
(D) To disinfect the water

Answer:D
Outcome(s): H4, H8

6. In which layer of the atmosphere does ozone act as a UV radiation shield?

(A) mesosphere
(B) stratosphere
(C) thermosphere
(D) troposphere

Answer: B
Outcome(s): H6

Section A

Multiple Choice Answer Grid

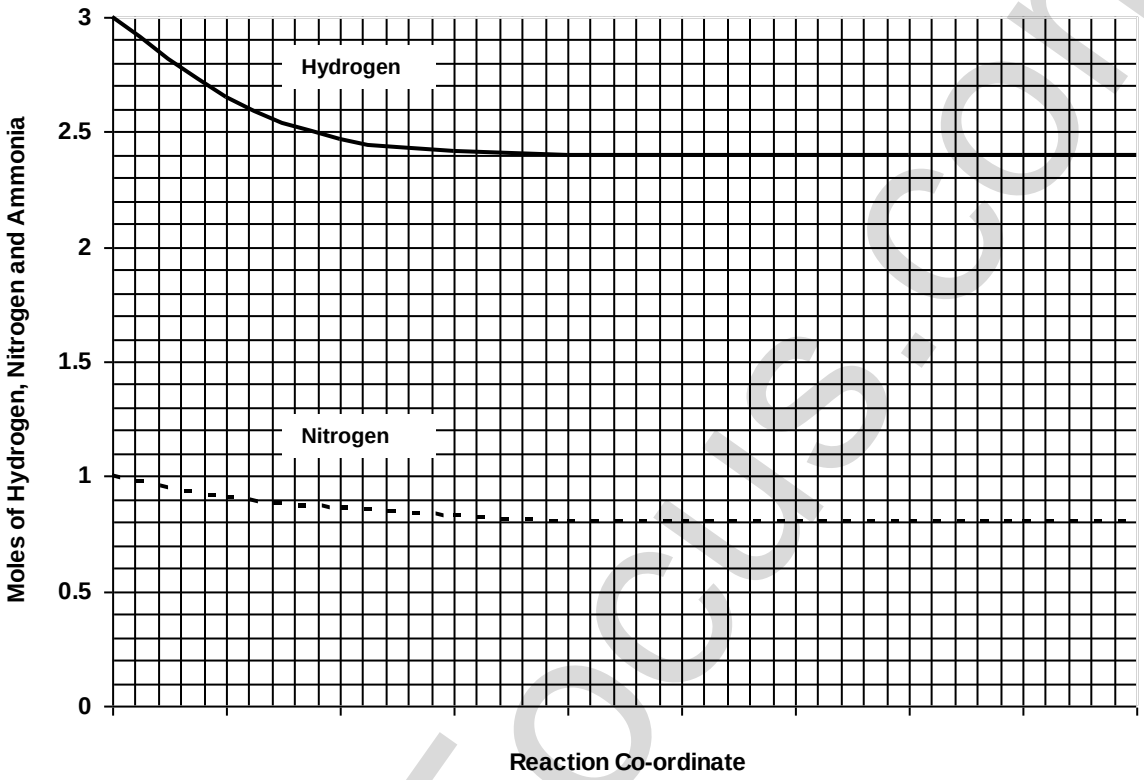
1.	A●	B O	C O	D O
2.	A ●	B O	C O	D O
3.	A O	B O	C ●	D O
4.	A O	B O	C ●	D O
5.	A O	B O	C O	D ●
6.	A O	B ●	C O	D O

Section B: Short Answer Questions

Question 7 (6 marks)

The Syntex Ammonia Corporation produces ammonia via the Haber process by mixing hydrogen and nitrogen in a 3:1 mole ratio and passing it over a promoted iron catalyst at 500°C and 200 atm. Under these conditions the yield of ammonia is 20%.

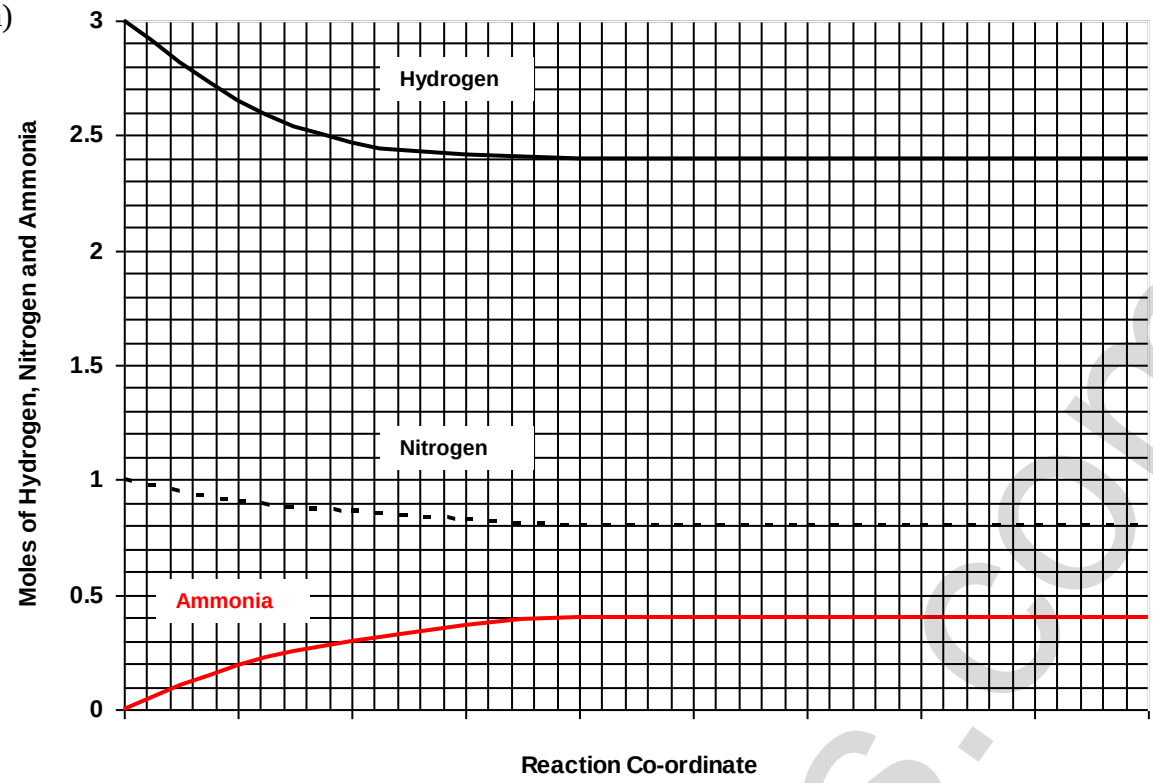
The graph shows a pair of lines for the reaction of hydrogen and nitrogen during the synthesis of ammonia…



(a) Indicate on the graph the amount of ammonia during the same period by drawing in a line showing the simultaneous production of ammonia during the process **(2 mark)**

(b) Explain the effects of temperature on the rate of production and yield of ammonia. **(4 marks)**

(a)



Answer – **Ammonia line must equilibrate at 0.4 mole to match hydrogen and nitrogen lines. (1 mark)**
Outcome – **H10**

(b) Explain the effects of temperature on the production of ammonia. **(4 marks)**

Outcome – **H8**

Temperature has a dual effect on the production of ammonia.

(1) An increase in temperature will increase the reaction rate (1 mark) because more molecules will have more energy to exceed the activation energy (1 mark).

(2) According to Le Châtelier's Principle, an increase in temperature will favour the endothermic reaction and shift the equilibrium to the left (1 mark), resulting to reduced ammonia production (1 mark).

(c) In 1918 Fritz Haber was awarded the Nobel Prize for the ammonia production process.
What was the greatest benefit of this process? **(1 mark)**

_____

_____

_____

_____

During the era of the Haber Process, scientists predicted the exhaustion of Chilean reserves of natural nitrate fertiliser would result in greatly lower agricultural production and possible famine. The Haber Process enabled the cheap production of ammonia which could be easily oxidised to produce synthetic nitrates.

Outcome – **H4**

Question 8 (7 marks)

Mount Ruse® Mineral Water is analysed for the presence of iron, chloride and carbonate ions.

(a) Complete the table showing suitable test reagents and results… **(6 marks)**

Ion tested	*Test reagent used (name <u>or</u> formula)*	*Observed result for a positive test*
iron (III)		
chloride		
carbonate		

Ion tested	***Test reagent used (name <u>or</u> formula)***	***Observed result for a positive test***	
iron(II)	**$K_3Fe(CN)_{6\ (aq)}$**	**Blue colouration forms**	**1 mark**
iron(II)	**$NaOH_{\ (aq)}$**	**Green precipitate forms**	
iron(III)	**$K_4Fe(CN)_{6\ (aq)}$**	**Blue colouration forms**	
iron(III)	**KSCN or NH_4SCN**	**Blood red colouration forms**	
iron(III)	**$NaOH_{\ (aq)}$**	**Brown precipitate forms**	
chloride	**$AgNO_{3\ (aq)}$**	**White precipitate forms**	**1 mark**
carbonate	**$HNO_{3\ (aq)}$**	**Effervescence**	**1 mark**

<u>Outcome</u> – H8, 11

(b) *Mount Ruse*® Mineral Water is also known to contain calcium ions.
Describe a simple test to detect calcium which does not involve a test reagent. **(1 mark)**

_____

A positive <u>flame test</u> for calcium ions would be indicated by an <u>orange/brick–red colouration</u>.

<u>Outcome</u> – H11

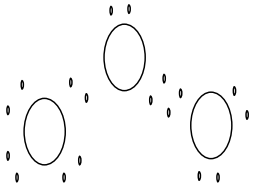
Question 9 (4 marks)

(a) Describe what is meant by a coordinate covalent bond.

……..

……

(b) Circle the covalent bond in the diagram of ozone.



(c) Identify the type of diagram used in question (b) above.

……

……

(d) The diagram used in question (b) above is one way to model a molecule of ozone. State one limitation of such a model

……

……

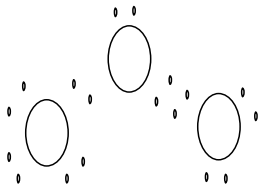
Outcome(s): H4, H6

Criteria	*Marks*
a) correctly defines coordinate covalent bond	1
b) correctly circles coordinate covalent bond	1
c) correctly identifies Lewis dot diagram	1
d) correctly states 1 limitation of modelling	1

Sample answers:

(a) A coordinate covalent bond is one in which both of the shared electrons come from the one atom

(b)



(c) Lewis dot diagrams

(d) One limitation of this model is that it is only a representation of the molecule and is not indicative of its size or its 3D nature.

Question 10 (5-marks)

The concentration of chromium in an aqueous sample was determined by pipetting 10.0 mL of the sample into a 50.0-mL volumetric flask and diluting to volume. The solution was measured by atomic absorption along with four standard solutions of chromium. The results are given in the table.

Sample	*Concentration, ppm*	*Absorbance*
Standard A	2.4	0.091
Standard B	4.8	0.177
Standard C	7.2	0.266
Standard D	9.6	0.353
Unknown Cr	Unknown	0.201

(a) Draw a graph of the data. **(2 marks)**

ABSORBANCE

CONCENTRATION (ppm)

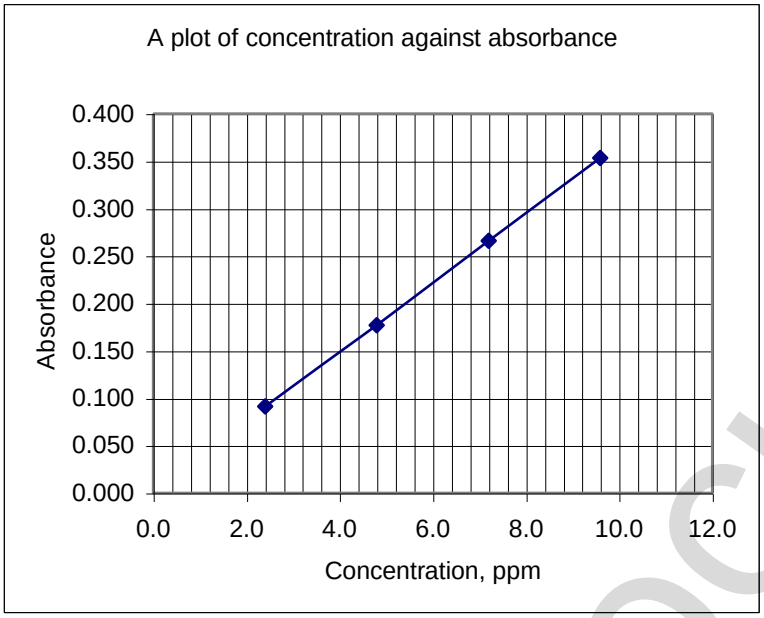
(b) Use the graph to calculate the concentration of Cr in the original sample in. **(3 marks)**

(i) ppm ……..

……

(ii) mol L^{-1} ……

……



Marking:

1 mark for axis labels
1 mark for points correctly plotted

(b) Calculate the concentration in mol L^{-1} of Cr in the original sample. (3 marks)

ANS

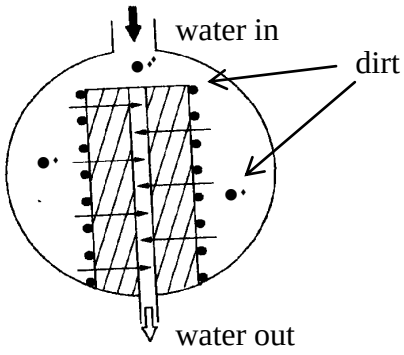
From the graph, the concentration in ppm of the unknown is 5.3 ppm (1 mark)

The concentration of Cr in the original sample is 5.3 ppm x $\frac{50}{10}$ *= 26.5 ppm* (1 mark)

in mol L^{-1} *Cr* $= \frac{26.5\,mg/L}{(1000\,mg/g)\,x\,52.00\,g/mole} = 5.1x10^{-4}\,mol\,L^{-1}$

Question 11 (6 marks)

Given below is a diagram which represents the design of a microscopic membrane filter.



Explain how the filter works and assess the effectiveness of this method of filtration in its use to purify water supply

……

……

……

……

Criteria	*Marks*
A judgement of effective usage, a description of usage, and a good description of function	5-6
Good explanation of function and a description of its usage	4
Good explanation of how the filter works	3
Adequate explanation of how the filter works	1-2

Sample Answer:

A membrane filter is usually a thin film of a synthetic polymer through which there are pores of fairly uniform size. These pores can be very small, e.g., 0.2μm, and can filter out much smaller particles than sand filters

The dirty water flows into the filter (black arrow) and the membrane filters out the particles (black dots) and clean water moves through the membrane and flows out of the centre of the filter (clear arrow). The filter can be easily cleaned by back flushing

These filter are very effective in water purification systems. They can filter out most particles and even *giardia* and *cryptosporidium* that caused recent health scares in Sydney water supplies. They are easily cleaned and reasonably strong and can be arranged with a large surface area for extensive water treatment.