Name:

IGCSE Chemistry: **w25 22**

17 Which statement about the conditions used in the Haber process and in the Contact process is correct?

A The typical pressure used in the Haber process is similar to that used in the Contact process.

B The typical temperature used in the Haber process is similar to that used in the Contact process.

C The Haber process uses a vanadium(V) oxide catalyst, and the Contact process uses an iron catalyst.

D Both processes produce an acidic gas.

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16 Which statement about reactions is correct?

A A reaction that is vigorous at room temperature has a high activation energy.

B If ΔH for a reaction is positive, bond making in the formation of the products is endothermic.

C In an exothermic reaction, the energy required to break bonds is less than the energy released to make bonds.

D Reactions with a positive enthalpy change always transfer thermal energy to the surroundings.

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16 Which row describes the conditions used in the manufacture of sulfuric acid by the Contact process?

	catalyst	pressure	temperature
A	iron	high	high
B	iron	low	low
C	vanadium(V) oxide	high	low
D	vanadium(V) oxide	low	high

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17 The equation for the reaction between iron(II) sulfate and bromine is shown.

$$6FeSO_4 + 3Br_2 \rightarrow 2Fe_2(SO_4)_3 + 2FeBr_3$$

Which row identifies the oxidising agent and the reducing agent?

	oxidising agent	reducing agent
A	Br_2	$FeSO_4$
B	$FeSO_4$	Br_2
C	$FeBr_3$	$Fe_2(SO_4)_3$
D	$Fe_2(SO_4)_3$	$FeBr_3$

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1 Using numbers only, state the:

(a) percentage of nitrogen in clean, dry air

..... [1]

(b) typical operating temperature of the Contact process in °C

..... [1]

(c) number of metals in Period 3 of the Periodic Table

..... [1]

(d) number of halogens which are gases at r.t.p.

..... [1]

(e) typical temperature for the fermentation of aqueous glucose in °C

..... [1]

(f) number of unbranched structural isomers of C_4H_8 which decolourise aqueous bromine

..... [1]

(g) number of covalent bonds in one molecule of ethanol

..... [1]

(h) number of carbon atoms in one molecule of propyl butanoate.

..... [1]

[Total: 8]

IGCSE Chemistry: **m25 42**

1 Using numbers only, state the:

(a) percentage of oxygen in clean, dry air ..... [1]

(b) typical operating temperature, **in °C**, used in the Haber process ..... [1]

(c) number of atoms in a diatomic molecule ..... [1]

(d) maximum number of electrons in the second electron shell of an atom ..... [1]

(e) number of hydrogen atoms in an alkane with 7 carbon atoms ..... [1]

(f) number of particles in **one** mole, in standard form. ..... [1]

[Total: 6]

4 Carbonyl chloride, $COCl_2$, is manufactured by reacting carbon monoxide with chlorine.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g) \qquad \Delta H = -105 \text{ kJ/mol}$$

The process takes place in a closed system, and an equilibrium is reached.
The conditions for this process are 200 °C and 200 kPa.

(a) Explain what is meant by the term closed system.

..... [1]

(b) State what the symbol ΔH represents.

..... [1]

(c) State how the value of ΔH shows that the forward reaction is exothermic.

..... [1]

(d) Deduce the value of ΔH for the reverse reaction. Include a sign in your answer.

..... [1]

(e) Complete Table 4.1 to show the effect, if any, on the concentration of $COCl_2(g)$ at equilibrium when the following changes to the conditions are applied.

Use only the words **increases**, **decreases** or **no change**.

Table 4.1

change to conditions	effect on the concentration of $COCl_2(g)$ at equilibrium
the temperature is increased	
some CO is added	
the pressure is increased	
a catalyst is added	

[4]

(f) The equation for the reaction can be represented as shown in Fig. 4.1.

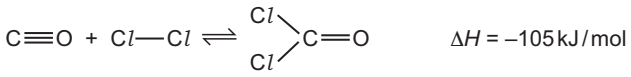

Fig. 4.1

Table 4.2 shows some bond energies.

Table 4.2

bond	C≡O	Cl–Cl	C–Cl
bond energy in kJ/mol	1075	240	340

Use the bond energies in Table 4.2 and the value of ΔH for the reaction to calculate the bond energy, in kJ/mol, of the C=O bond.

Use the following steps.

- Calculate the energy needed to break the bonds in the reactants.

..... kJ

- Calculate the energy released when the bonds in carbonyl chloride form.

..... kJ

- Calculate the bond energy of the C=O bond.

..... kJ/mol
[3]

(g) Complete the dot-and-cross diagram in Fig. 4.2 of a molecule of carbonyl chloride.

Show outer shell electrons only.

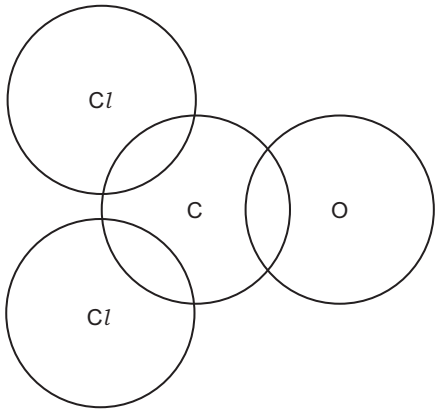

Fig. 4.2

[3]

[Total: 14]