



Annual Examinations for Secondary Schools 2022

YEAR 11

CHEMISTRY

TIME: 2 hours

Name: _____

Class: _____

Useful Data

Atomic numbers and relative atomic masses are shown in the Periodic Table printed below. One mole of any gas occupies 22.4 dm³ at standard temperature (0 °C) and pressure (1 atm.).

PERIODIC TABLE

1	2											3	4	5	6	7	0	
																	4 He 2	
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10	
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	35 Cl 17	40 Ar 18	
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63.5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36	
85 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54	
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86	

Key:

$$\frac{a}{\mathbf{X}} \frac{b}{b}$$

relative atomic mass
symbol
atomic number

Marks Grid [For Examiner's use only][illegible]

Theory Paper: 85%	Practical: 15%	Final Score: 100%

2. This question is about the Periodic Table.

a. Using the Periodic Table provided, give:

i. the name of the most reactive non-metal. _____ (1)

ii. the symbol of a metalloid found in period 3. _____ (1)

iii. the name of a transition metal that can form ions with a +2 or a +3 charge.

_____ (1)

b. An ionic compound is formed between two elements having the following electron configurations:

Element 1: **2, 8, 1**

Element 2: **2, 6**

Draw a dot and cross diagram showing all electron shells, to show the bonding in the compound formed. Label the two elements with their proper chemical symbol.

(3)

Total: 6 marks

3. This question is about group 1 and group 2 metals.

a. Arrange the group 2 metals according to their decreasing reactivity, starting with the most reactive metal. Use the chemical symbols in your answer.

_____ (1)

b. Explain why the reactivity in group 2 changes in the order you gave in part (a).

_____ (2)

c. Write a balanced chemical equation for the reaction of calcium with water.

_____ (2)

d. Would potassium react less or more vigorously than calcium with water?

_____ (1)

Total: 6 marks

4. The following question is about the effect of heat on substances.
- a. Two students were investigating the effect of heat on various solid substances. They placed a small sample of each solid in a test-tube and proceeded to heat the substances over a Bunsen flame. They recorded their observations in the table below.

Solid substance	Observations on heating
A: dark purple-black crystals	Quickly changes to a purple gas.
B: white crystalline	Brown gaseous mixture that relights a glowing splint evolved; yellow solid residue that turns white on cooling.
C: white crystalline	A dense white smoke produced.
D: blue-green powder	Black residue left behind; colourless droplets formed at the test-tube's mouth.

From the following list of substances, choose the correct substance that you think best fits the observations recorded. Each substance in the list can be used once or not at all.

sugar	lead(II) nitrate	copper(II) carbonate
zinc nitrate	iodine	calcium hydroxide
copper(II) hydroxide	potassium nitrate	ammonium chloride

Write your answers in the following table:

Solid A	
Solid B	
Solid C	
Solid D	

(4)

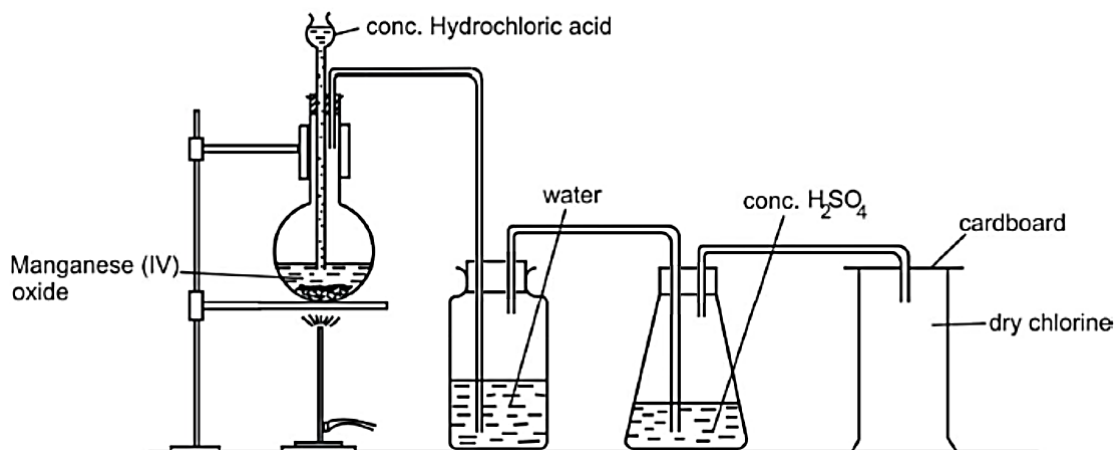
- b. Calcium hydrogencarbonate $[\text{Ca}(\text{HCO}_3)_2]$ decomposes on heating to give limestone, a gas that turns limewater milky, and water. Write a balanced equation for this thermal decomposition.

(2)

Total: 6 marks

5. This question is about group 7 elements.

- a. In the lab, chlorine can be prepared by the reaction of manganese(IV) oxide with concentrated hydrochloric acid. Following are the balanced equation and the apparatus used.



- i. Give a reason why the gaseous mixture produced is passed through water.

(1)

- ii. Why is the remaining gaseous mixture then passed through conc. sulfuric acid?

(1)

- iii. Why is dry chlorine collected using the method shown in the diagram?

(1)

- b. When chlorine is bubbled through a solution of sodium bromide, a reddish-brown liquid is produced. However, when iodine crystals are added to a solution of sodium bromide, no reaction occurs.

- i. Write an ionic equation, omitting spectator ions, for the reaction of chlorine with sodium bromide solution.

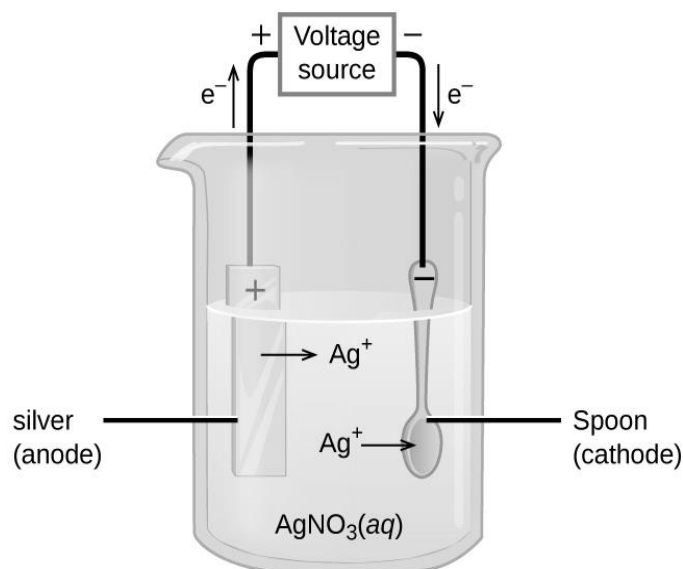
(2)

- ii. From the above observations, what do you conclude about the reactivity of iodine, bromine, and chlorine?

(1)

Total: 6 marks

6. The following question is about electrolysis. The diagram shows the setup used in order to electroplate a metal spoon with silver.



- a. Give the ionic half equation that occurs at the anode.

_____ (2)

- b. Give the ionic half equation that occurs at the cathode.

_____ (2)

- c. In another experiment, the silver anode is replaced by another made of graphite. Name the product that would be given off at the graphite anode.

_____ (1)

- d. Mention another industrial application that uses active electrodes as in the case of electroplating.

_____ (1)

Total: 6 marks

7. Propane, propene, and propyne are all hydrocarbons but they belong to different homologous series.

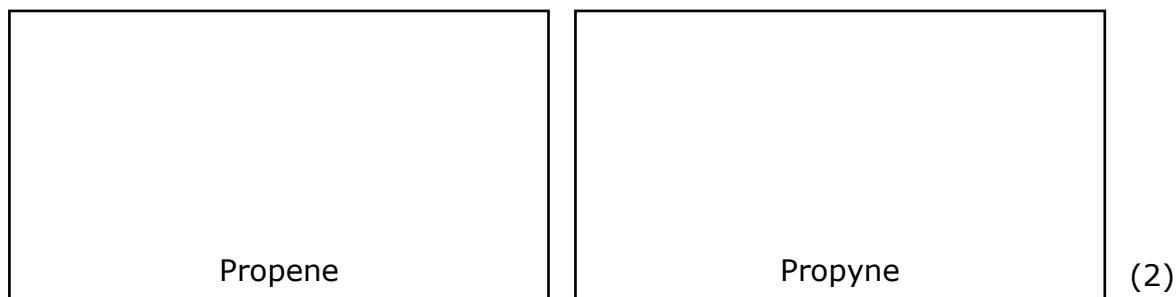
- a. Explain why these organic compounds are classified as hydrocarbons.

_____ (1)

- b. State why propene is known as an alkene.

_____ (1)

- c. Draw the structural diagrams of propene and propyne.

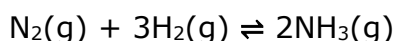


- d. Propane is commonly used as a fuel. Give a balanced equation for the complete combustion of this gas.

_____ (2)

Total: 6 marks

8. During the Haber Process the following dynamic equilibrium reaction occurs.



- a. Explain the meaning of the term dynamic equilibrium.

_____ (1)

- b. State an important condition related to the setup which is required for such an equilibrium to be established.

_____ (1)

- c. State whether the amount of ammonia will increase or decrease when:

i. Pressure is decreased: _____ (1)

ii. Hydrogen is added: _____ (1)

- d. In industry a catalyst in the form of finely divided iron is added. State the effect of the catalyst, if any, on the equilibrium position.

_____ (1)

- e. Name a crystalline substance made from ammonia which is used to increase crop production in the world.

_____ (1)

Total: 6 marks

9.

a. Fill in the blanks:

i. When water is added to anhydrous copper(II) sulfate powder it changes colour from _____ to blue. The blue substance is known as _____ copper(II) sulfate. (1)

ii. When sodium hydroxide solution is added to a solution containing lead(II) ions, a _____ precipitate forms which is _____ in excess sodium hydroxide solution. Since other ions including _____, give the same result, a confirmatory test is performed whereby adding a few drops of potassium iodide solution gives a _____ precipitate. (2)

iii. A flame test on sodium chloride crystals gives a _____ flame while a similar test on potassium chloride gives a _____ flame. (1)

b. The presence of halide ions can be detected by addition of acidified silver nitrate solution. Write an ionic equation to show what happens when bromide ions are present.

_____ (2)

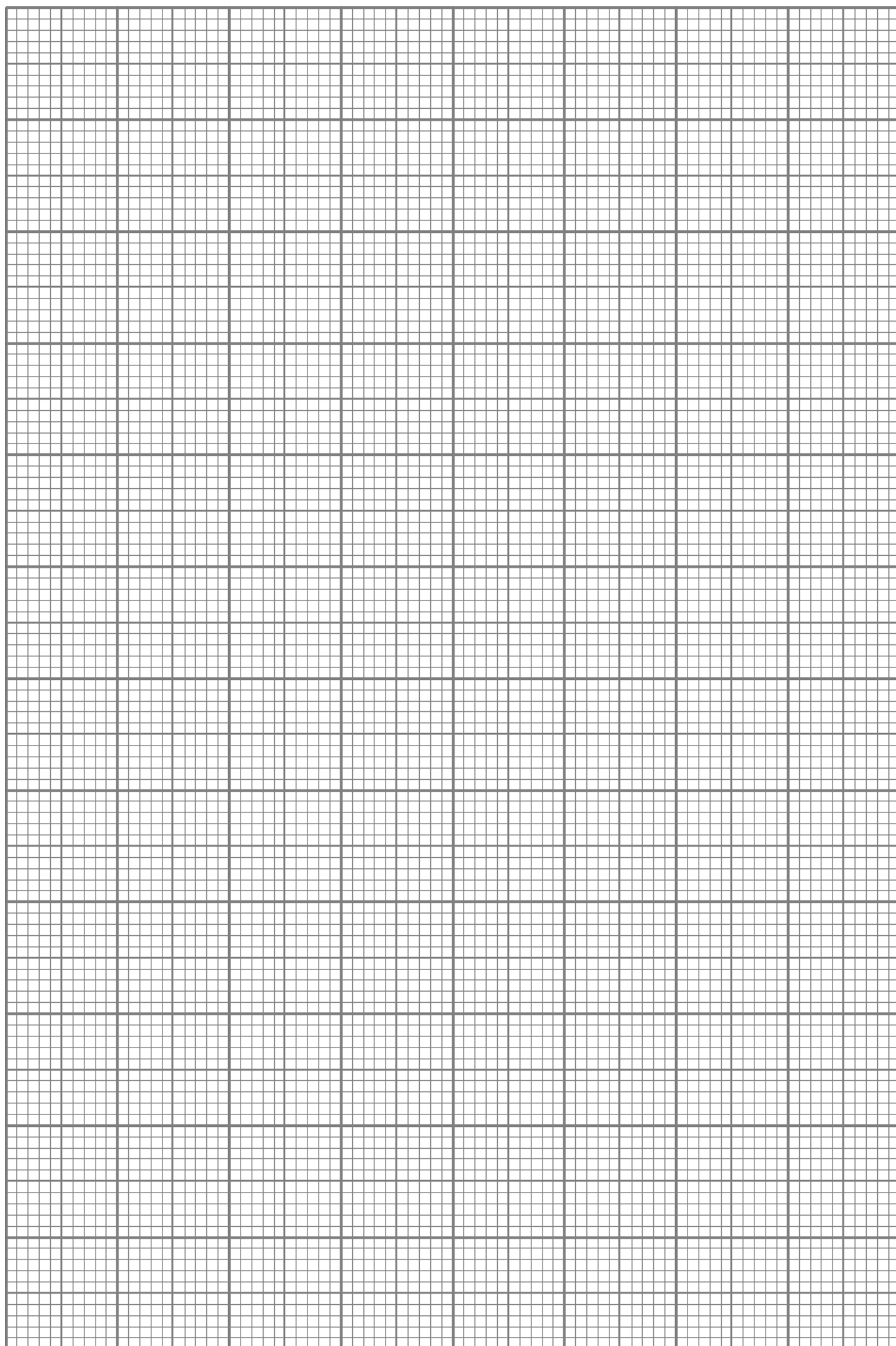
Total: 6 marks

Section B: Answer any TWO questions only on the spaces provided. This section carries 40 marks.

10. An experiment was carried out to find the rate at which hydrogen peroxide decomposes with the action of manganese(IV) oxide catalyst. A conical flask containing 25 cm^3 of 2.0 mol dm^{-3} hydrogen peroxide solution was placed on a digital weighing balance. 2.0 g of solid catalyst in large pieces was added, and the neck of the flask was covered with cotton wool. The mass of the flask and its contents was measured at the start of the reaction and at 2-minute intervals for 12 minutes. The results are shown in the table below.

Time (min)	0	2	4	6	8	10	12
Mass of flask and contents (g)	102.00	101.64	101.50	101.44	101.41	101.40	101.40
Loss in mass (g)	0.00	0.36	0.50	0.56	0.59	0.60	0.60

a. Plot the **loss in mass** on the y-axis against **time** on the x-axis on the graph paper provided on page 9. (6)



- b. Write a balanced equation for the decomposition of hydrogen peroxide to produce water and oxygen.

_____ (2)

- c. What mass of gas is formed?

_____ (1)

- d. How long does the reaction takes to be completed?

_____ (1)

- e. Use the graph to find how long it takes for 0.3 g of gas to be given off?

_____ (2)

- f. By looking at the graph, and referring to the collision theory, explain why the reaction is fast at the start and slows as the reaction proceeds.

_____ (2)

- g. Another experiment was conducted using 25 cm³ of a less concentrated hydrogen peroxide solution.

- i. On the graph plotted in part (a), sketch the curve you would expect to obtain. Label it 'G'. (2)

- ii. By referring to the collision theory, explain the sketch plotted.

_____ (1)

- h. On the graph plotted in part (a), sketch the curve you would expect to obtain if 2.0 g of powdered manganese(IV) oxide catalyst were used in a similar experiment. Label it 'H'. (2)

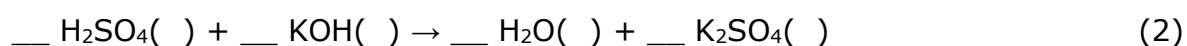
- i. Why does increasing the surface area of the catalyst results in an increased rate of reaction.

_____ (1)

Total: 20 marks

11. Two students carried out an experiment to find the concentration of a solution of sulfuric acid. They transferred 25.00 cm³ of sulfuric acid solution into a conical flask, added a few drops of indicator and carried out a titration using a burette. The acid was neutralized by 30.00 cm³ of potassium hydroxide solution of concentration 2.0 mol dm⁻³.

- a. Balance the following equation which represents the reaction taking place. Include also the state symbols.



- b. Rearrange in the correct order the following statements to form a method for carrying out the titration experiment. Use numbers 1 to 6 to indicate the correct sequence.

A couple of drops of indicator are put in each conical flask and the contents swirled.	
All glassware is washed with distilled water while taking care to finally rinse the burette with potassium hydroxide solution while the pipette is rinsed with sulfuric acid solution.	
The base is run slowly from the burette into the conical flask until there is a colour change which indicates that neutralization has occurred. The volume is noted for the burette.	
The burette is placed securely on a stand and clamp and is filled up to the 0 cm ³ mark with potassium hydroxide solution.	4
The titration is repeated until 2 concordant results are obtained.	
Using a pipette and pipette filler, 25 cm ³ of the acid is transferred to a conical flask. Three such conical flasks are prepared.	

(5)

- c. Draw a diagram of the burette which can be used in this experiment.

(1)

- d. Calculate the number of moles of potassium hydroxide used to reach neutralization.

(2)

e. Calculate the number of moles of sulfuric acid which were neutralized.

(2)

f. Calculate the concentration of the sulfuric acid in mol dm^{-3} .

(2)

g. State whether sulfuric acid is a strong or weak acid. Explain your reasoning.

(2)

h. When sulfuric acid is added to some magnesium, a colourless odourless gas is evolved.

i. Name and draw a suitable piece of apparatus which can be used to collect and measure the volume of the gas produced.

(1)

(1)

ii. Name the gas produced and describe a simple test to identify it.

(2)

Total: 20 marks

12. Iron is a very important transition metal. It is extracted from ores by reduction in a Blast Furnace.

a. Give **two** properties of transition metals.

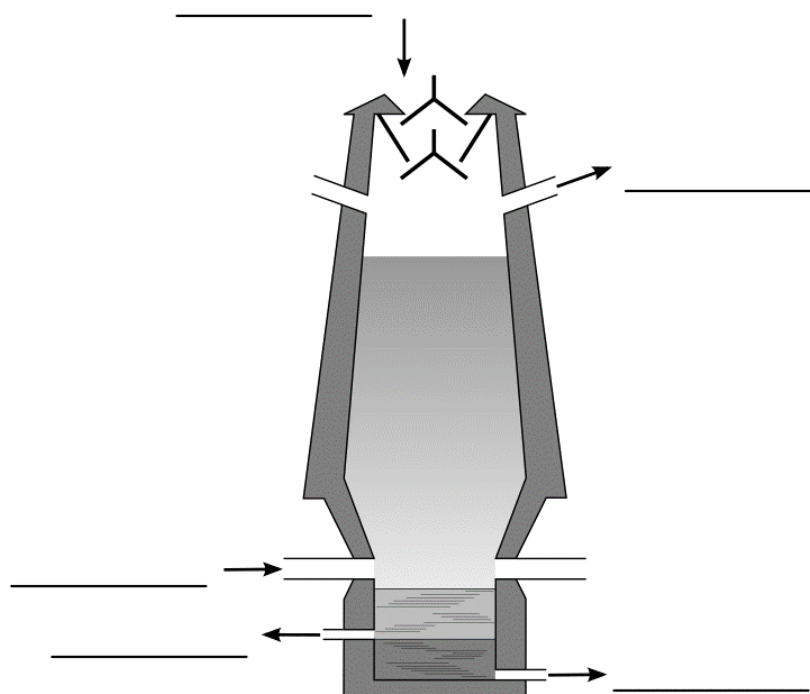
_____ (2)

b. Name the ore from which iron is extracted.

_____ (1)

c. The following is a diagram of the Blast Furnace which is used to produce molten iron. Use the labels from the grid below to label the diagram.

Hot air	Iron	Slag	Waste Gases	Iron ore + limestone + coke.
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d. Balance the following equation which shows the reduction of iron oxide to iron by means of carbon monoxide.



e. Explain why carbon monoxide is considered to be oxidised in the above reaction and name the compound which forms.

_____ (2)

f. Rust is an example of oxidation. Name **two** other substances besides iron which are required for rusting to occur.

_____ (2)

g. Mention **two** methods of rust prevention.

_____ (2)

h. When in solution, Fe^{2+} ions can be converted to Fe^{3+} ions by adding an oxidizing agent.

i. What is the colour of Fe^{2+} ions in solution?

_____ (1)

ii. State whether Fe^{2+} loses or gains an electron in this reaction.

_____ (1)

iii. Write a balanced ionic half equation for this reaction.

_____ (2)

Total: 20 marks