1 Ammonia reacts with nitric acid to form a salt which is present in many fertilisers.

Name the salt formed when ammonia reacts with nitric acid.

..... [1]

[Total: 1]

2 An alloy of zinc, copper and nickel is used to make coins.

Suggest **two** reasons why an alloy is used to make coins and **not** pure copper alone.

1 .....

2 ..... [2]

[Total: 2]

3 When aqueous sodium fluoride is added to chlorine, no reaction occurs.

Explain, using ideas about the reactivity of the halogens, why **no** reaction occurs.

.....

..... [1]

[Total: 1]

4 The table shows some information about the reaction of four metals with dry air at room temperature and on heating.

metal	reaction with dry air at room temperature	reaction with dry air on heating
iron	no reaction	only burns when in the form of a fine wire or powder
copper	no reaction	does not burn but the surface oxidises slowly
samarium	surface oxidises slowly	burns easily
sodium	surface oxidises rapidly	burns easily

Use this information to put the **four** metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 2]

5 Zinc is a metal.

Describe **three** physical properties which are characteristic of metals.

1 .....

2 .....

3 ..... [3]

[Total: 3]

6 Sodium reacts with water to form:

- an alkaline solution
- a gas which 'pops' with a lighted splint.

Complete the word equation for the reaction of sodium with water.

sodium + water → .... + ...

[2]

[Total: 2]

7 Magnesium is a metal in Group II of the Periodic Table.
Copper is a transition element.
Copper has a higher melting point and a higher boiling point than magnesium.

Describe **two** other properties of copper which are different from those of magnesium.

1 .....

2 ..... [2]

[Total: 2]

8 Helium, neon and argon are noble gases.

(a) Explain, in terms of the electronic structure, why neon is unreactive.

.....

..... [1]

(b) State **one** use of argon.

..... [1]

[Total: 2]

9 The following statements are about the procedure for making crystals of hydrated aluminium sulfate from aluminium hydroxide and sulfuric acid.

A Filter off the excess aluminium hydroxide.
B Filter off the crystals and dry between filter papers.
C Warm the filtrate to the point of crystallisation.
D Add aluminium hydroxide to warm dilute sulfuric acid and stir.
E Leave the mixture at room temperature to form more crystals.
F Add more aluminium hydroxide to the sulfuric acid until the aluminium hydroxide is in excess.

Put the statement **A**, **B**, **C**, **D**, **E** and **F** in the correct order.
The first one has been done for you.

D					

[2]

[Total: 2]

Limestone is added to the blast furnace. The limestone is converted into calcium oxide and carbon dioxide. The reaction is endothermic.

10

$$CaCO_3 \xrightarrow{heat} CaO + CO_2$$

(a) What type of chemical reaction is this?

..... [1]

(b) What type of oxide is calcium oxide?
Give a reason for your answer.

.....

..... [2]

[Total: 3]

11 Insoluble salts can be made by precipitation reactions.

A student mixed solutions of some soluble salts.

The results the student obtained are shown in the table.

		second salt solution		
		$Co(NO_3)_2(aq)$	$AgNO_3(aq)$	$Pb(NO_3)_2(aq)$
first salt solution	NaI(aq)	no change	yellow precipitate	yellow precipitate
	$Na_2CO_3(aq)$	purple precipitate	yellow precipitate	white precipitate
	$Na_2SO_4(aq)$	no change	white precipitate	white precipitate

All sodium salts are soluble in water.
Use only results from the table to answer the following questions.

(a) Name:

(i) an insoluble cobalt salt

..... [1]

(ii) an insoluble yellow lead salt

..... [1]

(b) Write the chemical equation for the reaction in which silver carbonate is formed.

..... [2]

(c) Write the ionic equation for the reaction in which lead(II) iodide is formed.

..... [2]

[Total: 6]

12 Indigo is a blue dye.

When an alkaline solution of indigo undergoes reduction, it turns colourless.

(a) What is meant by the term *reduction*?

..... [1]

(b) A piece of white cloth is soaked in the colourless solution.
When the cloth is left in the air it turns blue.

What type of chemical reaction occurs?

Draw a circle around the correct answer.

decomposition **fermentation** **oxidation** **polymerisation**

[1]

[Total: 2]

13 Gaseous phosphorus(III) chloride, PCl_3, reacts with gaseous chlorine to form gaseous phosphorus(V) chloride, PCl_5.

Under certain conditions the reaction reaches equilibrium.

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$$

State and explain the effect, if any, on the **position of equilibrium** if the pressure is increased. All other conditions are unchanged.

.....

.....

..... [2]

[Total: 2]

14 Sulfur dioxide is a pollutant in the air.

(a) State **one** source of sulfur dioxide in the air.

..... [1]

(b) Sulfur dioxide is oxidised to sulfur trioxide in the air.
Oxides of nitrogen act as catalysts for this reaction.

What is meant by the term *catalyst*?

.....

..... [1]

(c) Sulfur trioxide dissolves in rainwater to form acid rain.

Which **one** of the following pH values could be the pH of acid rain?
Draw a circle around the correct answer.

pH 4 pH 7 pH 9 pH 13 [1]

(d) State **one** adverse effect of acid rain on buildings.

..... [1]

[Total: 4]

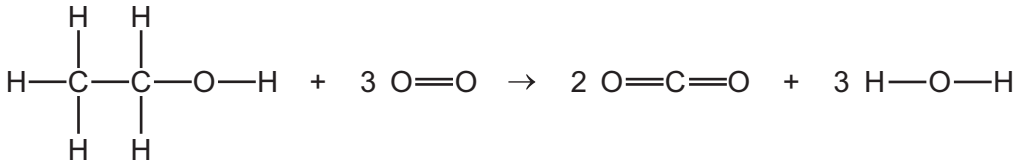
15 When ammonium chloride dissolves in water, the temperature of the solution decreases.

What is the name for a reaction where the temperature of the solution decreases?

..... [1]

[Total: 1]

16 The equation for the complete combustion of ethanol is shown.



Use the bond energies in the table to calculate the energy change, in kJ / mol, for the complete combustion of ethanol

bond	bond energy in kJ / mol
C–C	347
C–H	413
C–O	358
C=O	805
O–H	464
O=O	498

(a) Energy needed to break bonds.

..... kJ [1]

(b) Energy released when bonds are formed.

..... kJ [1]

(c) Energy change for the complete combustion of ethanol.

energy change = ... kJ / mol [1]

[Total: 3]

17 One element in the first 36 elements in the Periodic Table is used as the fuel in a fuel cell.

(a) Name this element.

..... [1]

(b) Write the overall chemical equation for the reaction which occurs when the element in **(a)** reacts in a fuel cell.

..... [2]

[Total: 3]

18 Concentrated hydrochloric acid is electrolysed using graphite electrodes.

(a) Name the products of this electrolysis at:

the positive electrode .....

the negative electrode. ..... [2]

(b) Suggest **one** observation that is made at the negative electrode.

..... [1]

[Total: 3]

19 Magnesium is manufactured by the electrolysis of molten magnesium chloride.

The negative electrode is made of iron.

Suggest a non-metal which could be used for the positive electrode.
Give a reason for your answer.

.....

..... [2]

[Total: 2]

20 Predict the products of the electrolysis of molten magnesium chloride at:

the positive electrode .....

the negative electrode. ..... [2]

[Total: 2]

21 Sodium hydroxide and ammonia are both bases. They both turn red litmus blue.

(a) The chemical equation shows a reaction that produces sodium hydroxide.

$$Na_2CO_3 + Ca(OH) \rightarrow 2NaOH + CaCO_3$$

Complete the word equation for this reaction

....	+	....	→	sodium hydroxide	+	....

[2]

[Total: 2]

22 Complete the word equation for the reaction of dilute sulfuric acid with magnesium.

sulfuric acid	+	magnesium	→	....	+	.....

[2]

[Total: 2]

23 A compound of chlorine has the formula $C_6H_4Cl_2$.

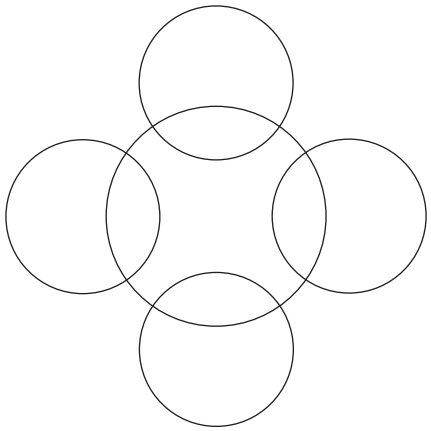
Complete the table to calculate the relative molecular mass of $C_6H_4Cl_2$.
Use your Periodic Table to help you.

type of atom	number of atoms	relative atomic mass	
carbon	6	12	6 x 12 = 72
hydrogen			
chlorine			

relative molecular mass = ... [2]

[Total: 2]

24 Draw a dot-and-cross diagram to show the electron arrangement in a molecule of methane, CH_4.
Show outer shell electrons only.



[2]

[Total: 2]

25 State the name of the particle which is lost from a lithium atom when it forms a lithium ion.

..... [1]

[Total: 1]

26 Draw the electronic structure of a sodium atom.

[2]

[Total: 2]

27 **Z** is a covalent substance. In an experiment, a sample of pure solid **Z** was continually heated for 11 minutes.

The experiment was repeated using a solid sample of impure **Z**.

Suggest the differences, if any, in the melting point and boiling point of the sample of **impureZ** compared to the sample of pure **Z**.

melting point .....

boiling point ..... [2]

[Total: 2]

28 When a piece of solid carbon dioxide is placed in a warm room, it undergoes sublimation.

What is meant by the term *sublimation*?

.....

..... [2]

[Total: 2]

29 Describe a chemical test for water.

test .....

observation ..... [2]

[Total: 2]

30 Balance the chemical equation for the oxidation of methane to form hydrogen.

$$.....CH_4 + O_2 \rightarrow 2CO + ...H_2$$ [2]

[Total: 2]

31 Balance the chemical equation for the complete combustion of methane.

$$CH_4 + ...O_2 \rightarrow CO_2 + H_2O$$

[2]

[Total: 2]

32 The reaction of sodium with water is exothermic.

What is meant by the term *exothermic*?

.....

..... [1]

[Total: 1]

33 Ammonia is used in the manufacture of nitric acid.

(a) Balance the chemical equation for the first step in the process.

$$4NH_3 + 5O_2 \rightarrow .....NO + 6H_2O$$

[1]

(b) The reaction is exothermic.

What is meant by the term *exothermic*?

.....

..... [1]

(c) The NO produced in the first step then reacts with oxygen to produce nitrogen dioxide, NO_2.

$$2NO + O_2 \rightarrow 2NO_2$$

How does this equation show that NO is oxidised?

.....

..... [1]

(d) Is nitrogen dioxide an acidic oxide or a basic oxide?
Give a reason for your answer.

.....

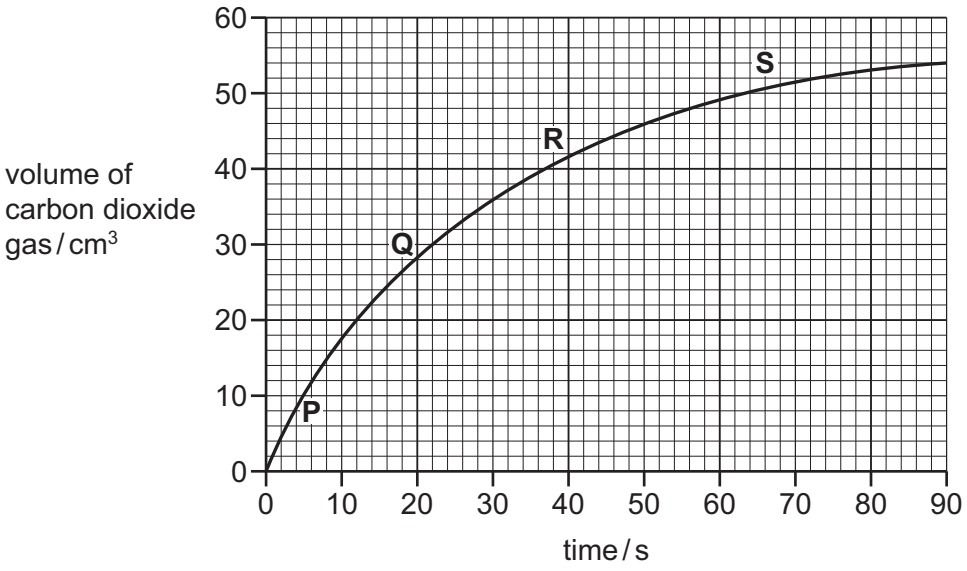
..... [1]

[Total: 4]

34 A student investigated the reaction of calcium carbonate with an excess of dilute hydrochloric acid by measuring the volume of carbon dioxide produced at 10 second intervals.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

The results are shown on the graph.



(a) How long did it take from the start of the experiment to collect 30 cm^3 of carbon dioxide?

..... s [1]

(b) At which point on the graph, **P**, **Q**, **R** or **S**, was the rate of reaction fastest?
Use the graph to explain your answer.

.....

..... [2]

(c) When 0.225 g of calcium carbonate is used, 54.0 cm^3 of carbon dioxide is formed.

Determine the mass of calcium carbonate needed to form 216 cm^3 of carbon dioxide.

mass of calcium carbonate = ... g [1]

(d) What effect do the following have on the rate of this reaction?

(i) Increasing the temperature of the reaction mixture.
All other conditions are kept the same.

..... [1]

(ii) Using larger pieces of calcium carbonate.
All other conditions are kept the same.

..... [1]

[Total: 6]

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0		Key atomic number atomic symbol name relative atomic mass									5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 116.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cr copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.4	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –