1 Helium and hydrogen can both be used to fill balloons.

Suggest **one** advantage of using helium rather than hydrogen to fill balloons.

..... [1]

[Total: 1]

2 This question is about the halogens and compounds of the halogens.

The properties of some halogens are shown in the table.

element	melting point in °C	boiling point in °C	density of liquid at boiling point in g/cm^3	colour
flourine	-220	-188	1.51	
chlorine	-101	.....	1.56	light green
bromine	-7	59	3.12	red-brown
iodine	114	184	.....	grey-black

(a) Complete the table to estimate:

- the boiling point of chlorine
- the density of iodine.

[2]

(b) Describe the trend in the melting points of the halogens down the group.

..... [1]

(c) Predict the physical state of bromine at -20 °C

..... [1]

(d) Which **one** of the following is most likely to be the colour of fluorine?
Tick **one** box.

dark green ☐

light grey-black ☐

light yellow ☐

purple ☐

[1]

[Total: 5]

3 This question is about Group I elements.

The properties of some Group I elements are shown in the table.

element	melting point in °C	boiling point in °C	relative thermal conductivity	atomic radius / pm
lithium	.....	1342	84	152
sodium	97	883	142	186
potassium	63	760	102	.....
rubidium	39	686	58	248

(a) Complete the table to estimate:

- the melting point of lithium [2]
- the atomic radius of potassium.

[2]

(b) Describe the trend in the boiling points of the Group I elements down the group.

..... [1]

(c) Caesium is below rubidium in Group I.

Use the information in the table to suggest why it is difficult to predict the thermal conductivity of caesium.

.....

..... [1]

(d) Predict the physical state of rubidium at 45 °C
Give a reason for your answer.

.....

..... [2]

[Total: 6]

4 This question is about solids, liquids and gases.

(a) The list gives the names of nine substances.

aqueous copper(II) sulfate

aqueous potassium manganate(VII)

aqueous sodium chloride

dilute hydrochloric acid

ethanol

hexene

mercury

octane

water

Answer the following questions about these substances.
Each substance may be used once, more than once or not at all.

State which substance:

(a) is an alkane

..... [1]

(b) is used, when acidified, to test for sulfur dioxide

..... [1]

(c) turns blue litmus red

..... [1]

(d) reacts with sodium to produce only aqueous sodium hydroxide and hydrogen

..... [1]

(e) is produced by the addition of steam to ethene.

..... [1]

[Total: 5]

5 This question is about the halogens and compounds of the halogens.

The properties of some halogens are shown in the table.

element	melting point in °C	boiling point in °C	density of liquid at its boiling point in g/cm^3	atomic radius in nm
chlorine	-101	-35	.....	0.099
bromine	-7	59	3.12	0.144

iodine	114	.....	4.93	0.133
astatine	302	337	6.35	

(a) Complete the table to estimate:

- the density of liquid chlorine
- the boiling point of iodine.

[2]

(b) Describe the trend in the atomic radius of the halogens down the group.

..... [1]

(c) Predict the physical state of bromine at 50 °C.
Give a reason for your answer.

.....

.....

..... [2]

[Total: 5]

6 This question is about solids and gases.

(a) The list gives the names of eight substances which are gases at room temperature.

ammonia

butane

carbon dioxide

carbon monoxide

chlorine

methane

propene

sulfur dioxide

Answer the following questions about these gases.
Each gas may be used once, more than once or not at all.

State which gas:

(a) is a poisonous product formed by the incomplete combustion of carbon

..... [1]

(b) is an alkene

..... [1]

(c) is formed when limestone is thermally decomposed

..... [1]

(d) is an element

..... [1]

(e) causes acid rain.

..... [1]

[Total: 5]

7 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]

8 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]

9 Fluorine is above chlorine in Group Vll of the Periodic Table.

Explain, using ideas about reactivity of the halogens, why chlorine does **not** react with aqueous sodium fluoride.

.....

..... [1]

[Total: 1]

10 The Periodic Table is very useful to chemists.

Refer only to elements with atomic numbers 1 to 36 in the Periodic Table provided when answering this question.

State which metal in the first 36 elements:

(a) is the Group I element which reacts most vigorously with water..... [1]

(b) reacts with air to form lime. ..... [1]

[Total: 2]

11 This question is about bromine and compounds of bromine.

(a) Complete the word equation to show the halogen and halide compound which react to form the products bromine and potassium chloride.

.....	+	....	→	bromine	+	potassium chloride

[2]

(b) Explain, in terms of the reactivity of the halogens, why aqueous bromine will **not** react with aqueous potassium chloride.

.....

..... [1]

[Total: 3]

12 Describe **three** properties of iron that show that it is a transition element and **not** a Group I element.

1 .....

2 .....

3 ..... [3]

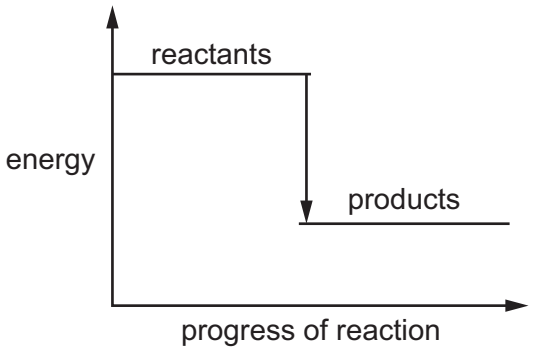
[Total: 3]

13 Bromine reacts with hydrogen sulfide, H_2S.

(a) Complete the chemical equation for this reaction.

..... + H_2S → .....HBr + S [2]

(b) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

[Total: 3]

14 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]

15 This question is about iodine and compounds of iodine.

(a) Complete the word equation to show the halogen and halide compound which react to form the products iodine and potassium bromide.

.....	+	.....	→	iodine	+	potassium bromide

[2]

(b) Explain, in terms of the reactivity of the halogens, why aqueous iodine does **not** react with aqueous potassium chloride.

.....

..... [1]

[Total: 3]

16 **(a)** Complete the word equation to show the halogen and halide compound which react to form the products iodine and sodium chloride.

.....	.....	iodine	sodium chloride

[2]

(b) Explain, in terms of the reactivity of the halogens, why aqueous bromine will **not** react with aqueous sodium chloride.

.....

..... [1]

[Total: 3]

17 Sodium is in Group I of the Periodic Table.

(a) Describe **two** physical properties of sodium which are different from the physical properties of transition elements such as copper.

1 .....

.....

2 .....

..... [2]

(b) Sodium reacts rapidly with water.

Give **one** observation made when sodium is added to water.

..... [1]

[Total: 3]

18 Nickel is a transition element. Nickel is stronger than sodium.

Describe **two** other differences in the physical properties of nickel and sodium.

1 .....

2 ..... [2]

[Total: 2]

19 The halogens are the elements in Group VII of the Periodic Table.

Predict the physical state and colour of astatine at room temperature and pressure.

physical state .....

colour ..... [2]

[Total: 2]

20 Reactions occur when some aqueous solutions of halogens are added to aqueous solutions of halides.

Use the key to complete the table to show the results of adding halogens to halides.

key
✓ = reaction
✗ = no reaction

		halides		
		KC*l*(aq)	KBr(aq)	KI(aq)
halogens	Cl_2(aq)		✓	
	Br_2(aq)			
	I_2(aq)			

[2]

[Total: 2]

21 When chlorine reacts with aqueous potassium bromide a displacement reaction occurs.

(a) Describe the colour change of the solution.

from ..... to ..... [2]

(b) Write a chemical equation for this reaction.

..... [2]

[Total: 4]

22 Predict **one** difference in the appearance of aqueous solutions of nickel compounds compared to aqueous solutions of sodium compounds.

.....

..... [1]

[Total: 1]

23 Copper is a transition element. It can have variable oxidation states.

State **two** other chemical properties of transition elements which make them different from Group I elements.

1 .....

2 ..... [2]

[Total: 2]

24 Chromium is a transition element. Sodium is an element in Group I of the Periodic Table.

Describe **two** ways in which the properties of chromium are different from those of sodium.

1 .....

2 ..... [2]

[Total: 2]

25 Period 3 of the Periodic Table is shown.

sodium	magnesium	aluminium	silicon	phosphorus	sulfur	chlorine	argon

Answer the following questions using only these elements.

Each element may be used once, more than once or not at all.

State which element:

(a) is a gas at room temperature and pressure

..... [1]

(b) forms a basic oxide with a formula of the form X_2O

..... [1]

(c) is made of atoms which have a full outer shell of electrons

..... [1]

(d) forms an oxide which causes acid rain

..... [1]

(e) is extracted from bauxite

..... [1]

(f) forms an oxide which has a macromolecular structure

..... [1]

(g) consists of diatomic molecules.

..... [1]

[Total: 7]

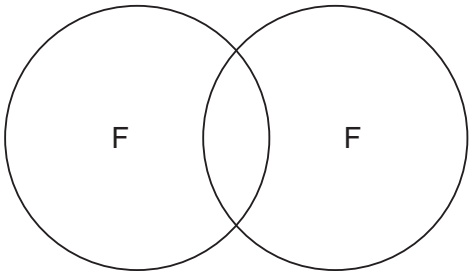
26 Fluorine is a Group VII element. Fluorine forms compounds with metals and non-metals.

(a) Predict the physical state of fluorine at room temperature and pressure.

..... [1]

(b) Fluorine exists as diatomic molecules.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of fluorine. Show outer shell electrons only.



[2]

(c) Write a chemical equation for the reaction between sodium and fluorine.

..... [2]

(d) Explain why chlorine does **not** react with aqueous sodium fluoride.

.....

..... [1]

[Total: 6]

27 Titanium is extracted from an ore called rutile. Rutile is an impure form of titanium(IV) oxide, TiO_2.

Rutile is mixed with coke and heated in a furnace through which chlorine gas is passed. The product is gaseous titanium(IV) chloride, $TiCl_4$.

Titanium(IV) chloride is heated with an excess of magnesium, in an atmosphere of argon.

(a) Balance the chemical equation for the reaction.

$$TiCl_4 + ...Mg \rightarrow Ti + ...MgCl_2$$ [1]

(b) Titanium(IV) chloride can be reacted with sodium instead of magnesium.

The reaction between titanium(IV) chloride and sodium is similar to the reaction between titanium(IV) chloride and magnesium.

Write a chemical equation for the reaction between titanium(IV) chloride and sodium.

..... [1]

(c) Suggest why the reaction between titanium(IV) chloride and magnesium is done in an atmosphere of argon and **not** in air.

.....

..... [1]

[Total: 3]

28 This question is about transition elements.

(a) Transition elements are harder and stronger than Group I elements.

Describe **two** other differences in **physical** properties between transition elements and Group I elements.

1 .....

2 ..... [2]

(b) State **one** physical property of transition elements that is similar to Group I elements.

..... [1]

(c) State **two** chemical properties of transition elements.

1 .....

2 ..... [2]

[Total: 5]

29 When aqueous potassium iodide reacts with aqueous chlorine, the solution turns brown.

Name the brown substance that forms. Using ideas about the reactivity of the halogens, suggest why the brown substance forms.

.....

..... [2]

[Total: 2]

30 The table shows the properties of some Group VII elements.

element	boiling point in °C	density at room temperature in g / cm^3	physical state at room temperature
fluorine	–188	0.0017	
chlorine		0.0032	gas
bromine	59	3.1	liquid
iodine	184	4.9	solid

(a) Use this information to:

- identify the physical state of fluorine at room temperature

.....

- estimate the boiling point of chlorine.

..... [2]

(b) Suggest why the density of chlorine is much lower than the densities of bromine and iodine.

.....

..... [1]

[Total: 3]

31 The table shows the properties of some Group I elements.

element	density in g / cm3	melting point in °C	relative hardness
sodium	0.97	98	4.9
potassium	0.86	63	2.6
rubidium	1.53		1.6
caesium		29	1.0

When potassium reacts with water, it floats and melts into a ball. A flame is observed.

(a) What colour does potassium give to the flame?

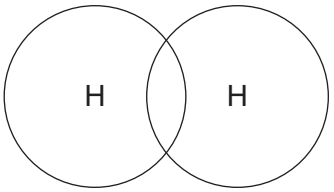
..... [1]

(b) Use the information in the table to suggest why potassium floats on water.

..... [1]

(c) Hydrogen is produced when potassium reacts with water.

Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrogen.



[1]

[Total: 3]

32 The table shows the properties of some Group I elements.

element	density in g / cm^3	melting point in °C	relative hardness
sodium	0.97	98	4.9
potassium	0.86	63	2.6
rubidium	1.53		1.6
caesium		29	1.0

(a) Describe the trend in the relative hardness of the Group I elements.

..... [1]

(b) Predict the melting point of rubidium.

..... [1]

(c) Explain why it is difficult to predict the density of caesium.

.....

..... [1]

[Total: 3]

33 Argon is present in clean, dry air.

(a) Give **one** use of argon.

..... [1]

(b) Which **two** of the following statements about argon are correct?
Tick **two** boxes.

Argon is unreactive.	☐
Argon is diatomic.	☐
Argon is monatomic.	☐
Argon forms ionic compounds.	☐
Argon is a greenhouse gas.	☐

[2]

[Total: 3]

34 Aqueous potassium bromide reacts with aqueous chlorine.

Complete the word equation for this reaction.

potassium bromide + chlorine → ..... + ...

[2]

[Total: 2]

35 Aqueous potassium bromide reacts with aqueous chlorine.

Using ideas about the reactivity of the halogens, explain why aqueous potassium bromide does **not** react with aqueous iodine.

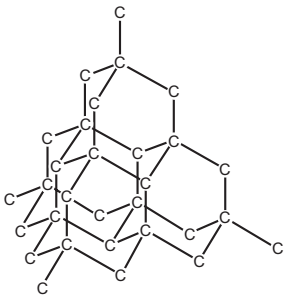
.....

..... [1]

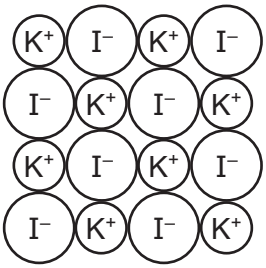
[Total: 1]

36 The diagrams show the structures of four substances, **R**, **S**, **T** and **U**.

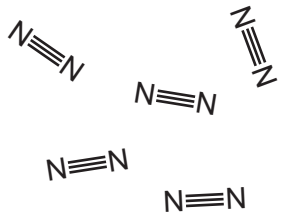
R



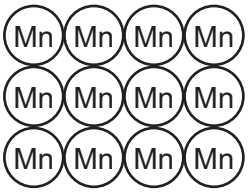
S



T



U



State which **one** of these substances, **R**, **S**, **T** or **U** can act as a catalyst.

..... [1]

[Total: 1]

37 The table gives some information about four different particles, **A**, **B**, **C** and **D**.

particle	number of electrons	number of neutrons	number of protons	electronic structure	charge on particle
A	11	12	11	2,8,1	0
B		14	11	2,8,1	0
C	18	20		2,8,8	0
D	18	20	17		

(a) Complete the table. The first row has been done for you.

[4]

(b) Give **two** particles from the table which are isotopes of each other.

..... [1]

(c) Element **Z** is in the same group of the Periodic Table as **A** and is less reactive than **A**.

State the identity of element **Z**.

..... [1]

(d) **C** is unreactive.

Use information from the table to explain why.

..... [1]

[Total: 7]

38 This question is about Group I elements and their compounds.

The properties of some Group I elements are shown in the table.

element	boiling point / °C	atomic radius / pm	relative thermal conductivity	observations when it reacts with cold water
sodium	883	186	3.9	rapid bubbling but does **not** burst into flame
potassium	759	227		very rapid bubbling and bursts into flame
rubidium	688		1.6	
caesium	671	265	1.0	explodes

(a) Complete the table to estimate

- the relative thermal conductivity of potassium
- the atomic radius of rubidium

[2]

(b) Describe the trend in the boiling points of the Group I elements.

..... [1]

(c) Use the information in the table to predict what you would observe when rubidium reacts with cold water.

..... [1]

[Total: 4]

39 The names of nine gases are given.

ammonia

carbon monoxide

chlorine

ethane

ethene

helium

hydrogen

neon

oxygen

State which gas is a monatomic gas with ten protons in its nucleus.

..... [1]

[Total: 1]

40 The names of seven gases are given.

ammonia
ethene
helium
hydrogen
hydrogen chloride
methane
nitrogen

State which gas is monatomic.

..... [1]

[Total: 1]