Name: _____

Class: _____

Date: _____

Atomic Structure & Periodic Table part 5 AQA Triple Chemistry

Time: **51 minutes**

Marks: **50 marks**

Comments:

1.

(a) What is the name given to the block of elements in the middle of the Periodic Table which includes vanadium?

_____

(1)

(b) Some of the properties of vanadium are shown in this list.

- It has a high melting point.
- It is a solid at room temperature.
- It is a conductor of electricity.
- It is a good conductor of heat.
- It forms coloured compounds.
- If forms crystalline compounds.
- It forms compounds that are catalysts.

Select **two** properties, from the list above, which are **not** typical of a Group 1 metal.

1. _____

2. _____

(2)

(Total 3 marks)

2.

Sodium is a Group 1 element.

(a) (i) A small piece of sodium is added to some water containing Universal Indicator solution.

Describe what you would **see** happening.

_____

_____

_____

_____

_____

_____

(3)

(ii) Complete **and** balance the equation for the reaction of sodium with water.

___Na + ___H_2O → _____ + H_2

(2)

(b) Francium is the most reactive element in Group 1.

Explain why in terms of electronic structure.

_____

_____

_____

_____

_____

_____

(3)

(c) The transition elements have different properties from the elements in Group 1.

Give **two** of these different properties of transition elements.

1. _____

_____

2. _____

_____

(2)

(Total 10 marks)

3. Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.

(a) State why transition metal oxides are added to pottery glazes.

_____

(1)

(b) Use the table of ions on the Data Sheet to help you work out the formula of iron(III) oxide.

_____

(1)

(c) Cobalt oxide is reacted with hydrogen to form cobalt.

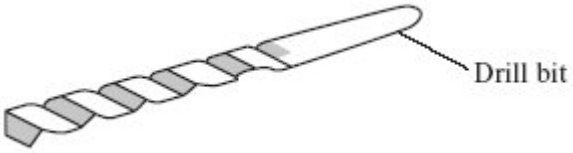
(i) Balance the equation for this reaction.

$$Co_3O_4 + \ldots\ldots H_2 \rightarrow 3\,Co + \ldots\ldots H_2O$$

(1)

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.



Suggest **two** properties of transition metals that make them suitable for making cutting tools.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

4. This question is about metals.

(a) Platinum is used to make jewellery.

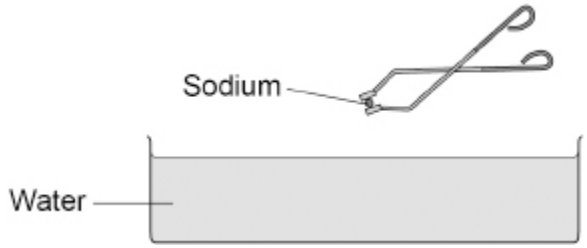
Suggest **one** reason why platinum is used to make jewellery.

_____

_____

(1)

(b) The figure below shows a piece of sodium being added to water.



Give **two** observations that could be seen when sodium is added to water.

1 _____

_____

2 _____

_____

(2)

(c) Copper is a transition element.

Sodium is a Group 1 element.

What are **two** differences between copper and sodium?

Tick (✓) **two** boxes.

Copper has a lower melting point. ☐

Copper is harder. ☐

Copper is less dense. ☐

Copper is less reactive. ☐

Copper is less strong. ☐

(2)

(d) The metals aluminium and copper can be used to make pans for cooking.

The table below shows information about the two metals.

The higher the value for thermal conductivity, the better the metal conducts thermal energy.

	Aluminium	**Copper**
Thermal conductivity in arbitrary units	250	400
Density in g/cm^3	2.7	8.9
Cost of metal per kg in £	1.50	7.00

Evaluate the use of pans made of aluminium and of copper.

Use the table.

(4)

(Total 9 marks)

5. An atom of aluminium has the symbol $^{27}_{13}Al$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons _____

Number of neutrons _____

Number of electrons _____

(3)

(b) Why is aluminium positioned in Group 3 of the periodic table?

_____

_____

(1)

(c) In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in the table below.

	Transition elements		**Group 1 elements**	
	Chromium	Iron	Sodium	Caesium
Melting point in °C	1857	1535	98	29
Formula of oxides	CrO Cr_2O_3 CrO_2 CrO_3	FeO Fe_2O_3 Fe_3O_4	Na_2O	Cs_2O

Use your own knowledge **and** the data in the table above to compare the chemical and physical properties of transition elements and Group 1 elements.

(6)

(Total 10 marks)

6. (a) Balance these chemical equations.

(i) H_2 + O_2 → H_2O

(1)

(ii) Al + O_2 → Al_2O_3

(1)

(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

_____

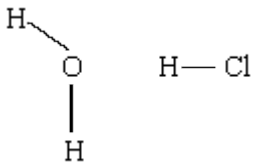
_____

_____

_____

(2)

(c) Explain, as fully as you can, why a water molecule contains two hydrogen atoms but a hydrogen chloride molecule contains only one.



(You may use a diagram in your answer if you wish).

_____

_____

_____

_____

(3)

(Total 7 marks)

7. (a) The table shows how Group 7 elements react with hydrogen.

Element	Reaction with hydrogen	
	Description	**Product**
Fluorine	Explosive reaction in dim light	Hydrogen fluoride
Chlorine	Explosive reaction in sunlight	Hydrogen chloride
Bromine	Reacts if heated	Hydrogen bromide
Iodine	Reacts if heated strongly	Hydrogen iodine

(i) Explain why all the Group 7 elements react in a similar way with hydrogen.

_____

_____

_____

_____

(2)

(ii) Explain the difference in the rates of the reaction of fluorine with hydrogen, and of iodine with hydrogen.

_____

_____

_____

_____

(2)

(b) Explain why Group 0 elements are monatomic.

_____

_____

_____

_____

(2)

(Total 6 marks)

1.

(a) transition / transitional metals / elements / d-block

for one mark

1

(b) coloured
catalyst

(*accept* high melting point)

for 1 mark each

2

[3]

2.

(a) (i) UI / solution turns blue / purple

allow violet / lilac

1

any **two** from:

- floats
- melts / forms a sphere
- moves

  *note: moves on surface = **2** marks (points 1 and 3)*
- effervescence / fizz / bubbles / gas

  ignore the name of the gas
- (yellow) flame

  ignore sparks / ignites / burns

  allow dissolves
- reduces in size

  ignore 'reacts violently' unqualified

  ignore reference to exothermic / heat evolved

2

(ii) **2**Na + **2**H_2O → **2NaOH** + H_2

*correct equation = **2** marks*

allow correct multiples / fractions

if this equation is unbalanced,

*allow **1** mark for NaOH*

2

(b) *it = francium*

*outer electron / shell / energy level must be mentioned once for all **3** marks*

biggest atom **or** (outer) shell / energy level / electron furthest from nucleus **or** most (number of) shells

1

least attraction (to nucleus) **or** most shielding

allow the attraction is very weak

*do **not** allow less magnetic / gravitational attraction*

1

(outer) electron more easily lost / taken

ignore francium reacts more easily / vigorously

1

(c) any **two** from:

ignore other properties / specific reactions

they / it = transition elements

transition elements:

allow if state group 1 elements

- high melting point **or** high boiling point
  - *low melting point or low boiling point*
- high density
  - *low density*
- strong / hard
  - *weak / soft*
- not very reactive
  - *reactive*
- catalysts
  - *not catalysts*
- ions have different charges
  - *+1 ions*
- coloured compounds
  - *white compounds*

2

[10]

3. (a) colour

1

(b) Fe_2O_3 or $(Fe^{3+})_2\ (O^{2-})_3$

2 and 3 should be below halfway on Fe and O

1

(c) (i) 4 4

or correct multiples

1

(ii) any **two** from:

ignore references to malleable / ductile / conductivity / stiff / boiling point / density

- high melting point

  accept can withstand high temperatures

- strong / tough

  accept <u>not</u> brittle

- hard

  *do **not** accept flexible*

- not (very) reactive

2

[5]

4. (a) any **one** from:

- unreactive

  allow does not react with air / water / skin

  allow does not tarnish

- appearance

  allow aesthetic reasons

- easily shaped

  allow malleable

  allow easily moulded

  ignore references to cost

  ignore references to hardness / strength

  ignore references to melting / boiling point

1

(b) any **two** from:

- bubbles
- moves
- floats
- melts

  allow forms a ball

- disappears

  allow catches fire

2

(c) copper is harder

1

copper is less reactive

1

(d) **Level 2:** Some logically linked reasons are given. There may also be a simple judgement.

3-4

Level 1: Relevant points are made. They are not logically linked.

1-2

No relevant content

0

Indicative content

- copper is the better conductor
- so heats food more quickly

- copper has the higher density
- so the pan is heavier

- copper costs more per kilogram
- so the pan is more expensive to buy

- simple judgement

[9]

5. (a) 13 (protons)

The answers must be in the correct order.

*if no other marks awarded, award **1** mark if number of protons and electrons are equal*

1

14 (neutrons)

1

13 (electrons)

1

(b) has three electrons in outer energy level / shell

allow electronic structure is 2.8.3

1

(c) **Level 3 (5–6 marks):**
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

Level 2 (3–4 marks):
A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

Level 1 (1–2 marks):
Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

0 marks:
No relevant content.

Indicative content

Physical
Transition elements
- high melting points
- high densities
- strong
- hard

Group 1
- low melting points
- low densities
- soft

Chemical
Transition elements
- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1
- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

6

[10]

6. (a) (i) $2\ H_2 + O_2 \rightarrow 2\ H_2O$ (*allow* $H_2 + ½O_2 \rightarrow H_2O$)
both circled for 1 mark

1

(ii) $4\ A1 + 3\ O_2 \rightarrow 2\ A1_2O_3$
all circled for 1 mark

1

(b) *idea that:*
must end up with the same number of atoms
otherwise matter is shown to be lost/gained
doesn't show correct amount of each element/compared

each for 1 mark

2

(c) *idea that:*
oxygen has 2 electrons short in outer shell) in words or
chlorine has 1 electron short in outer shell) indicated on diagram
(shared pair/covalent bond with) hydrogen
atom supplies **one** further electron*
(but do not allow hydrogen **gives away electron or **ionic bond**)*

for 1 mark each

3

[7]

7. (a) (i) same number of electrons

allow all have 7 electrons

1

in outermost shell

1

(ii) fluorine has fewer shells than iodine / less shielding

1

gains electrons more easily / more pull

1

(b) outermost shell full

1

no tendency to lose / gain electrons

1

[6]