The Periodic Table – 2020 O Level

1. Nov/2021/Paper_11/No.27

An atom of which element has the same electronic configuration as an atom of an ion of strontium?

A calcium

B krypton

C rubidium

D selenium

2. Nov/2021/Paper_21/No.4

This question is about halogens and halogen compounds.

(a) A drop of bromine liquid was placed in a sealed glass jar.

After a time, the colour of the bromine had spread throughout the jar.

Explain this observation in terms of the kinetic particle theory.

.....

.....

.....

.....

..... [3]

(b) Chlorine, bromine and iodine are halogens.

(i) State the trend in the colour of the halogens from chlorine to iodine.

.....

..... [1]

(ii) State the physical state of chlorine and iodine at room temperature and pressure.

chlorine .....

iodine .....

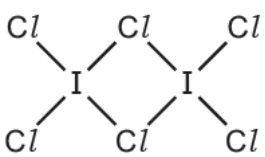
[1]

(iii) Chlorine is used to make other chemicals.

State one other use of chlorine.

..... [1]

(c) The molecular structure of a compound of iodine and chlorine is shown.



Deduce the molecular formula of this compound.

..... [1]

(d) Fluorine reacts with aqueous sodium hydroxide to produce sodium fluoride, NaF, water and oxygen.

$$2F_2 + 4NaOH \rightarrow 4NaF + 2H_2O + O_2$$

Calculate the maximum volume of oxygen produced, in dm^3, at room temperature and pressure, when 0.037 mol of sodium hydroxide react completely with fluorine.

Give your answer to **two** significant figures.

volume of oxygen ..... dm^3 [2]

[Total: 9]

3. Nov/2021/Paper_21/No.5

Platinum and vanadium are both transition elements.

(a) Transition elements are metals which are hard, strong and have high melting points and boiling points.

State two other properties which are typical of transition elements but **not** of all metals.

1 .....

2 .....

[2]

(b) Vanadium(V) oxide, V_2O_5, is a catalyst in the Contact process.

(i) State how a catalyst increases the rate of a chemical reaction.

.....

..... [1]

(ii) State the conditions used in the Contact process.

.....

..... [2]

(c) Vanadium(V) oxide is reduced to vanadium by heating with aluminium.

Complete the equation for this reaction.

$$3V_2O_5 + ...Al \rightarrow .....V + ...Al_2O_3$$ [1]

(d) A fuel cell generates electricity when hydrogen and oxygen react on platinum electrodes.

(i) Name the process used in industry to separate oxygen from air.

..... [1]

(ii) The reaction at one of the electrodes in the fuel cell is shown.

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

State whether this is an oxidation or reduction reaction.

Explain your answer.

.....

..... [1]

[Total: 8]

4. Nov/2021/Paper_21/No.9

Calcium is a metal in Group II of the Periodic Table.

(a) Calcium can be used as a reducing agent.

Describe a test for reducing agents.

test .....

observations .....

[2]

(b) An ion of calcium has the symbol

$$^{44}_{20}Ca^{2+}$$

Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

[2]

(c) When calcium carbonate is heated in a closed container, an equilibrium mixture is formed.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

The forward reaction is endothermic.

(i) Describe and explain the effect, if any, on the position of equilibrium when a hole is made in the container.

.....

.....

..... [2]

(ii) Describe and explain the effect, if any, on the position of equilibrium when the temperature is increased.

.....

.....

..... [2]

(d) When heated, calcium oxide reacts with chlorine to form calcium chloride and a gas which relights a glowing splint.

Complete the equation for this reaction.

$$2CaO + \text{.....} \rightarrow \text{.....}CaCl_2 + \text{.....}$$ [1]

(e) Calcium chloride is soluble in water.

Name one **other** calcium salt which is soluble in water.

..... [1]

[Total: 10]

5. Nov/2021/Paper_22/No.4c

(c) Sodium and potassium react with water in a similar way to lithium.

(i) Explain, in terms of their electronic configuration, why lithium, sodium and potassium all react in a similar way.

.....

..... [1]

(ii) Describe the trend in reactivity of the Group I elements lithium, sodium and potassium.

..... [1]

6. Nov/2021/Paper_22/No.9

Lead is a metal in Group IV of the Periodic Table.

(a) An ion of lead has the symbol

$$^{207}_{82}Pb^{2+}$$

Deduce the number of electrons and neutrons in this ion.

number of electrons .....

number of neutrons .....

[2]

(b) Lead(IV) oxide, PbO_2, is an oxidising agent.

(i) Describe a test for oxidising agents.

test .....

observations .....

[2]

(ii) Lead(IV) oxide reacts with concentrated hydrochloric acid to form lead(IV) chloride, $PbCl_4$, and water.

Construct the equation for this reaction.

..... [1]

(c) When lead(IV) chloride is warmed in a closed container an equilibrium mixture is formed.

The forward reaction is exothermic.

$$PbCl_4(l) \rightleftharpoons PbCl_2(s) + Cl_2(g)$$

lead(IV) chloride lead(II) chloride

(i) Describe and explain the effect, if any, on the position of equilibrium when the concentration of chlorine is increased.

.....

.....

..... [2]

(ii) Describe and explain the effect, if any, on the position of equilibrium when the temperature is increased.

.....

.....

..... [2]

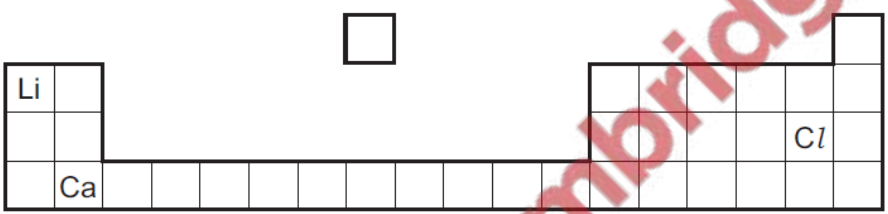
Name a lead salt which is soluble in water.

..... [1]

[Total: 10]

7. Jun/2020/Paper_11/No.23

The diagram shows part of the Periodic Table.



Which element has the highest proton number and which element has the largest number of valence electrons?

	highest proton number	highest number of valence electrons
A	Ca	Ca
B	Ca	Cl
C	Li	Ca
D	Li	Cl

8. Jun/2020/Paper_11/No.24

A lump of element X can be cut by a knife.

During its reaction with water, X floats and melts.

What is X?

A calcium

B copper

C magnesium

D potassium

9. Jun/2020/Paper_11/No.25

Which statement about the properties of some elements is correct?

A All noble gases are unreactive due to having eight electrons in their outer shells.

B The Group VII element astatine, At_2, is expected to be a black solid at room temperature.

C The reactivity of the elements in both Group I and Group VII increases down the group.

D When aqueous chlorine is added to aqueous potassium bromide there is no change in colour.

10. Jun/2020/Paper_12/No.24

A lump of element X can be cut by a knife.

During its reaction with water, X floats and melts.

What is X?

A calcium

B copper

C magnesium

D potassium

11. Jun/2020/Paper_12/No.25

Chlorine is passed into separate samples of aqueous potassium iodide and aqueous potassium bromide.

In which solutions is there a colour change?

	KI(aq)	KBr(aq)
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

key

✓ = yes

✗ = no

12. Jun/2020/Paper_21/No.8

This question is about the chlorides of the elements in Period 3.

(a) State the electronic configuration of the positive ion in sodium chloride, NaCl.

..... [1]

(b) Magnesium chloride crystals can be prepared by reacting an insoluble base with an acid.

(i) Name an insoluble base and the acid that can be used.

insoluble base .....

acid .....

[1]

(ii) Describe the essential practical details for the preparation of pure magnesium chloride crystals.

.....

.....

.....

.....

..... [3]

(c) Anhydrous aluminium chloride contains 20.2% by mass of aluminium.

(i) Show that the empirical formula for anhydrous aluminium chloride is $AlCl_3$.

[2]

(ii) A sample of anhydrous aluminium chloride has a mass of 2.34 g.

The sample contains 0.00876 mol of anhydrous aluminium chloride.

Calculate the relative molecular mass and give the molecular formula for anhydrous aluminium chloride.

relative molecular mass .....

molecular formula .....

[2]

(d) Silicon(IV) chloride, $SiCl_4$, has a simple molecular structure.

Predict **one** physical property of silicon(IV) chloride at room temperature.

..... [1]

[Total: 10]

13. Jun/2020/Paper_21/No.9

Iron is a transition element.

(a) State two physical properties of iron that are typical of a transition element.

1. .....

2. .....

[2]

(b) Name an industrial process that uses iron as a catalyst.

..... [1]

(c) Iron(II) sulfate thermally decomposes to form iron(III) oxide, sulfur dioxide and sulfur trioxide.

$$2FeSO_4(s) \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

(i) Explain how the equation shows that this reaction involves oxidation.

.....

..... [1]

(ii) A sample of 6.08 g of $FeSO_4$ is heated until all the sample has thermally decomposed.

Calculate the volume of sulfur dioxide formed, $SO_2(g)$, in dm^3, measured at room temperature and pressure.

volume of sulfur dioxide ..... dm^3 [3]

(d) Iron(III) oxide reacts with dilute sulfuric acid to make iron(III) sulfate, $Fe_2(SO_4)_3$.

Construct the equation for this reaction.

..... [1]

(e) Describe a chemical test that can be used to distinguish between aqueous solutions of iron(II) sulfate and iron(III) sulfate.

chemical test .....

result with iron(II) sulfate .....

result with iron(III) sulfate .....

[2]

[Total: 10]

14. Jun/2020/Paper_22/No.7

This question is about some of the oxides of the elements in Period 3.

(a) State the electronic configuration of the negative ion in sodium oxide, Na_2O.

..... [1]

(b) Magnesium oxide is an insoluble base that can be used to prepare pure magnesium sulfate crystals.

Describe the essential practical details for the preparation of pure magnesium sulfate crystals from magnesium oxide.

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.....

.....

.....

.....

.....

..... [4]

(c) An oxide of phosphorus contains 43.7% by mass of phosphorus.

(i) Show that the empirical formula for this oxide is P_2O_5.

[2]

(ii) A sample of this oxide has a mass of 2.56 g.

The sample contains 0.00901 mol of the oxide.

Calculate the relative molecular mass and hence the molecular formula for this oxide of phosphorus.

relative molecular mass .....

molecular formula .....

[2]

(d) State the structure and bonding in silicon dioxide, SiO_2.

..... [1]

[Total: 10]

15. Jun/2020/Paper_22/No.8

Copper is a transition element.

(a) State two properties that are typical of the compounds of a transition element.

1 .....

2 .....

[2]

(b) Aqueous copper(II) sulfate reacts with aqueous potassium iodide.

The ionic equation for this reaction is shown.

$$2Cu^{2+}(aq) + 4I^{-}(aq) \rightarrow 2CuI(s) + I_2(aq)$$

Explain how this equation shows that the reaction involves oxidation.

.....

..... [1]

(c) Anhydrous copper(II) sulfate decomposes when heated strongly.

$$CuSO_4(s) \rightarrow CuO(s) + SO_3(g)$$

A sample of 6.40 g of $CuSO_4$ is heated until all of the sample has thermally decomposed.

Calculate the volume of sulfur trioxide formed, in dm^3, measured at room temperature and pressure.

volume of sulfur trioxide ..... dm^3 [3]

(d) Iron reacts with aqueous copper(II) sulfate to make aqueous iron(II) sulfate and copper.

(i) Construct the ionic equation for this reaction.

..... [1]

(ii) Suggest one observation that would be seen during this reaction.

.....

..... [1]

(e) Describe a chemical test that can be used to distinguish between aqueous solutions of iron(II) sulfate and copper(II) sulfate.

chemical test .....

result with iron(II) sulfate .....

result with copper(II) sulfate .....

[2]

[Total: 10]