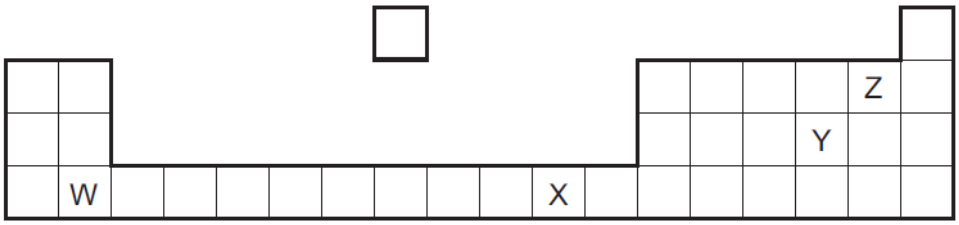
The Periodic Table – 2021 O Level

1. Nov/2021/Paper_11/No.27

The diagram shows part of the Periodic Table.



Which two letters represent elements that can react together to form covalent compounds?

A W and X **B** W and Y **C** X and Y **D** Y and Z

2. Nov/2021/Paper_11/No.28

Which statement about elements in the Periodic Table is correct?

A Elements at the left-hand side of the Periodic Table are more metallic than those, in the same period, near the right-hand side.

B Elements at the top of a group lose electrons more readily than those, in the same group, that are lower in the Periodic Table.

C Elements in the same group of the Periodic Table have the same number of completed shells of electrons.

D Elements in the same period of the Periodic Table have the same number of electrons in the outer shell.

3. Nov/2021/Paper_11/No.29

Which statement about the properties of the elements in Group VIII of the Periodic Table, helium to xenon, is correct?

A Argon reacts with iron to form a compound.

B Helium is less dense than air.

C The elements change from gas to solid down the group.

D The elements exist as covalent molecules.

4. Nov/2021/Paper_11/No.30

Which two statements indicate that metal M may have a proton number between 21 and 30?

1 It conducts electricity.

2 It does not react with water.

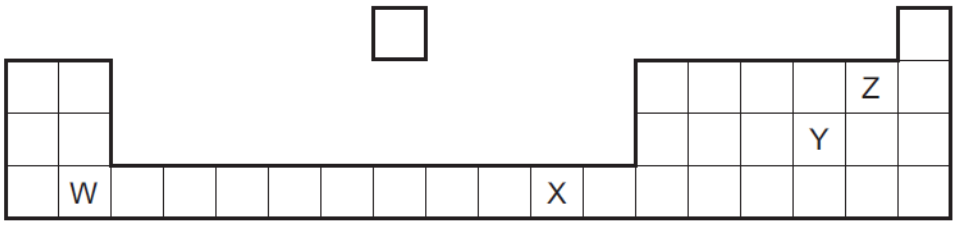
3 It forms two basic oxides with formulae MO and M_2O_3.

4 It forms two coloured sulfates.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

5. Nov/2021/Paper_12/No.27

The diagram shows part of the Periodic Table.



Which two letters represent elements that can react together to form covalent compounds?

A W and X **B** W and Y **C** X and Y **D** Y and Z

6. Nov/2021/Paper_12/No.28

Which statement about some of the elements in the Periodic Table is correct?

A The element germanium, in Group IV, has less metallic character than gallium, in Group III.

B Elements in Group V form ions with a charge of 5+.

C Elements in the same group react in a similar way because they all contain the same number of electrons.

D Transition elements are given this name as they easily change from solids to liquids.

7. Nov/2021/Paper_12/No.29

These statements are about the halogens.

1 All halogens are non-metallic, diatomic molecules.

2 Chlorine displaces both bromine and iodine from aqueous solutions of their salts.

3 The halogens become more reactive on descending Group VII of the Periodic Table.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

8. Nov/2021/Paper_12/No.30

Which two statements indicate that metal M may have a proton number between 21 and 30?

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A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

9. Nov/2021/Paper_21/No.10

This question is about elements in Group IV of the Periodic Table.

(a) The table shows some properties of the Group IV elements.

element	density at room temperature in g/cm^3	melting point in °C	boiling point in °C
carbon (diamond)		3550	4827
silicon	2.34	1410	2355
germanium	5.35	937	2830
tin		232	2260
lead	11.34	328	1740

(i) Predict the density of tin.

..... [1]

(ii) Describe the general trend in the boiling points of the Group IV elements.

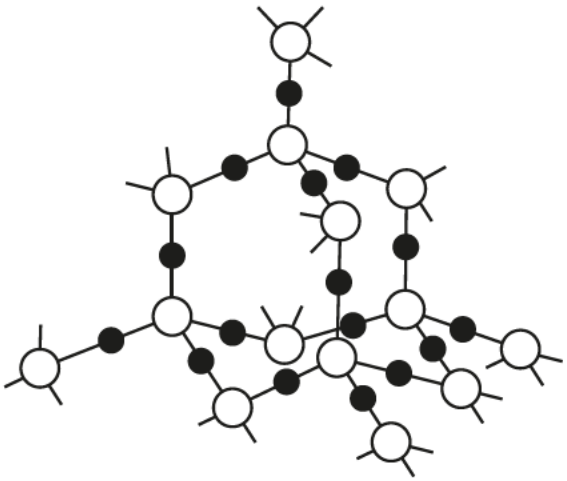
..... [1]

(iii) Predict the state of silicon at 1600 °C.
Give a reason for your answer.

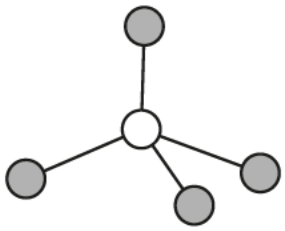
.....

..... [1]

(b) The structure of two compounds of silicon, **P** and **Q**, are shown.



P



Q

● oxygen atom

○ silicon atom

● chlorine atom

(i) Explain in terms of structure and bonding why compound **P** has a high melting point and compound **Q** has a low melting point.

compound **P** .....

.....

.....

compound **Q** .....

.....

.....

[4]

(ii) Draw a dot-and-cross diagram for a molecule of compound **Q**.

Show only the outer shell electrons.

[1]

(c) A compound of carbon, hydrogen and silicon has the formula $Si(CH_3)_4$.

Calculate the percentage by mass of **carbon** in this compound.

[2]

[Total: 10]

10. Nov/2021/Paper_22/No.7

Sodium is a metal in Group I of the Periodic Table. Diamond (carbon) is a non-metal which is a good conductor of heat.

(a) State two **differences** in the physical properties of sodium and diamond.

1 .....

2 .....

[2]

(b) An ion of sodium has the symbol

$$^{23}_{11}Na^{+}$$

Deduce the number of protons, neutrons and electrons in this ion.

number of protons .....

number of neutrons .....

number of electrons .....

[3]

(c) Sodium reacts with nitrogen to form sodium nitride.
Complete the equation for this reaction.

..... Na + ... → ..... Na_3N [1]

(d) When carbon is heated with steam in a closed container an equilibrium mixture is formed.

$$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$$

The forward reaction is endothermic.

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

.....

.....

..... [2]

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

.....

.....

..... [2]

[Total: 10]

11. Nov/2021/Paper_22/No.10

This question is about elements in Group V of the Periodic Table.

(a) The table shows some properties of the Group V elements.

element	density at room temperature in g/cm^3	melting point in °C
nitrogen	1.17×10^{-3}	–210
phosphorus	2.34	44
arsenic	5.73	
antimony		631
bismuth	9.80	272

Use the information in the table to:

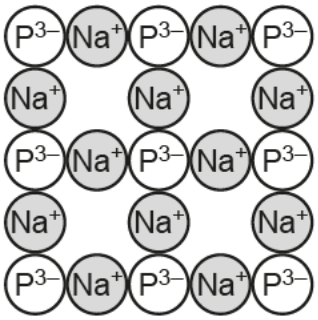
(i) predict the density of antimony

..... [1]

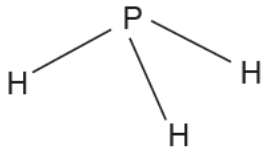
(ii) suggest why it is difficult to predict the melting point of arsenic.

..... [1]

(b) The structure of two compounds of phosphorus, **R** and **S**, are shown.



R



S

(i) Explain in terms of structure and bonding why compound **R** has a high melting point and compound **S** has a low melting point.

compound **R** .....

.....

.....

compound **S** .....

.....

.....

[4]

(ii) Explain why compound **R** conducts electricity when molten.

..... [1]

(iii) Draw a dot-and-cross diagram for a molecule of compound **S**.

Show only the outer shell electrons.

[1]

(c) An oxide of phosphorus has the formula P_4O_{10}.

Calculate the percentage by mass of phosphorus in this compound.

[2]

[Total: 10]

12. Jun/2021/Paper_11/No.27

Elements X and Y combine to form an ionic compound.

Atoms of X have more protons than atoms of Y.

Atoms of Y have more valence electrons than atoms of X.

Which statement is correct?

A Ions of X are negatively charged.

B Atoms of X have more electron shells than atoms of Y.

C X and Y are in the same period of the Periodic Table.

D X and Y are in the same group of the Periodic Table.

13. Jun/2021/Paper_11/No.28

The elements in Group I of the Periodic Table show trends in both their reactivities and their melting points. Rubidium is in Group I.

Which statement about rubidium is correct?

A It has a higher melting point than potassium.

B It reacts with water to produce an acidic solution.

C It reacts with water to produce oxygen gas.

D It is more reactive than potassium.

14. Jun/2021/Paper_11/No.30

Group I elements and transition elements are metals.

Student X suggests that the Group I elements are above hydrogen in the metal reactivity series but that not all transition elements are.

Student Y suggests that the densities of Group I elements are lower than those of the transition elements.

Which students are correct?

A both X and Y

B X only

C Y only

D neither X nor Y

15. Jun/2021/Paper_12/No.7

Use the Periodic Table to answer this question.

Which two particles have the same number of electrons?

A Ar and Ca

B Na^+ and K^+

C Fe^{2+} and Fe^{3+}

D Ca^{2+} and Sc^{3+}

16. Jun/2021/Paper_12/No.28

The proton number of caesium is 55.

Compared with lithium, the melting point of caesium is .....1..... and the reaction of caesium with water is .....2..... vigorous. The number of valence electrons in caesium is .....3..... compared to lithium.

Which words correctly complete gaps 1, 2 and 3?

	1	2	3
A	higher	more	the same
B	higher	less	the same
C	lower	more	greater
D	lower	more	the same

17. Jun/2021/Paper_12/No.29

Nickel is a transition element.

Which properties does it have?

1 It can act as a catalyst.

2 It conducts electricity when molten.

3 It forms coloured compounds.

4 It has only one oxidation state in its compounds.

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 2 only **D** 1 and 3 only

18. Jun/2021/Paper_12/No.30

Which metal reacts with steam and can be extracted from its ore by reduction with carbon?

A magnesium

B calcium

C copper

D zinc

19. Jun/2021/Paper_21/No.2

Helium, neon, argon, krypton, xenon and radon are noble gases in Group VIII.

(a) Name the noble gas which has the greatest volume composition in air.

..... [1]

(b) State one use for helium.

..... [1]

(c) Radon is very unreactive.

Use the electronic structure of radon to explain why.

.....

..... [1]

(d) Two isotopes of radon are shown.

$^{220}_{86}Rn$ $^{222}_{86}Rn$

(i) Give one similarity in the atomic structure of these two isotopes.

..... [1]

(ii) Give one difference in the atomic structure of these two isotopes.

..... [1]

(e) Xenon forms a compound that contains only xenon, oxygen and fluorine.

The compound contains 22.1% oxygen by mass and 17.5% fluorine by mass.

Calculate the empirical formula of this compound.

empirical formula ..... [3]

(f) A sample of neon has a volume of 21 dm^3 at room temperature and pressure.

(i) The temperature of the sample is increased.

The pressure remains constant.

Describe and explain, using kinetic particle theory, what happens to the volume of the sample.

.....

..... [1]

(ii) The pressure of the sample is increased.

The temperature remains constant.

Describe and explain, using kinetic particle theory, what happens to the volume of the sample.

.....

..... [1]

(iii) Calculate the mass of neon in the 21 dm^3 sample.

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

mass ..... g [2]

[Total: 12]

20. Jun/2021/Paper_21/No.8

Silver is a transition element with proton number 47.

(a) Use the Periodic Table to state the number of occupied electron shells in an atom of silver.

..... [1]

(b) Describe, with the aid of a diagram, the metallic bonding in silver.

.....

.....

.....

..... [3]

(c) Give two physical properties of silver that are **only** characteristic of transition elements but **not** of all metals.

1. .....

2. .....

[1]

(d) Silver nitrate is a white crystalline soluble salt.

Name a suitable combination of an acid and an insoluble base which is used to prepare silver nitrate.

acid .....

base .....

[1]

(e) Aqueous silver nitrate, $AgNO_3(aq)$, is electrolysed using inert electrodes.

The products of the electrolysis are silver and oxygen.

(i) Silver ions are reduced at the cathode to make silver atoms.

Construct the ionic equation for this reduction.

..... [1]

(ii) Hydroxide ions are oxidised at the anode to make both oxygen molecules and water molecules.

Construct the ionic equation for this oxidation.

..... [1]

(iii) Explain why solid silver nitrate cannot be electrolysed.

.....

..... [1]

(f) Acidified aqueous silver nitrate reacts with aqueous sodium iodide.

State the observations for this reaction.

..... [1]

[Total: 10]

21. Jun/2021/Paper_22/No.2

Oxygen, sulfur, selenium, tellurium and polonium are in Group VI.

(a) State the percentage composition by volume of oxygen in dry air.

..... [1]

(b) State one large-scale use for oxygen.

..... [1]

(c) Two isotopes of polonium are shown.

$^{209}_{84}Po$ $^{210}_{84}Po$

(i) Explain why both isotopes have the same chemical properties.

..... [1]

(ii) Give one difference in the atomic structure of these two isotopes.

..... [1]

(d) Selenium forms a compound that contains only selenium, oxygen and chlorine.

The compound contains 9.6% oxygen by mass and 42.8% chlorine by mass.

Calculate the empirical formula of this compound.

empirical formula ..... [3]

(e) A sample of oxygen has a volume of 11.5 dm^3 at room temperature and pressure.

(i) The temperature of the sample is decreased.

The pressure remains constant.

Describe and explain, using kinetic particle theory, what happens to the volume of the sample.

.....

..... [1]

(ii) The pressure of the sample is decreased.

The temperature remains constant.

Describe and explain, using kinetic particle theory, what happens to the volume of the sample.

.....

..... [1]

(iii) Calculate the mass of oxygen in the 11.5 dm^3 sample at room temperature and pressure.

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

mass ..... g [2]

[Total: 11]

22. Jun/2021/Paper_22/No.8

Lead is a metal with proton number 82.

(a) **(i)** Use the Periodic Table to state the number of occupied electron shells in an atom of lead.

..... [1]

(ii) Use the Periodic Table to state the number of electrons in the outer shell of an atom of lead.

..... [1]

(b) Describe, with the aid of a labelled diagram, the metallic bonding in lead.

.....

.....

.....

..... [3]

(c) Give two physical properties of lead that are characteristic of all metals.

1. .....

2. .....

[1]

(d) Lead(II) ethanoate is a white crystalline soluble salt.

Name a suitable combination of an acid and an insoluble base which is used to prepare lead(II) ethanoate.

acid .....

base .....

[1]

(e) Aqueous lead(II) ethanoate reacts with aqueous sodium iodide.

A yellow precipitate of lead(II) iodide, PbI_2, is formed.

Construct the ionic equation, with state symbols, for this reaction.

..... [2]

(f) Explain why solid lead(II) iodide cannot be electrolysed.

.....

.....

..... [1]

[Total: 10]