Atoms, Elements and Compounds – 2023 June IGCSE Chemistry 0620

1. June/2023/Paper_ 0620/11/No.2

The atomic structures of four particles, W, X, Y and Z, are shown.

	electrons	neutrons	protons
W	2	2	2
X	2	2	3
Y	2	3	2
Z	3	2	3

Which particles are isotopes of the same element?

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

2. June/2023/Paper_ 0620/11/No.5

Which row shows the properties of an ionic compound?

	electrical conductivity of solid	melting point /°C
A	good	98
B	good	3652
C	poor	78
D	poor	801

3. June/2023/Paper_ 0620/11/No .4

The atomic structures of four particles, W, X, Y and Z, are shown.

	electrons	neutrons	protons
W	2	2	2
X	2	2	3
Y	2	3	2
Z	3	2	3

Which particles are isotopes of the same element?

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

4. June/2023/Paper_ 0620/11/No.3

What are the relative charge and relative mass of an electron?

	relative charge	relative mass
A	0	1
B	0	$\frac{1}{2000}$
C	–1	1
D	–1	$\frac{1}{2000}$

5. June/2023/Paper_ 0620/11/No.6

Which row describes the formation of single covalent bonds in methane?

A	atoms share a pair of electrons	both atoms gain a noble gas electronic structure
B	atoms share a pair of electrons	both atoms have the same number of electrons in their outer shell
C	electrons are transferred from one atom to another	both atoms gain a noble gas electronic structure
D	electrons are transferred from one atom to another	both atoms have the same number of electrons in their outer shell

6. June/2023/Paper_ 0620/12/No.2

Which statement explains why water is a compound?

A The hydrogen and oxygen atoms in a molecule of water can only be separated by chemical means.

B The hydrogen and oxygen atoms in a molecule of water can be separated using physical means.

C The number of hydrogen and oxygen atoms in a molecule of water is variable.

D Water has the same chemical properties as both hydrogen and oxygen.

7. June/2023/Paper_ 0620/12/No.3

An atom of element X contains:

- 5 protons
- 6 neutrons
- 5 electrons.

Which statements about element X are correct?

1 X has an atomic number of 6.

2 X has a nucleon number of 11.

3 X is in Group II of the Periodic Table.

4 X is in the second period of the Periodic Table.

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

8. June/2023/Paper_ 0620/12/No.4

Which row describes properties of lithium fluoride?

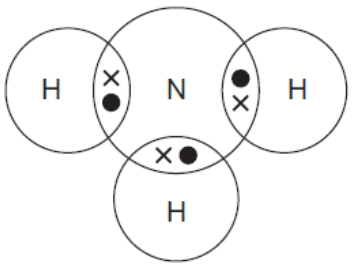
	electrical conductivity when solid	electrical conductivity when molten	melting point
A	does not conduct	conducts	high
B	does not conduct	does not conduct	low
C	conducts	conducts	high
D	conducts	does not conduct	low

9. June/2023/Paper_ 0620/12/No.5

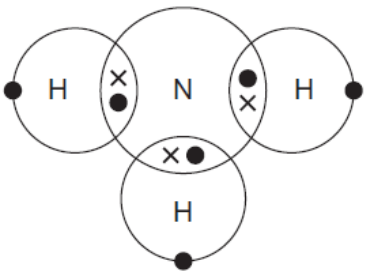
Ammonia, NH_3, is a covalent molecule.

Which diagram shows the outer-shell electron arrangement in a molecule of ammonia?

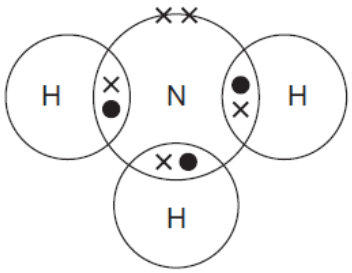
A



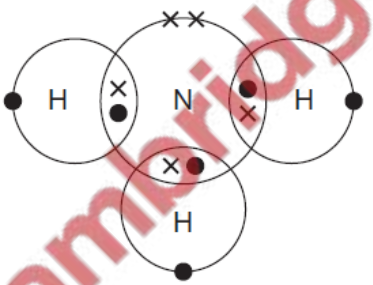
B



C



D



10. June/2023/Paper_ 0620/12/No.6

Which substance has a giant covalent structure?

A ethanol

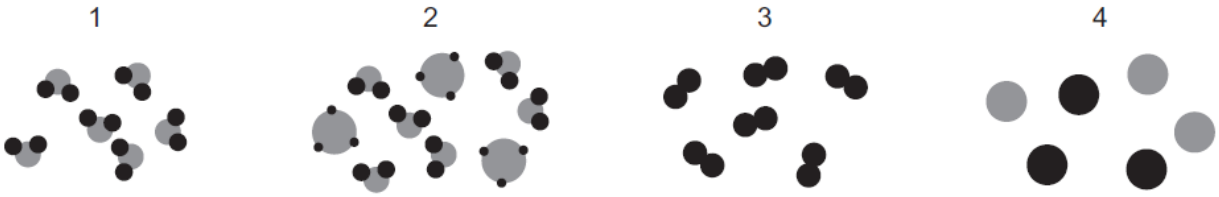
B graphite

C methane

D sodium chloride

11. June/2023/Paper_ 0620/13/No.2

The diagrams represent some elements, compounds and mixtures.



Which row describes the numbered substances?

	1	2	3	4
A	element	mixture of compounds	compound	mixture of elements
B	compound	mixture of compounds	element	mixture of elements
C	element	mixture of elements	compound	mixture of compounds
D	compound	mixture of elements	element	mixture of compounds

12. June/2023/Paper_ 0620/13/No.3

Two atoms, X and Y, have the same mass number but different atomic numbers.

Which statement about X and Y is correct?

A They have the same number of protons.

B They have the same number of electrons.

C They are in the same group of the Periodic Table.

D They have different numbers of neutrons.

13. June/2023/Paper_ 0620/13/No.4

The symbols for two different isotopes of element S are shown.

$^{m}_{n}S$ $^{p}_{q}S$

The letters m, n, p and q represent whole numbers.

Which statements about the values of m, n, p and q are correct?

1 m = p

2 n = q

3 m > q

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

14. June/2023/Paper_ 0620/13/No.5

Which statement about potassium fluoride is correct?

A It can conduct electricity when it is solid.

B It dissolves in water.

C It has a low melting point.

D It is a molecule.

15. June/2023/Paper_ 0620/13/No.6

In which molecule are all the outer-shell electrons involved in covalent bonding?

A Cl_2 **B** CH_4 **C** HCl **D** NH_3

16. June/2023/Paper_ 0620/13/No.7

What is the formula of potassium oxide?

A P_2O **B** PO_2 **C** KO **D** K_2O

17. June/2023/Paper_ 0620/21/No.2

Which row about elements, mixtures and compounds is correct?

	metallic element	non-metallic element	mixture	compound
A	copper	methane	brass	sulfur
B	brass	sulfur	copper	methane
C	copper	sulfur	brass	methane
D	brass	methane	copper	sulfur

18. June/2023/Paper_ 0620/21/No.3

The atomic structures of four particles, W, X, Y and Z, are shown.

	electrons	neutrons	protons
W	2	2	2
X	2	2	3
Y	2	3	2
Z	3	2	3

Which particles are isotopes of the same element?

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

19. June/2023/Paper_ 0620/21/No.4

Which statement explains why isotopes of the same element have the same chemical properties?

A They have the same number of outer shell electrons.

B They have the same number of neutrons.

C They have different numbers of protons.

D They have different mass numbers.

20. June/2023/Paper_ 0620/21/No.5

Nitrogen forms a nitride ion with the formula N^{3-}.

Which particle does **not** have the same electronic configuration as the nitride ion?

A Al^{3+} **B** Cl^{-} **C** Na^{+} **D** O^{2-}

21. June/2023/Paper_ 0620/21/No.6

Which row describes the formation of single covalent bonds in methane?

A	atoms share a pair of electrons	both atoms gain a noble gas electronic structure
B	atoms share a pair of electrons	both atoms have the same number of electrons in their outer shell
C	electrons are transferred from one atom to another	both atoms gain a noble gas electronic structure
D	electrons are transferred from one atom to another	both atoms have the same number of electrons in their outer shell

22. June/2023/Paper_ 0620/21/No.7

Which formula is an empirical formula?

A C_2H_4O

B $C_4H_8O_2$

C C_3H_7COOH

D $CH_3CH_2CH_2COOH$

23. June/2023/Paper_ 0620/22/No.2

An atom of element X contains:

- 5 protons
- 6 neutrons
- 5 electrons.

Which statements about element X are correct?

1 X has an atomic number of 6.

2 X has a nucleon number of 11.

3 X is in Group II of the Periodic Table.

4 X is in the second period of the Periodic Table.

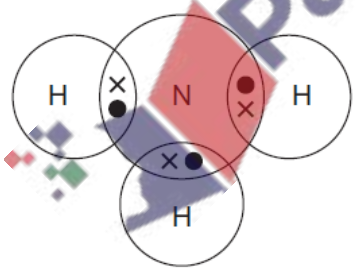
A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

24. June/2023/Paper_ 0620/22/No.3

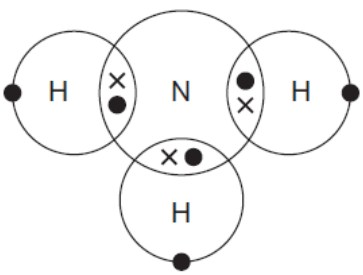
Ammonia, NH_3, is a covalent molecule.

Which diagram shows the outer-shell electron arrangement in a molecule of ammonia?

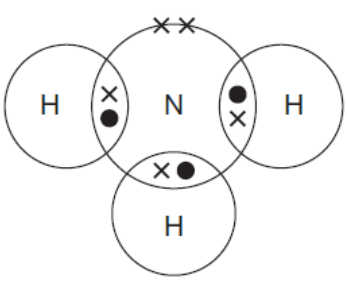
A



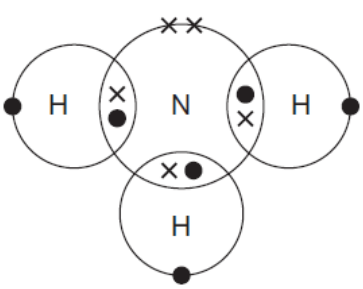
B



C



D



25. June/2023/Paper_ 0620/22/No.4

Which structure does silicon(IV) oxide most closely resemble?

A carbon dioxide

B diamond

C graphite

D sodium chloride

26. June/2023/Paper_ 0620/22/No.5

Substance P conducts electricity when solid.

Which particles move in solid P so that it can conduct electricity?

1 anions

2 cations

3 electrons

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

27. June/2023/Paper_ 0620/23/No.2

The diagrams represent some elements, compounds and mixtures.

1 2 3 4

Which row describes the numbered substances?

	1	2	3	4
A	element	mixture of compounds	compound	mixture of elements
B	compound	mixture of compounds	element	mixture of elements
C	element	mixture of elements	compound	mixture of compounds
D	compound	mixture of elements	element	mixture of compounds

28. June/2023/Paper_ 0620/23/No.3

Two atoms, X and Y, have the same mass number but different atomic numbers.

Which statement about X and Y is correct?

A They have the same number of protons.

B They have the same number of electrons.

C They are in the same group of the Periodic Table.

D They have different numbers of neutrons.

29. June/2023/Paper_ 0620/23/No.4

A sample of pure iron contains three isotopes only.

percentage abundance of isotope / %	isotope
2	^{n}Fe
6	^{54}Fe
92	^{56}Fe

The iron in the sample has a relative atomic mass of 55.9.

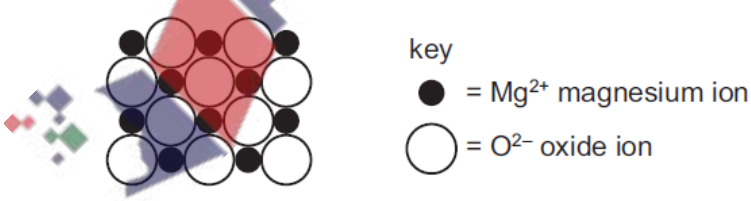
What is the value of *n*?

A 53 **B** 55 **C** 57 **D** 58

30. June/2023/Paper_ 0620/23/No.5

Magnesium oxide is a white solid at room temperature and pressure.

Part of the structure of solid magnesium oxide is shown.



Three statements are listed.

1 Magnesium ions are smaller than oxide ions because they contain fewer electrons.

2 Magnesium oxide has good electrical conductivity when molten because the ions are mobile.

3 Magnesium oxide has a high melting point because of the strong electrostatic attraction between the ions and delocalised electrons in the giant lattice.

Which statements are correct?

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

31. June/2023/Paper_ 0620/23/No.6

In which molecule are all the outer-shell electrons involved in covalent bonding?

A Cl_2 **B** CH_4 **C** HCl **D** NH_3

32. June/2023/Paper_ 0620/23/No.7

Which row describes the properties of silicon(IV) oxide?

	giant covalent structure	melting point
A	no	high
B	no	low
C	yes	high
D	yes	low

33. June/2023/Paper_ 0620/31/No.4(a, b)

This question is about sulfur and compounds of sulfur.

(a) Sulfur has several isotopes.

Define the term isotopes.

.....

..... [2]

(b) Deduce the number of protons, neutrons and electrons in the sulfide ion shown.

$^{36}_{16}S^{2-}$

number of protons .....

number of neutrons .....

number of electrons .....

[3]

34. June/2023/Paper_ 0620/31/No.8(c)

This question is about nitrogen and compounds of nitrogen.

(c) Ammonia is a simple molecule with covalent bonds.

(i) Describe a covalent bond.

.....

..... [2]

(ii) Complete Fig. 8.1 to show the dot-and-cross diagram for a molecule of ammonia.

Show outer shell electrons only.

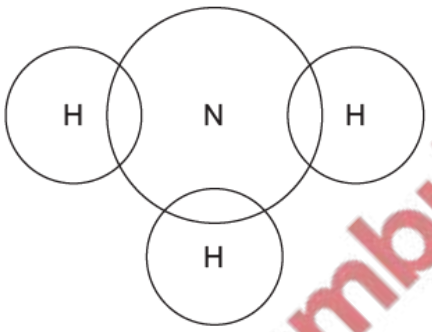


Fig. 8.1

[2]

(iii) Aqueous ammonia is alkaline.

Choose from the list, the pH value that is alkaline.

Draw a circle around your chosen answer.

pH 1 **pH 5** **pH 7** **pH 10** [1]

(iv) Aqueous ammonia releases ammonia gas.

Ammonia gas turns damp red litmus paper blue.

A long glass tube is set up as shown in Fig. 8.2.

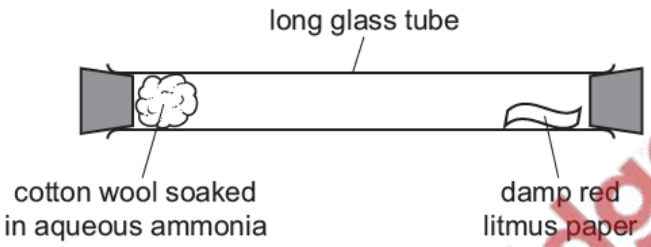


Fig. 8.2

At first, the litmus paper does **not** turn blue.
After a short time, the litmus paper turns blue.

Explain these results in terms of the kinetic particle theory.

.....

.....

.....

.....

..... [3]

35. June/2023/Paper_ 0620/32/No.4(a, b)

This question is about chlorine and compounds of chlorine.

(a) Chlorine has diatomic molecules.

Define the term diatomic.

..... [1]

(b) Deduce the number of protons, neutrons and electrons in the chloride ion shown.

$^{37}_{17}Cl^-$

number of protons .....

number of neutrons .....

number of electrons .....

[3]

36. June/2023/Paper_ 0620/33/No.4(a)

This question is about bromine and compounds of bromine.

(a) Deduce the number of protons, neutrons and electrons in the bromide ion shown.

$^{81}_{35}Br^-$

number of protons .....

number of neutrons .....

number of electrons .....

[3]

37. June/2023/Paper_ 0620/33/No.8(c)

(c) Hydrobromic acid is formed when hydrogen bromide dissolves in water.

(i) Write the formula of the ion which is present in all acids.

..... [1]

(ii) Complete the word equation for the reaction of any acid with any carbonate.

acid	+	carbonate	→	.....	+	.....	+	....

[3]

(iii) A few drops of litmus indicator are added to a dilute acid.

State the colour of the solution.

..... [1]

38. June/2023/Paper_ 0620/41/No.2(b)

The symbols of the elements in Period 2 of the Periodic Table are shown.

Li Be B C N O F Ne

Use the symbols of the elements in Period 2 to answer the questions that follow.
Each symbol may be used once, more than once or not at all.

(b) Boron, B, has two isotopes.

(i) State the meaning of the term isotopes.

.....

..... [2]

(ii) Table 2.1 shows the relative masses and the percentage abundances of the two isotopes of boron.

Table 2.1

relative mass of isotope	percentage abundance of isotope
10	20
11	80

Calculate the relative atomic mass of boron to **one** decimal place.

relative atomic mass = ... [2]

39. June/2023/Paper_ 0620/41/No.3

This question is about ionic and covalent compounds.

(a) (i) Sodium reacts with oxygen to form the ionic compound sodium oxide.
The electronic configurations of an atom of sodium and an atom of oxygen are shown in Fig. 3.1.

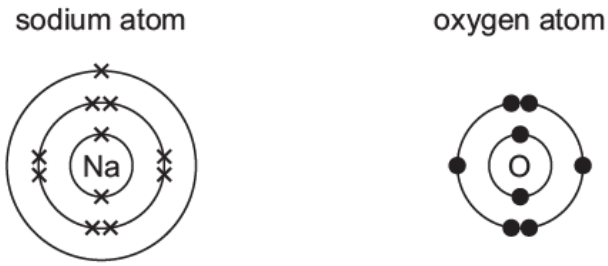


Fig. 3.1

Ions are formed by the transfer of electrons from sodium atoms to oxygen atoms.

Complete the dot-and-cross diagrams in Fig. 3.2 to show the electronic configuration of **one** sodium ion and **one** oxide ion. Show the charges on the ions.

Fig. 3.2

[3]

(ii) Write the formula of sodium oxide.

..... [1]

(b) Carbon dioxide, CO_2, is a covalent compound.

Complete the dot-and-cross diagram in Fig. 3.3 to show the electronic configuration in a molecule of carbon dioxide. Show outer shell electrons only.

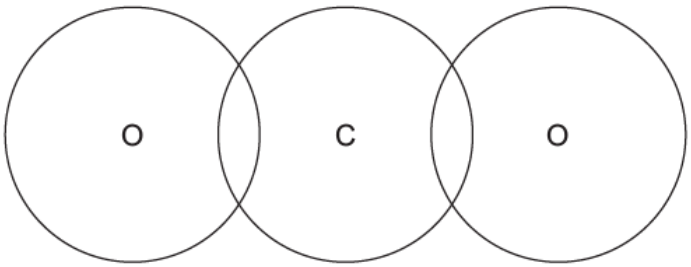


Fig. 3.3

[2]

(c) The melting points of sodium oxide and carbon dioxide are shown in Table 3.1.

Table 3.1

	melting point/°C
sodium oxide	1275
carbon dioxide	–78

(i) Explain, in terms of bonding, why sodium oxide has a high melting point.

.....

.....

.....

..... [2]

(ii) Carbon dioxide has a low melting point.

State the general term for the weak forces that cause carbon dioxide to have a low melting point.

..... [1]

[Total: 9]

40. June/2023/Paper_ 0620/43/No.3

Magnesium forms ionic compounds.

(a) Magnesium reacts with fluorine to form the ionic compound magnesium fluoride.
The electronic configurations of an atom of magnesium and an atom of fluorine are shown in Fig. 3.1.

Fig. 3.1

(i) Ions are formed by the transfer of electrons from magnesium atoms to fluorine atoms.

Complete the dot-and-cross diagrams in Fig. 3.2 to show the electronic configurations of **one** magnesium ion and **one** fluoride ion. Show the charges on the ions.

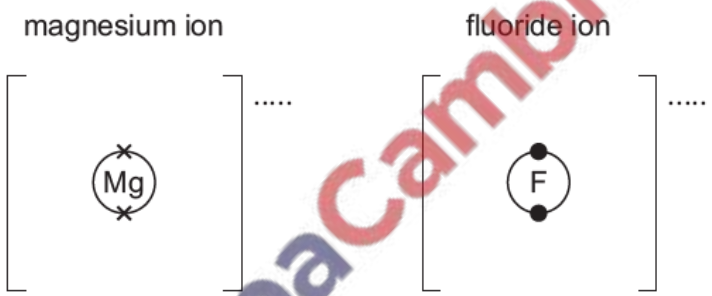


Fig. 3.2

[3]

(ii) Deduce the formula of magnesium fluoride.

..... [1]

(iii) When solid magnesium fluoride is dissolved in water it forms a solution that conducts electricity.

State one other change that can be made to solid magnesium fluoride to allow it to conduct electricity.

..... [1]

(b) Silicon tetrachloride, $SiCl_4$, and silicon(IV) oxide, SiO_2, are covalent compounds.

Complete the dot-and-cross diagram in Fig. 3.3 to show the electronic configuration in a molecule of silicon tetrachloride. Show outer shell electrons only.

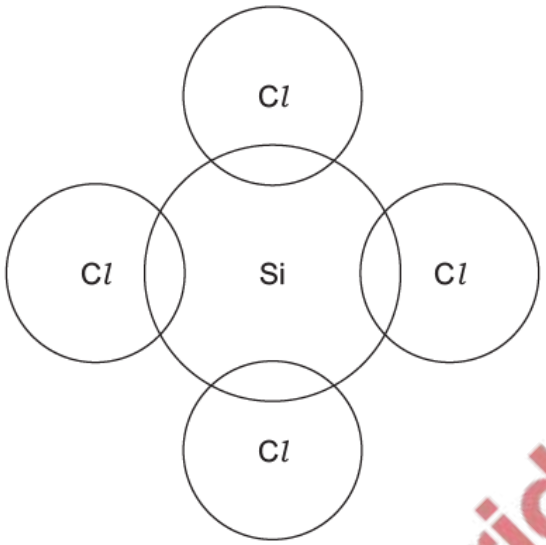


Fig. 3.3

[2]

(c) The melting points of silicon tetrachloride and silicon(IV) oxide are shown in Table 3.1.

Table 3.1

	melting point / °C
silicon tetrachloride	–69
silicon(IV) oxide	1710

(i) Silicon tetrachloride has a low melting point because it has weak forces of attraction between particles.

Name the type of particles that are held together by these weak forces of attraction.

..... [1]

(ii) Explain, in terms of structure and bonding, why silicon(IV) oxide has a high melting point.

.....

.....

.....

..... [2]

[Total: 10]

41. March/2023/Paper_ 0620/12/No.3

Which statement describes a compound?

A It contains two or more elements chemically combined.

B It contains two or more elements physically combined.

C It contains two or more elements forming an alloy.

D It contains two or more elements that can easily be separated.

42. March/2023/Paper_ 0620/12/No.5

Which statement about ions and ionic bonds is correct?

A Bromine atoms form negatively charged bromide ions.

B Ionic bonds form between elements in Group VII of the Periodic Table.

C Positive ions are formed when atoms lose protons.

D Potassium iodide contains negatively charged potassium ions.

43. March/2023/Paper_ 0620/12/No.6

Which molecule has only two shared pairs of electrons?

A CH_4 **B** Cl_2 **C** HCl **D** H_2O

44. March/2023/Paper_ 0620/12/No.7

Which statement about graphite explains why it is used as an electrode?

A It contains ions.

B It has a giant covalent structure.

C It is a metal.

D It has mobile electrons.

45. March/2023/Paper_ 0620/22/No.3

There are two stable isotopes of bromine.

The mass number of isotope 1 is 79.

The mass number of isotope 2 is 81.

Which statement is correct?

A The isotopes have the same number of neutrons.

B The isotopes have different chemical properties.

C The isotopes have different numbers of protons.

D The isotopes have the same number of outer electrons.

46. March/2023/Paper_ 0620/22/No.4

Which statement about ions and ionic bonds is correct?

A Bromine atoms form negatively charged bromide ions.

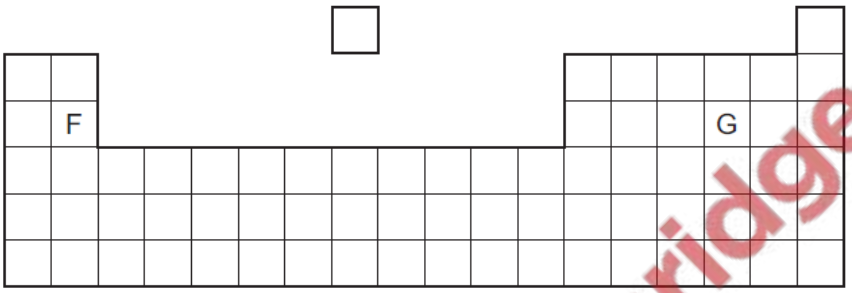
B Ionic bonds form between elements in Group VII of the Periodic Table.

C Positive ions are formed when atoms lose protons.

D Potassium iodide contains negatively charged potassium ions.

47. March/2023/Paper_ 0620/22/No.5

Part of the Periodic Table is shown.



Which type of chemical bonding is present in the oxide of F and in the oxide of G?

	oxide of F	oxide of G
A	covalent	covalent
B	covalent	ionic
C	ionic	covalent
D	ionic	ionic

48. March/2023/Paper_ 0620/22/No.6

Elements X and Y react to form a compound.

Element X loses two electrons and element Y gains one electron.

What is the charge on the ions of elements X and Y and what is the formula of the compound?

	charge on X	charge on Y	formula of compound
A	2+	–	X_2Y
B	2+	–	XY_2
C	2–	+	X_2Y
D	2–	+	XY_2

49. March/2023/Paper_ 0620/22/No.7

Which statement about graphite explains why it is used as an electrode?

A It contains ions.

B It has a giant covalent structure.

C It is a metal.

D It has mobile electrons.

50. March/2023/Paper_ 0620/32/No.1

A list of symbols and formulae is shown.

Br_2
CH_4
C_2H_4
Cl^-
CO_2
Cr^{3+}
Cu^{2+}
H_2
K^+
N_2
N^{3-}
O_2
SO_4^{2-}

Answer the following questions about these symbols and formulae.
Each symbol or formula may be used once, more than once or not at all.

State which symbol or formula represents:

(a) a molecule containing only five atoms

..... [1]

(b) a diatomic molecule of an element in Group VII of the Periodic Table

..... [1]

(c) an ion formed when an atom gains one electron

..... [1]

(d) an ion which forms a green precipitate when a few drops of aqueous sodium hydroxide are added to it

..... [1]

(e) a compound produced by the thermal decomposition of calcium carbonate

..... [1]

(f) a product of photosynthesis.

..... [1]

[Total: 6]

51. March/2023/Paper_ 0620/32/No.2(c)

(c) Complete Fig. 2.1 to show:

- the electronic configuration of a sodium ion
- the charge on the ion.

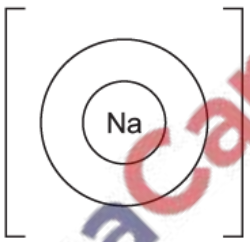


Fig. 2.1

[2]

52. March/2023/Paper_ 0620/32/No.3(a)

This question is about compounds of nitrogen.

(a) Complete the dot-and-cross diagram in Fig. 3.1 of a molecule of ammonia.

Show outer shell electrons only.

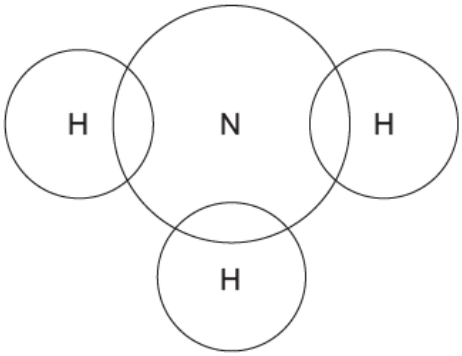


Fig. 3.1

[2]

53. March/2023/Paper_ 0620/42/No.1(h)

(h) Complete the dot-and-cross diagram in Fig. 1.1 for a molecule of CO_2.

Show outer shell electrons only.

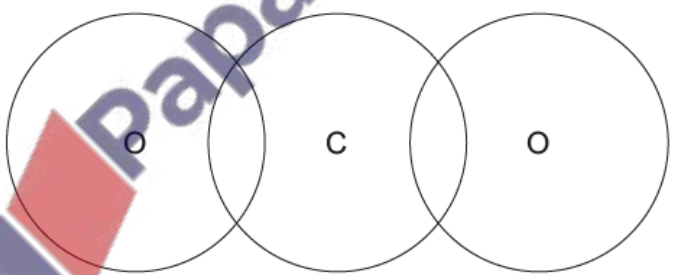


Fig. 1.1

[2]

54. March/2023/Paper_ 0620/42/No.2(a, c, d)

Lithium, sodium and potassium are Group I elements.

(a) Name the type of bonding in these elements.

..... [1]

(c) Lithium has two naturally occurring types of atoms, ^{6}Li and ^{7}Li.

(i) State the name given to atoms of the same element with different nucleon numbers.

..... [1]

(ii) Complete Table 2.1 to show the number of protons, neutrons and electrons in the atom and ion of lithium shown.

Table 2.1

	^{6}Li	$^{7}Li^{+}$
protons		
neutrons		
electrons		

[3]

(iii) Table 2.2 shows the relative abundance of the two naturally occurring atoms of lithium.

Table 2.2

atom	^{6}Li	^{7}Li
relative abundance	10%	90%

Calculate the relative atomic mass of lithium to **one** decimal place.

relative atomic mass = ... [2]

(d) Potassium oxide, K_2O, is an ionic compound.

Complete Fig. 2.1 to show the electronic configurations of the ions in potassium oxide. Show the charges on the ions.

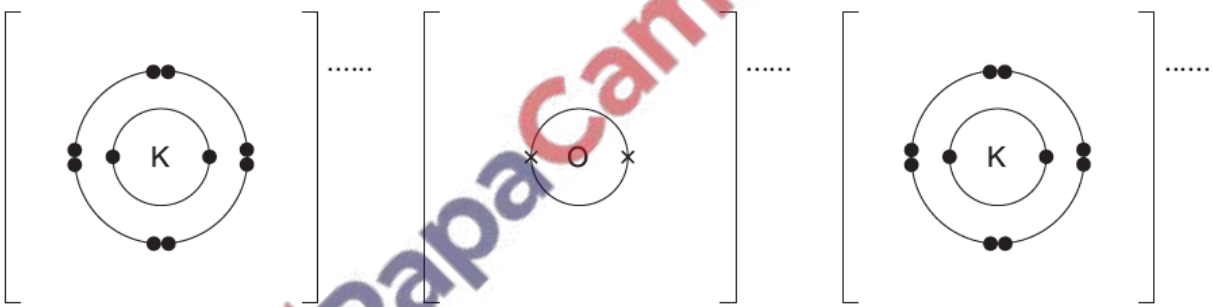


Fig. 2.1

[3]