1. Atomic Structure

1.3 Electrons, energy levels and atomic orbitals

Paper 1

Question Paper

1 In which pairs are **both** species free radicals?

1 Cl and O

2 Cl^- and O^{2-}

3 Cl and O^-

4 Cl^+ and O^{2+}

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

2 Which species is a free radical?

A He **B** Be^- **C** O^{2-} **D** Zn

3 Which statement about the electrons in a ground state carbon atom is correct?

A Electrons are present in four different energy levels.

B There are more electrons in p orbitals than there are in s orbitals.

C The occupied orbital of highest energy is spherical.

D The occupied orbital of lowest energy is spherical.

4 Which atom has its outermost electron in an orbital of the shape shown, with principal quantum number 3?

A sodium

B chlorine

C calcium

D bromine

5 Equations involving four enthalpy changes are shown.

$Na(g) \rightarrow Na^+(g) + e^-$ $\Delta H = W$

$Na(g) \rightarrow Na^{2+}(g) + 2e^-$ $\Delta H = X$

$Na(s) \rightarrow Na(g)$ $\Delta H = Y$

$Na(s) \rightarrow Na^{2+}(g) + 2e^-$ $\Delta H = Z$

Which equation represents the second ionisation energy of sodium?

A X **B** X + Y – W **C** X – W **D** Z – W

6 Which type of interaction exists between water molecules and metal cations in aqueous solution?

A dipole-dipole interactions

B hydrogen bonds

C ion-dipole interactions

D ionic bonds

7 Which atom has more unpaired electrons than paired electrons in orbitals of principal quantum number 2?

A carbon

B nitrogen

C oxygen

D fluorine

8 In which pair of species do both species have only one unpaired p electron?

A Ar^+ and C^- **B** B and Ti^+ **C** F and Ga **D** Se^- and Si^-

9 Which atomic orbitals are occupied in an atom of phosphorus?

A 1p 2s 2p **B** 2s 2p 2d **C** 2s 2p 3s **D** 2p 3s 3d

10 In which pair does each species have the same number of unpaired electrons?

A Al and Cu^{2+}

B Ca and Cr^{3+}

C Ca and Ni^{2+}

D Fe^{3+} and O^{2-}

11 Which statement about the electrons in a ground state carbon atom is correct?

A Electrons are present in four different energy levels.

B There are more electrons in p orbitals than there are in s orbitals.

C The occupied orbital of highest energy is spherical.

D The occupied orbital of lowest energy is spherical.

12 The outermost electron in an atom of neon occupies a particular orbital.

Which row shows the relative energy and shape of this orbital?

	energy of orbital relative to other occupied orbitals	shape of orbital
A	higher or equal	
B	higher or equal	
C	lower or equal	
D	lower or equal	

13 The eight elements sodium to argon are in the same period of the Periodic Table.

The equation corresponding to the first ionisation energy is shown.

$$X(g) \rightarrow X^{+}(g) + e^{-}$$

For which of these eight elements is the electron in this equation removed from a filled orbital?

A Mg, Al, Si, P, S, Cl and Ar

B Al, Si, P, S, Cl and Ar only

C Mg, S, Cl and Ar only

D S, Cl and Ar only

14 This question refers to isolated gaseous atoms.

In which atom are all electrons paired?

A Ba **B** Br **C** S **D** Si

15 The electronic configuration of an atom of sulfur is $1s^2 2s^2 2p^6 3s^2 3p^4$.

How many valence shell and unpaired electrons are present in one sulfur atom?

	valence shell electrons	unpaired electrons
A	2	1
B	4	2
C	6	0
D	6	2