**IB Chemistry – HL**

**Topic 2 Questions**

**1.** What is the electron configuration for an atom with Z = 22?

A. 1s22s22p63s23p63d4

B. 1s22s22p63s23p64s24p2

C. 1s22s22p63s23p63d24p2

D. 1s22s22p63s23p64s23d2

(Total 1 mark)

**2.** What is the total number of p orbitals containing one or more electrons in germanium (atomic number 32)?

A. 2

B. 3

C. 5

D. 8

(Total 1 mark)

**3.** How many electrons are there in **all** the d orbitals in an atom of xenon?

A. 10

B. 18

C. 20

D. 36

(Total 1 mark)

**4.** Which is correct about the element tin (Sn) (Z = 50)?

|  |  |
| --- | --- |
| Number of main energy levels containing electrons | Number of electrons in highest main energy level |
| A. | 4 | 4 |
| B. | 4 | 14 |
| C. | 5 | 4 |
| D. | 5 | 14 |

(Total 1 mark)

**5.** What is the total number of electrons in p orbitals in an atom of iodine?

A. 5

B. 7

C. 17

D. 23

(Total 1 mark)

**6.** A transition metal ion X2+ has the electronic configuration [Ar]3d9. What is the atomic number of the element?

A. 27

B. 28

C. 29

D. 30

(Total 1 mark)

**7.** How many orbitals are there in the n = 3 level of an atom?

A. 3

B. 5

C. 7

D. 9

(Total 1 mark)

**8.** What is the electron configuration for the copper(I) ion, (*Z* = 29)?

A. [Ar]4s23d9

B. [Ar]4s13d10

C. [Ar]4s13d9

D. [Ar]3d10

(Total 1 mark)

**9.** (i) State the full electron configuration for argon.

……………………………………………………………………………………………

(1)

(ii) Give the formulas of **two** oppositely charged ions which have the same electron configuration as argon.

……………………………………………………………………………………………

(2)

(Total 3 marks)

**10.** (a) Use the Aufbau principle to write the electron configuration of an atom of germanium.

...................................................................................................................................

(1)

(b) The successive ionization energies of germanium are shown in the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1st | 2nd | 3rd | 4th | 5th |
| Ionization energy / kJ mol–1 | 760 | 1540 | 3300 | 4390 | 8950 |

(i) Identify the sub-level from which the electron is removed when the first ionization energy of germanium is measured.

.........................................................................................................................

(1)

(ii) Write an equation, including state symbols, for the process occurring when measuring the second ionization energy of germanium.

.........................................................................................................................

(1)

(iii) Explain why the difference between the 4th and 5th ionization energies is much greater than the difference between any two other successive values.

.........................................................................................................................

.........................................................................................................................

.........................................................................................................................

.........................................................................................................................

(2)

(Total 5 marks)

**11.** (i) Explain why successive ionization energies of an element increase.

...................................................................................................................................

...................................................................................................................................

(1)

(ii) Explain how successive ionization energies account for the existence of three main energy levels in the sodium atom.

...................................................................................................................................

...................................................................................................................................

...................................................................................................................................

...................................................................................................................................

...................................................................................................................................

...................................................................................................................................

(3)

(Total 4 marks)

**IB Chemistry – HL**

**Topic 2 Answers**

**1.** D

[1]

**2.** D

[1]

**3.** C

[1]

**4.** C

[1]

**5.** D

[1]

**6.** C

[1]

**7.** D

[1]

**8.** D

[1]

**9.** (i) 1s22s22p63s23p6; 1

Do not accept [Ne] 3s23p6 or 2, 8, 8.

(ii) K+ /Ca2+ /Sc3+/Ti4+;  
Cl–/S2–/P3–; 2

Accept other suitable pairs of ions.

[3]

**10.** (a) 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p2/[Ar] 4s2 3d10 4p2; 1

Do not penalize for interchanging 4s2and 3d10.

(b) (i) (4)p; 1

(ii) Ge+(g)  Ge2+(g) + e; 1

Do not penalize for e(g).

Accept loss of electron on LHS.

(iii) 5th electron removed from energy level closer to nucleus/5th electron removed from 3rd energy level and 4th electron from 4th energy level/*OWTTE*;

attraction by nucleus or protons greater (for electrons closer to  
nucleus)/*OWTTE*; 2

[5]

**11.** (i) same nuclear charge, fewer electrons (thus more energy required to  
remove successive electrons)/harder to remove an electron from  
an ion with increasing positive charge/nucleus has greater effect  
on smaller number of electrons/*OWTTE*; 1

(ii) large increases in IE when 2nd **and** 10th electron removed; thus,  
1st electron further from nucleus than 2nd electron; and 9th electron  
further from nucleus than 10th electron; large increases indicate  
changes in main energy levels/*OWTTE*;

**OR**

outermost/3p electron has low IE because it is far/furthest from the nucleus;

electron(s) in second shell/2p electrons are much closer (to nucleus) **and**  
need much more energy to remove/IE much higher/very high/there is a  
big jump in IE;

electron(s) in first/innermost shell/1s electrons are even closer (to nucleus)  
and need much more energy to remove (than those in second shell/2s or 2p  
electrons); 3

[4]