

IB Topics 2 & 12 Multiple Choice Practice

1. What is the number of protons and the number of neutrons in ^{131}I ?

	Protons	Neutrons
A.	53	78
B.	53	131
C.	78	53
D.	131	53

2. Which is the electron configuration of a chromium atom in the ground state?

- A. $[\text{Ne}]3s^23p^64s^13d^4$
- B. $[\text{Ar}]3d^3$
- C. $1s^22s^22p^63s^23p^64s^23d^4$
- D. $[\text{Ar}]4s^13d^5$

3. In which set do all the species contain more electrons than neutrons?

- A. ^{14}N , ^{16}O , ^{11}C
- B. ^{14}N , ^{16}O , $^{11}\text{C}^{4-}$
- C. $^{14}\text{N}^{3-}$, $^{16}\text{O}^{2-}$, ^{11}C
- D. $^{14}\text{N}^{3-}$, $^{16}\text{O}^{2-}$, $^{11}\text{C}^{4+}$

4. Which electron transition in the hydrogen atom emission spectrum emits radiation with the longest wavelength?

- A. $n = 2 \rightarrow n = 1$
- B. $n = 1 \rightarrow n = 2$
- C. $n = 4 \rightarrow n = 1$
- D. $n = 3 \rightarrow n = 2$

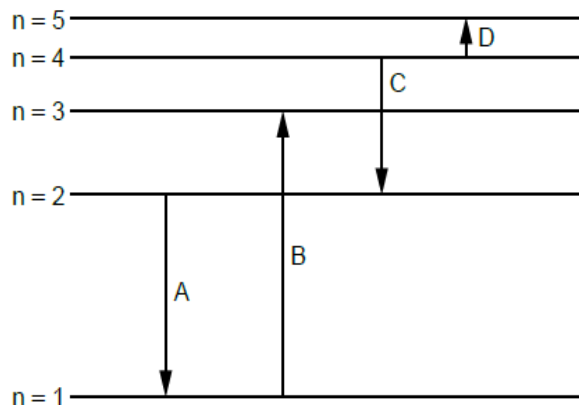
5. The full electron configuration of an element is: $1s^22s^22p^63s^23p^2$
To which group and period does the element belong?

	Group	Period
A.	2	3
B.	3	2
C.	3	4
D.	14	3

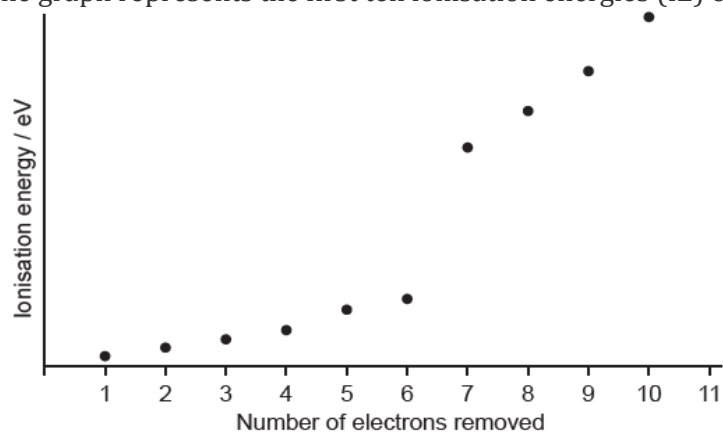
6. What does $^{24}_{12}\text{Mg}^{2+}$ represent?

- A. An ion with 12 protons and 24 neutrons
- B. An ion with 14 protons and 24 neutrons
- C. An ion with 12 protons and 12 neutrons
- D. An ion with 12 protons and 22 neutrons

7. Which electron transition emits radiation of the longest wavelength?



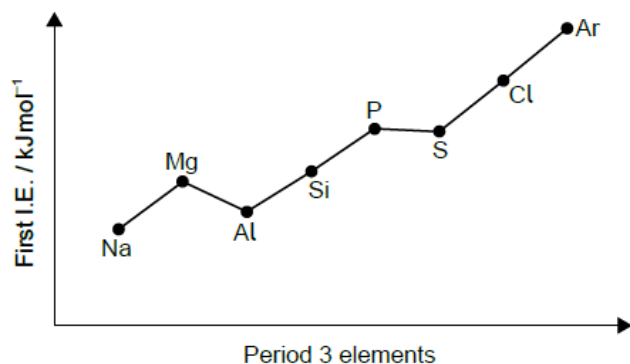
8. The graph represents the first ten ionisation energies (IE) of an element.



What is the element?

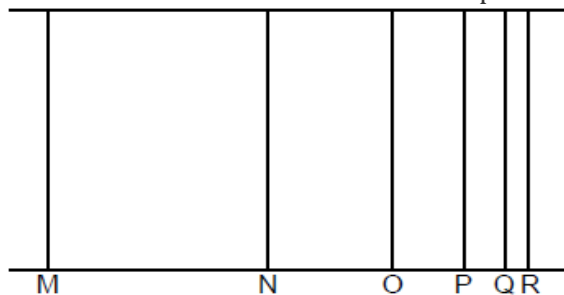
- A. O
- B. S
- C. Ne
- D. Cl

9. Which statement explains one of the decreases in first ionization energy (I.E.) across period 3?



- A. The nuclear charge of element Al is greater than element Mg.
- B. The electron-electron repulsion is greater, for the electron with the opposite spin, in element S than in element P.
- C. A new sub-level is being filled at element S.
- D. The p orbital being filled in element Al is at a lower energy than the s orbital in element Mg.

10. Which is correct for the line emission spectrum for hydrogen?



- A. Line M has a higher energy than line N.
- B. Line N has a lower frequency than line M.
- C. Line M has a longer wavelength than line N.
- D. Lines converge at lower energy.

11. Which is correct for the chromium isotope $^{53}_{24}\text{Cr}$?

- A. 24 neutrons and 53 nucleons
- B. 24 protons and 29 nucleons
- C. 24 protons and 29 neutrons
- D. 24 electrons and 53 neutrons

12. What is the condensed electron configuration of the Fe^{2+} ion?

- A. $[\text{Ar}]3d^6$
- B. $[\text{Ar}]3d^44s^2$
- C. $[\text{Ar}]3d^54s^1$
- D. $[\text{Ar}]3d^64s^2$

13. Which electron configuration is correct for the selenide ion, Se^{2-} ?

- A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^4$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^6$
- C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

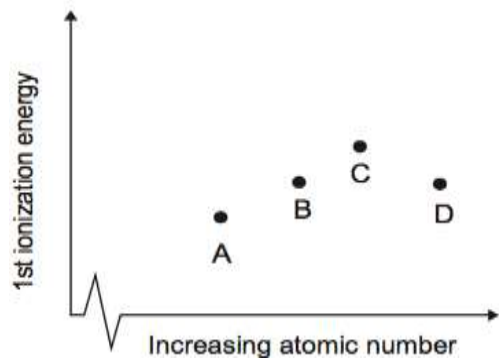
14. Which representation would be correct for a species, **Z**, which has 31 protons, 40 neutrons and 28 electrons?

- A. $^{71}_{31}\text{Z}^{3+}$
- B. $^{71}_{31}\text{Z}^{3-}$
- C. $^{71}_{40}\text{Z}^{3+}$
- D. $^{71}_{28}\text{Z}^{3+}$

15. A period 3 element, **M**, forms an oxide of the type M_2O . Which represents the first four successive ionization energies of **M**?

Ionization energy / kJ mol^{-1}				
	First	Second	Third	Fourth
A.	496	4563	6913	9544
B.	738	1451	7733	10541
C.	578	1817	2745	11578
D.	787	1577	3232	4356

16. The diagram shows the first ionization energies of four consecutive elements in the periodic table. Which element is in Group 14?



17. Which statements about the chlorine free radical are correct?

- I. It has 18 electrons.
 - II. It is an uncharged species.
 - III. It is formed by homolytic fission.
- A. I and II only
 B. I and III only
 C. II and III only
 D. I, II and III

18. Which statement about the isotopes of nitrogen is correct?

	Number of electrons	Number of neutrons	Mass number
A.	same	same	same
B.	same	same	different
C.	same	different	different
D.	different	different	different

19. Ultraviolet radiation has a shorter wavelength than infrared radiation. How does the frequency and energy of ultraviolet radiation compare with infrared radiation?

	Frequency	Energy
A.	higher	higher
B.	higher	lower
C.	lower	higher
D.	lower	lower

20. What is the total number of valence electrons in CH_3COO^- ?

- A. 16
- B. 22
- C. 23
- D. 24

21. Which statement is correct for the ion ${}^9_4\text{Be}^{2+}$?
- The ion contains 15 subatomic particles in the nucleus.
 - The ion contains more protons than neutrons in the nucleus.
 - The ion has an electron arrangement of 2,2.
 - Most of the total volume of the ion is empty space.
22. Which ion will be deflected most in a mass spectrometer?
- ${}^{16}\text{O}^+$
 - ${}^{16}\text{O}^{2+}$
 - ${}^{18}\text{O}^+$
 - ${}^{18}\text{O}^{2+}$
23. The first ionization energies (in kJmol^{-1}) of five **successive** elements in the periodic table are: 1314, 1681, 2081, 496 and 738
What could these elements be?
- d-block elements
 - The last two elements of one period and the first three elements of the next period
 - The last three elements of one period and the first two elements of the next period
 - The last five elements of a period

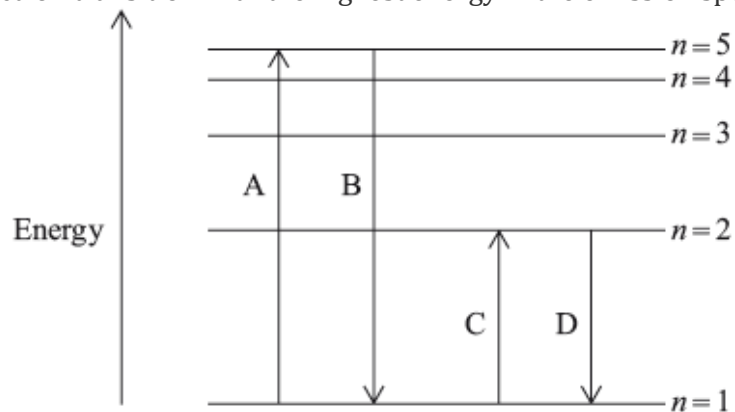
24. What is the electron configuration of the copper(I) ion, Cu^+ ?

- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^9$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

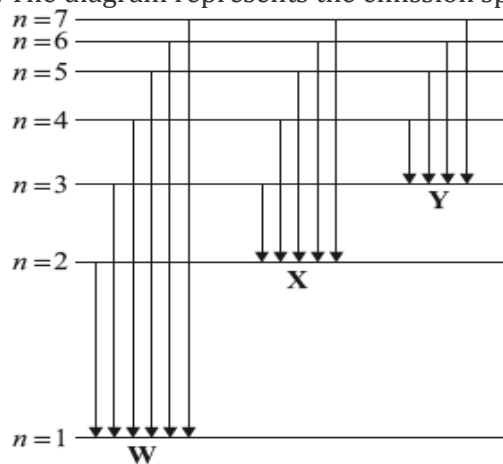
25. Which ion will show the **least** deflection in a mass spectrometer?

- ${}^{35}\text{Cl}^+$
- ${}^{35}\text{Cl}^{2+}$
- ${}^{35}\text{Cl}{}^{35}\text{Cl}^+$
- ${}^{35}\text{Cl}{}^{37}\text{Cl}^+$

26. Some possible electron transitions in a hydrogen atom are shown below. Which letter represents the electron transition with the highest energy in the emission spectrum?



27. The diagram represents the emission spectrum of hydrogen. Groups of arrows are labelled **W**, **X** and **Y**.



Which statement is correct?

- A. The arrows represent the transition of electrons to different energy levels when heat is supplied.
- B. The arrows of **W** represent emission in the UV region.
- C. The smallest arrow of **X** represents a violet line in the emission spectrum.
- D. The arrows of **Y** represent emission of electromagnetic waves with higher energy than those represented by **X** and **W**.

28. Which species have the same electron arrangements?

- I. O^{2-} , F^{-} , Ne
 - II. Li^{+} , Na^{+} , K^{+}
 - III. S^{2-} , Ar, K^{+}
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

29. Which statement about the periodic table is correct?

- A. The elements with atomic numbers 8, 16 and 34 have the same number of main energy levels.
- B. The elements with atomic numbers 8, 9 and 10 have similar chemical properties.
- C. The elements with atomic numbers 20, 21 and 22 are in the same group.
- D. The elements with atomic numbers 20, 38 and 56 have the same number of electrons in their outer energy level.

30. What does ${}_{24}^{52}\text{X}$ represent?

- A. An isotope of Te with 24 neutrons
- B. An isotope of Te with 24 electrons
- C. An isotope of Cr with 28 protons
- D. An isotope of Cr with 28 neutrons

31. Which species would be deflected most in a mass spectrometer?

- A. ${}^{24}\text{Mg}^{2+}$
- B. ${}^{24}\text{Mg}^{+}$
- C. ${}^{25}\text{Mg}^{2+}$
- D. ${}^{25}\text{Mg}^{+}$

32. Successive ionization energies for an element, Z, are shown in the table below.

Electrons removed	1st	2nd	3rd	4th	5th
Ionization energy / kJ mol^{-1}	736	1450	7740	10 500	13 600

What is the most likely formula for the ion of Z?

- A. Z^+
- B. Z^{2+}
- C. Z^{3+}
- D. Z^{4+}

33. Which electron configurations do not follow the Hund's rule?

	1s	2s	2p		
I.	$\uparrow \downarrow$	$\uparrow \downarrow$	\uparrow	\uparrow	\uparrow
II.	$\uparrow \downarrow$	$\uparrow \downarrow$	$\uparrow \downarrow$	\uparrow	
III.	$\uparrow \downarrow$	$\uparrow \downarrow$	\uparrow	\downarrow	\uparrow

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

34. Which statement correctly describes the atomic emission spectrum of hydrogen?

- A. It is a continuous spectrum converging at high frequency.
- B. It is a line spectrum converging at high frequency.
- C. It is a continuous spectrum converging at low frequency.
- D. It is a line spectrum converging at low frequency.

35. Which equation represents the second ionization energy of potassium?

- A. $\text{K}(\text{g}) \rightarrow \text{K}^{2+}(\text{g}) + 2\text{e}^-$
- B. $\text{K}^+(\text{g}) \rightarrow \text{K}^{2+}(\text{g}) + \text{e}^-$
- C. $\text{K}(\text{s}) \rightarrow \text{K}^{2+}(\text{g}) + 2\text{e}^-$
- D. $\text{K}^+(\text{s}) \rightarrow \text{K}^{2+}(\text{g}) + \text{e}^-$

36. What are the numbers of neutrons and electrons in the iodine ion, $^{125}\text{I}^+$?

	Neutrons	Electrons
A.	53	53
B.	72	52
C.	72	53
D.	125	52

37. In the emission spectrum of the hydrogen atom, which electronic transition would produce a line in the ultraviolet region of the electromagnetic spectrum?

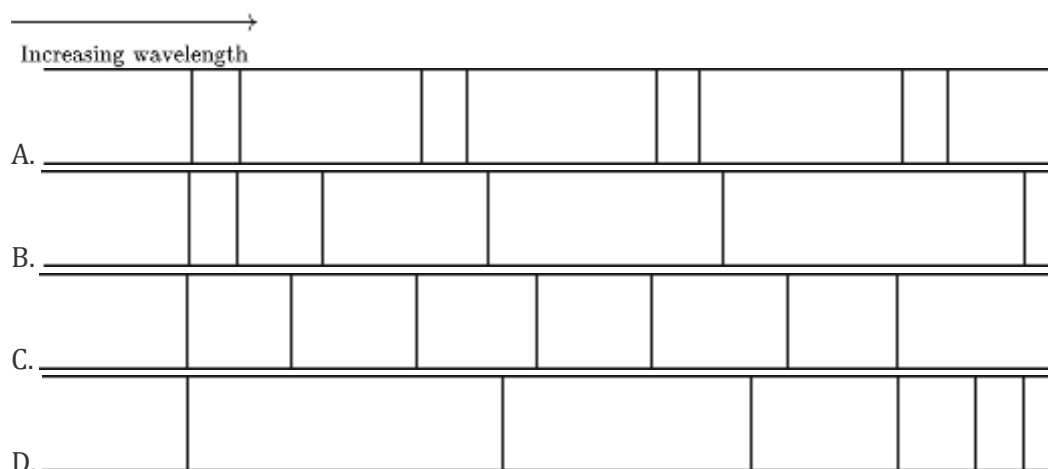
- A. $n = 1 \rightarrow n = 3$
- B. $n = 3 \rightarrow n = 1$
- C. $n = 3 \rightarrow n = 2$
- D. $n = 10 \rightarrow n = 2$

38. Which statements about the isotopes of an element are correct?

- I. They have the same chemical properties.
- II. They have different physical properties.
- III. They have the same number of protons and electrons.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

39. Which diagram shows a pattern similar to the emission spectrum of hydrogen?



40. Which is an isotope of ^{24}Mg ?

- A. $^{24}_{11}\text{Na}$
- B. $^{24}_{21}\text{Mg}^{2+}$
- C. $^{26}_{12}\text{Mg}$
- D. $^{22}_{10}\text{Ne}$

41. What are the numbers of neutrons and electrons in the iodine ion, $^{125}\text{I}^+$?

	Neutrons	Electrons
A.	53	53
B.	72	52
C.	72	53
D.	125	52

42. What is the abbreviated electron configuration of the telluride ion, Te^{2-} ?

- A. $[\text{Kr}]5s^2 5d^{10} 5p^6$
- B. $[\text{Kr}]5s^2 4d^{10} 5p^2$
- C. $[\text{Kr}]5s^2 4d^{10} 5p^4$
- D. $[\text{Kr}]5s^2 4d^{10} 5p^6$

43. What is the correct electron configuration of the Cu^+ ion?

- A. $[\text{Ar}] 3d^9 4s^1$
- B. $[\text{Ar}] 3d^7 4s^2$
- C. $[\text{Ar}] 3d^{10}$
- D. $[\text{Ar}] 3d^8 4s^1$

44. Which species has the electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$?

- A. Ni
- B. Ni^{2+}
- C. Fe
- D. Cu^{2+}

45. What is the correct number of each particle in an oxygen ion, $^{18}\text{O}^{2-}$?

	Protons	Neutrons	Electrons
A.	8	8	10
B.	8	10	8
C.	8	8	6
D.	8	10	10

46. Which statement about the electromagnetic spectrum is correct?

- A. Infrared light has a shorter wavelength than ultraviolet light.
- B. Visible light has a shorter wavelength than ultraviolet light.
- C. The frequency of visible light is higher than the frequency of infrared light.
- D. The energy of infrared light is higher than the energy of visible light.

47. Which subatomic particles are located in the nucleus of an atom?

- A. Protons and electrons
- B. Neutrons and electrons
- C. Protons and neutrons
- D. Protons, neutrons and electrons

48. What is the name of the type of spectrum consisting only of specific wavelengths?

- A. Electromagnetic
- B. Continuous
- C. Line
- D. Mass

49. Which statements are correct for silicon?

- I. Its electron arrangement is 2,8,4.
 - II. It has four electrons in its highest occupied energy level.
 - III. In the solid state, each silicon atom is covalently bonded to four other silicon atoms in a tetrahedral arrangement.
- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

50. In the electromagnetic spectrum, which will have the shortest wavelength **and** the greatest energy?

	Shortest wavelength	Greatest energy
A.	ultraviolet	ultraviolet
B.	infrared	infrared
C.	ultraviolet	infrared
D.	infrared	ultraviolet

51. A sample of zinc has the following composition:

Isotope	% abundance
^{64}Zn	55
^{66}Zn	40
^{68}Zn	5

What is the relative atomic mass of the zinc in this sample?

- A. 64.5
B. 65.0
C. 65.9
D. 66.4

52. Which statement about the electromagnetic spectrum is **not** correct?

- A. The wavelength of ultraviolet radiation is shorter than infrared radiation.
B. The frequency of visible radiation is higher than the frequency of ultraviolet radiation.
C. The energy of infrared radiation is lower than the energy of ultraviolet radiation.
D. Wavelength is inversely proportional to frequency.

53. Which statement about the numbers of protons, electrons and neutrons in an atom is always correct?

- A. The number of neutrons minus the number of electrons is zero.
B. The number of protons plus the number of neutrons equals the number of electrons.
C. The number of protons equals the number of electrons.
D. The number of neutrons equals the number of protons.

54. Which statements about the isotopes of chlorine, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$, are correct?

- I. They have the same chemical properties.
 - II. They have the same atomic number.
 - III. They have the same physical properties.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

55. In the emission spectrum of hydrogen, which electronic transition would produce a line in the visible region of the electromagnetic spectrum?

- A. $n = 2 \rightarrow n = 1$
- B. $n = 3 \rightarrow n = 2$
- C. $n = 2 \rightarrow n = 3$
- D. $n = \infty \rightarrow n = 1$

56. Which shows the sub-levels in order of **increasing** energy in the fourth energy level of an atom?

- A. $f < d < p < s$
- B. $p < d < f < s$
- C. $d < f < p < s$
- D. $s < p < d < f$

57. What is the electron configuration of vanadium?

- A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^3$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
- C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^1$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

58. Which quantities are the same for all atoms of chlorine?

- I. Number of protons
 - II. Number of neutrons
 - III. Number of electrons
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

59. Consider the relative abundance of the isotopes of element X.

What is the relative atomic mass of X?

- A. 24
- B. 25
- C. Between 24 and 25
- D. Between 25 and 26

Isotope	Relative abundance (%)
^{24}X	80
^{25}X	10
^{26}X	10

60. Values for the successive ionization energies for an unknown element are given in the table below.

First ionization energy / kJ mol^{-1}	Second ionization energy / kJ mol^{-1}	Third ionization energy / kJ mol^{-1}	Fourth ionization energy / kJ mol^{-1}
420	3600	4400	5900

In which group of the periodic table would the unknown element be found?

- A. 1
- B. 2
- C. 3
- D. 4

61. Which statement about the species $^{63}\text{Cu}^{2+}$ and $^{65}\text{Cu}^{+}$ is correct?

- A. Both species have the same number of protons.
- B. Both species have the same number of electrons.
- C. Both species have the same number of neutrons.
- D. Both species have the same electron arrangement.

62. Which statement about the isotopes of an element is correct?

- A. They have the same mass number.
- B. They have a different atomic number.
- C. They have the same chemical properties.
- D. They are located in different places in the periodic table.

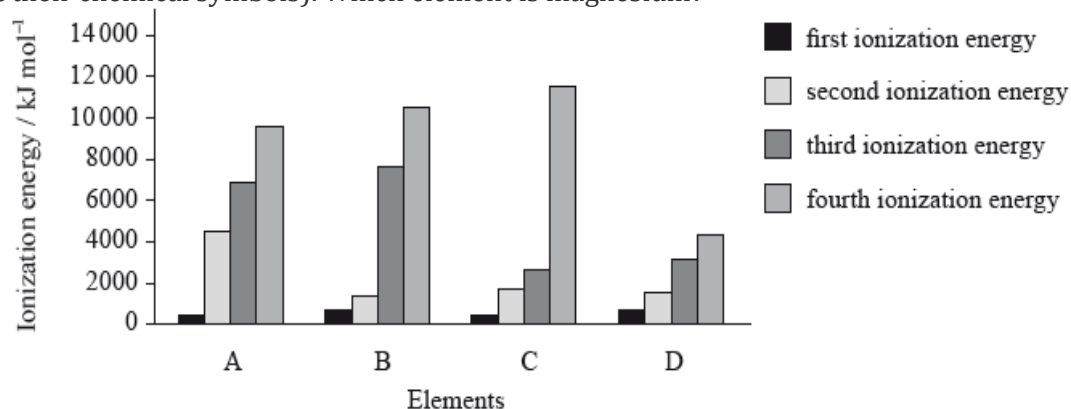
63. How many electrons does the ion $^{31}_{15}\text{P}^{3-}$ contain?

- A. 12
- B. 15
- C. 16
- D. 18

64. What is the electron arrangement of the Mg^{2-} ion?

- A. 2,2
- B. 2,8
- C. 2,8,2
- D. 2,8,8

65. The graph below shows the first four ionization energies of four elements A, B, C and D (the letters are not their chemical symbols). Which element is magnesium?



66. Which species have the same number of electrons?



A. I and II only

B. I and III only

C. II and III only

D. I, II and III

67. How many protons, neutrons and electrons are present in each atom of ^{31}P ?

	Protons	Neutrons	Electrons
A.	16	15	16
B.	15	16	15
C.	15	31	15
D.	16	31	16

68. Which is correct for the following regions of the electromagnetic spectrum?

	Ultraviolet (UV)		Infrared (IR)	
A.	high energy	short wavelength	low energy	low frequency
B.	high energy	low frequency	low energy	long wavelength
C.	high frequency	short wavelength	high energy	long wavelength
D.	high frequency	long wavelength	low frequency	low energy

69. What is the atomic number of a neutral atom which has 51 neutrons and 40 electrons?

A. 40

B. 51

C. 91

D. 131

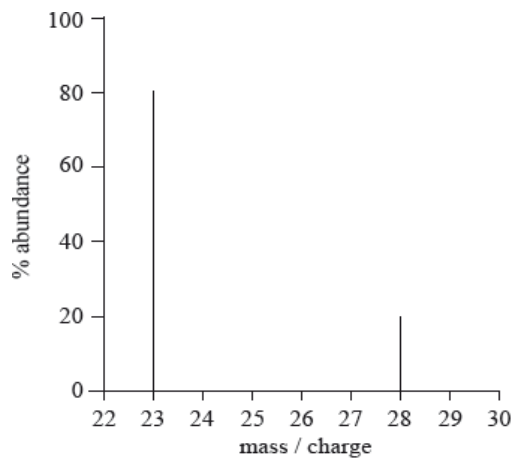
70. What is the relative atomic mass of an element with the following mass spectrum?

A. 24

B. 25

C. 26

D. 27



71. Between which ionization energies of boron will there be the greatest difference?

- A. Between 1st and 2nd ionization energies
- B. Between 2nd and 3rd ionization energies
- C. Between 3rd and 4th ionization energies
- D. Between 4th and 5th ionization energies

72. Which species possesses only two unpaired electrons?

- A. Zn
- B. Mg
- C. Ti^{2+}
- D. Fe^{2+}

73. The table below shows the number of protons, neutrons and electrons present in five species.

Species	Number of protons	Number of neutrons	Number of electrons
X	6	8	6
Y	7	7	7
Z	7	7	8
W	8	8	8
Q	8	10	8

Which **two** species are isotopes of the same element?

- A. X and W
- B. Y and Z
- C. Z and W
- D. W and Q

74. What is the order of increasing energy of the orbitals within a single energy level?

- A. $d < s < f < p$
- B. $s < p < d < f$
- C. $p < s < f < d$
- D. $f < d < p < s$

75. What is the electron configuration of the Cr^{2+} ion?

- A. $[\text{Ar}]3d^5 4s^1$
- B. $[\text{Ar}]3d^3 4s^1$
- C. $[\text{Ar}]3d^6 4s^1$
- D. $[\text{Ar}]3d^4 4s^0$

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IB Topics 2 & 12 Multiple Choice Practice

1. A	2. D	3. C	4. D	5. D
6. C	7. C	8. B	9. B	10. C
11. C	12. A	13. D	14. A	15. A
16. B	17. C	18. C	19. A	20. D
21. D	22. B	23. C	24. D	25. D
26. B	27. B	28. D	29. D	30. D
31. A	32. B	33. C	34. B	35. B
36. B	37. B	38. D	39. B	40. C
41. B	42. D	43. C	44. B	45. C
46. D	47. C	48. C	49. D	50. A
51. B	52. B	53. C	54. A	55. B
56. D	57. B	58. B	59. C	60. A
61. A	62. C	63. D	64. B	65. B
66. A	67. B	68. A	69. A	70. A
71. C	72. C	73. D	74. B	75. D