PAST IB TEST QUESTIONS - TOPICS 2 AND 3

1. Consider the composition of the species W, X, Y and Z below. Which species is an anion?

Species	Number of protons	Number of neutrons	Number of electrons
W	9	10	10
X	11	12	11
Y	12	12	12
Z	13	14	10

A. W
B. X
C. Y
D. Z

2. Energy levels for an electron in a hydrogen atom are

A. evenly spaced.
B. farther apart near the nucleus.
C. closer together near the nucleus.
D. arranged randomly.

3. Which is related to the number of electrons in the outer main energy level of the elements from the alkali metals to the halogens?

I. Group number
II. Period number

A. I only
B. II only
C. Both I and II
D. Neither I nor II

4. The element vanadium has two isotopes, $^{50}_{23}V$ and $^{51}_{23}V$, and a relative atomic mass of 50.94.

a) Define the term *isotope*.

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b) State the number of protons, electrons and neutrons in $^{50}_{23}V$.

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c) State and explain which is the more abundant isotope.

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d) State the name and the mass number of the isotope relative to which **all** atomic masses are measured.

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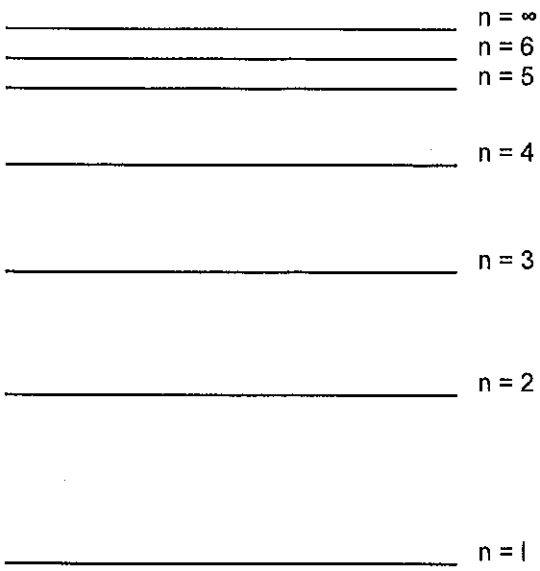
5. The diagram below (not to scale) represents some of the electron energy levels in the hydrogen atom.



i) Draw an arrow on the diagram to represent the electron transition for the ionization of hydrogen. Label this arrow A.

ii) Draw an arrow on the diagram to represent the lowest energy transition in the visible emission spectrum. Label this arrow B.

6. What is the correct number of each particle in a fluoride ion, 19F–?

	protons	neutrons	electrons
A.	9	10	8
B.	9	10	9
C.	9	10	10
D.	9	19	10

7. Which statement is correct for the emission spectrum of the hydrogen atom?

A. The lines converge at lower energies.

B. The lines are produced when electrons move from lower to higher energy levels.

C. The lines in the visible region involve electron transitions into the energy level closest to the nucleus.

D. The line corresponding to the greatest emission of energy is in the ultraviolet region.

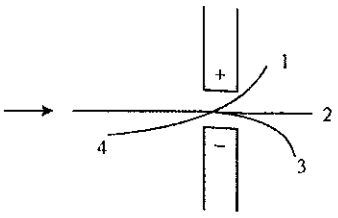
8. Electrons are directed into an electric field from left to right as indicated by the arrow in the diagram below. Which path is most probable for these electrons?

A. 1

B. 2

C. 3

D. 4



9. How many valence electrons are present in an atom of an element with atomic number 16?

A. 2 C. 6

B. 4 D. 8

10. a) Evidence for the existence of energy levels in atoms is provided by line spectra. State how a line spectrum differs from a continuous spectrum.

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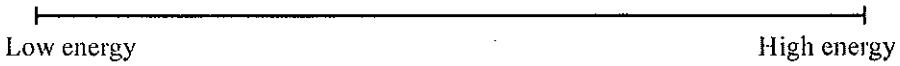
b) On the diagram below draw **four** lines in the visible line spectrum of hydrogen.



(c) Explain how the formation of lines indicates the presence of energy levels.

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11. A certain sample of element *Z* contains 60% of ^{69}Z and 40% of ^{71}Z. What is the relative atomic mass of element *Z* in this sample?

A. 69.2 C. 70.0

B. 69.8 D. 70.2

12. What is the difference between two neutral atoms represented by the symbols $^{59}_{27}Co$ and $^{59}_{28}Ni$?

A. The number of neutrons only.

B. The number of protons and electrons only.

C. The number of protons and neutrons only.

D. The number of protons, neutrons and electrons.

13. Which pair of elements reacts most readily?

A. $Li + Br_2$ C. $K + Br_2$

B. $Li + Cl_2$ D. $K + Cl_2$

14. For which element are the group number and the period number the same?

A. Li C. B

B. Be D. Mg

15. Explain the following statements.

a) The first ionization energy of sodium is

i) less than that of magnesium.

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ii) greater than that of potassium.

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b) The electronegativity of chlorine is higher than that of sulfur.

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16. The following table shows values that appear in the Data Booklet.

Table 1 Covalent (atomic) radii / 10–12 m

				N	O	F
				70	66	58
Na	Mg	Al	Si	P	S	Cl
186	160	143	117	110	104	99

Table 2 Ionic radii/10–12 m

				N^{3-}	O^{2-}	F^-
				171	146	133
Na^+	Mg^{2+}	Al^{3+}	Si^{4+}	P^{3-}	S^{2-}	Cl^-
98	65	45	42	212	190	181

Explain why

i) the magnesium ion is much smaller than the magnesium atom.

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ii) there is a large increase in ionic radius from silicon to phosphorus.

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iii) the ionic radius of Na+ is less than that of F–.

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17. Which of the following properties of the halogens increase from F to I?

I. Atomic radius

II. Melting point

III. Electronegativity

A. I only

B. I and II only

C. I and III only

D. I, II and III

18. Table 6 of the Data Booklet lists melting points of the elements. Explain the trend in the melting points of the alkali metals, halogens and period 3 elements.

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19. i) Explain how the first ionization energy of K compares with that of Na and Ar.

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ii) Explain the difference between the first ionization energies of Na and Mg.

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iii) Suggest why much more energy is needed to remove an electron from Na+ than from Mg+.

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20. Rubidium is an element in the same group of the periodic table as lithium and sodium. It is likely to be a metal which has a

A. high melting point and reacts slowly with water.

B. high melting point and reacts vigorously with water.

C. low melting point and reacts vigorously with water.

D. low melting point and reacts slowly with water.

21. When the following species are arranged in order of **increasing** radius, what is the correct order?

A. Cl^-, Ar, K^+

B. K^+, Ar , Cl^-

C. Cl^-, K^+, Ar

D. Ar, Cl^-, K^+

22. Table 8 of the Data Booklet gives the atomic and ionic radii of elements. State and explain the difference between

i) the atomic radius of nitrogen and oxygen.

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ii) the atomic radius of nitrogen and phosphorus.

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iii) the atomic and ionic radius of nitrogen.

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24. What increases **in equal steps of one** from left to right in the periodic table for the elements lithium to neon?

A. the number of occupied electron energy levels

B. the number of neutrons in the most common isotope

C. the number of electrons in the atom

D. the atomic mass

25. State and explain the trends in the atomic radius and the ionization energy

i) for the alkali metals Li to Cs.

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ii) for the period 3 elements Na to Cl.

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26. i) Describe **three** similarities and **one** difference in the reactions of lithium and potassium with water.

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ii) Give an equation for **one** of these reactions. Suggest a pH value for the resulting solution, and give a reason for your answer.

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