IB Chemistry – SL

Topic 3 Questions

1. Which pair of elements reacts most readily?

A. $Li + Br_2$

B. $Li + Cl_2$

C. $K + Br_2$

D. $K + Cl_2$

(Total 1 mark)

2. 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

(Total 1 mark)

3. Which pair would react together most vigorously?

A. Li and Cl_2

B. Li and Br_2

C. K and Cl_2

D. K and Br_2

(Total 1 mark)

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

A. Li

B. Be

C. B

D. Mg

(Total 1 mark)

5. Which of the physical properties below decrease with increasing atomic number for both the alkali metals and the halogens?

I. Atomic radius

II. Ionization energy

III. Melting point

A. I only

B. II only

C. III only

D. I and III only

(Total 1 mark)

6. 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.

(Total 1 mark)

7. 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^+

(Total 1 mark)

8. 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

(Total 1 mark)

9. Which property decreases down group 7 in the periodic table?

A. atomic radius

B. electronegativity

C. ionic radius

D. melting point

(Total 1 mark)

10. Which properties are typical of most non-metals in period 3 (Na to Ar)?

I. They form ions by gaining one or more electrons.

II. They are poor conductors of heat and electricity.

III. They have high melting points.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

11. A potassium atom has a larger atomic radius than a sodium atom. Which statement about potassium correctly explains this difference?

A. It has a larger nuclear charge.

B. It has a lower electronegativity.

C. It has more energy levels occupied by electrons.

D. It has a lower ionization energy.

(Total 1 mark)

12. Which factors lead to an element having a low value of first ionization energy?

I. large atomic radius

II. high number of occupied energy levels

III. high nuclear charge

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

13. Which statement about electronegativity is correct?

A. Electronegativity decreases across a period.

B. Electronegativity increases down a group.

C. Metals generally have lower electronegativity values than non-metals.

D. Noble gases have the highest electronegativity values.

(Total 1 mark)

14. Which statement is correct for a periodic trend?

A. Ionization energy increases from Li to Cs.

B. Melting point increases from Li to Cs.

C. Ionization energy increases from F to I.

D. Melting point increases from F to I.

(Total 1 mark)

15. Which compound of an element in period 3 reacts with water to form a solution with a pH greater than 7?

A. SiO_2

B. $SiCl_4$

C. NaCl

D. Na_2O

(Total 1 mark)

16. Which equation represents the first ionization energy of fluorine?

A. $F(g) + e^- \rightarrow F^-(g)$

B. $F^-(g) \rightarrow F(g) + e^-$

C. $F^+(g) \rightarrow F(g) + e^-$

D. $F(g) \rightarrow F^+(g) + e^-$

(Total 1 mark)

17. Which statement is correct for the halogen group?

A. Halide ions are all reducing agents, with iodide ions being the weakest.

B. Halogens are all oxidizing agents, with chlorine being the strongest.

C. Chloride ions can be oxidized to chlorine by bromine.

D. Iodide ions can be oxidized to iodine by chlorine.

(Total 1 mark)

18. Which of the following statements are correct?

I. The melting points decrease from Li → Cs for the alkali metals.
II. The melting points increase from F → I for the halogens.
III. The melting points decrease from Na → Ar for the period 3 elements.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

19. Which element is a transition metal?

A. Ca

B. Cr

C. Ge

D. Se

(Total 1 mark)

20. When Na, K, and Mg are arranged in **increasing** order of atomic radius (smallest first), which order is correct?

A. Na, K, Mg

B. Na, Mg, K

C. K, Mg, Na

D. Mg, Na, K

(Total 1 mark)

21. Which oxides produce an acidic solution when added to water?

I. SiO_2

II. P_4O_6

III. SO_2

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

22. Which series is arranged in order of **increasing** radius?

A. $Ca^{2+} < Cl^{-} < K^{+}$

B. $K^{+} < Ca^{2+} < Cl^{-}$

C. $Ca^{2+} < K^{+} < Cl^{-}$

D. $Cl^{-} < K^{+} < Ca^{2+}$

(Total 1 mark)

23. Describe the acid-base character of the oxides of the period 3 elements Na to Ar. For sodium oxide and sulfur trioxide, write balanced equations to illustrate their acid-base character.

.....

.....

.....

.....

.....

(Total 4 marks)

24. 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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 8 marks)

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

……..

……..

……..

……..

……..

……..

(3)

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

……..

……..

……..

……..

……..

……..

(4)

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

……..

……..

……..

(1)

(Total 8 marks)

26. Nitrogen is found in period 2 and group 5 of the periodic table.

(i) Distinguish between the terms *period* and *group*.

……

……

(1)

(ii) State the electron arrangement of nitrogen and explain why it is found in period 2 and group 5 of the periodic table.

……

……

(3)
(Total 4 marks)

27. 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.

……

……

……

……

(2)

(ii) the atomic radius of nitrogen and phosphorus.

……

……

……

……

(1)

(iii) the atomic and ionic radius of nitrogen.

……

……

……

……

(2)
(Total 5 marks)

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

(i) for the alkali metals Li to Cs.

……

……

……

……

……

……

(4)

(ii) for the period 3 elements Na to Cl.

……

……

……

……

……

……

(4)
(Total 8 marks)

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

……

……

……

……

……

……

……

……

(4)

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

……

……

……

(3)
(Total 7 marks)

30. (a) Classify each of the following oxides as acidic, basic or amphoteric.

(i) aluminium oxide

……

(1)

(ii) sodium oxide

……

(1)

(iii) sulfur dioxide

……

(1)

(b) Write an equation for each reaction between water and

(i) sodium oxide

……

……

(1)

(ii) sulfur dioxide.

……

……

(1)
(Total 5 marks)

31. This question is about Period 3 elements and their compounds.

(a) Explain, in terms of their structure and bonding, why the element sulfur is a non-conductor of electricity and aluminium is a good conductor of electricity.

.....

.....

.....

.....

.....

.....

(4)

(b) Explain, in terms of its structure and bonding, why silicon dioxide, SiO_2, has a high melting point.

.....

.....

.....

(2)
(Total 6 marks)

32. Explain why

(i) the first ionization energy of magnesium is lower than that of fluorine.

(2)

(ii) magnesium has a higher melting point than sodium.

(3)
(Total 5 marks)

33. Discuss the acid-base nature of the period 3 oxides. Write an equation to illustrate the reaction of one of these oxides to produce an acid, and another equation of another of these oxides to produce a hydroxide.

(Total 5 marks)

34. Information about the halogens appears in the Data Booklet.

(i) Explain why the ionic radius of chlorine is less than that of sulfur.

(2)

(ii) Explain what is meant by the term *electronegativity* and explain why the electronegativity of chlorine is greater than that of bromine.

(3)
(Total 5 marks)

35. (a) (i) State the meaning of the term *electronegativity* and explain why the noble gases are not assigned electronegativity values.

(2)

(ii) State and explain the trend in electronegativity across period 3 from Na to Cl.

(2)

(iii) Explain why Cl_2 rather than Br_2 would react more vigorously with a solution of I^-.

(2)

(b) State the acid-base properties of the following period 3 oxides.

$$MgO \quad Al_2O_3 \quad P_4O_6$$

Write equations to demonstrate the acid-base properties of each compound.

(7)
(Total 13 marks)

36. (i) Define the term *ionization energy*.

(1)

(ii) Write an equation for the reaction of lithium with water.

(1)

(iii) State and explain the trend in the ionization energy of alkali metals down the group.

(3)

(iv) Explain why the electronegativity of phosphorus is greater than that of aluminium.

(2)

(v) Table 8 in the Data Booklet contains two values for the ionic radius of silicon. Explain, by reference to atomic structure and electron arrangements, why the two values are very different.

(4)

(Total 11 marks)

37. Explain why sulfur has a lower first ionization energy than oxygen, and also a lower first ionization energy than phosphorus.

(Total 4 marks)

38. With reference to the types of bonding present in period 3 elements:

(i) explain why Mg has a higher melting point than Na.

(2)

(ii) explain why Si has a very high melting point.

(2)

(iii) explain why the other non-metal elements of period 3 have low melting points.

(2)

(Total 6 marks)

39. Describe the acid-base character of the oxides of the period 3 elements Na to Ar. For sodium oxide and sulfur trioxide, write balanced equations to illustrate their acid-base character.

(Total 3 marks)

40. Explain the following statements.

(a) The first ionization energy of sodium is

(i) less than that of magnesium.

……

……

……

……

(2)

(ii) greater than that of potassium.

……

……

(1)

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

…….

…….

…….

…….

(2)
(Total 5 marks)

41. (a) (i) Define the term *ionization energy*.

.....

.....

(2)

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

.....

(1)

(b) The first ionization energies of the elements are shown in Table 7 of the Data Booklet. Explain why the first ionization energy of magnesium is greater than that of sodium.

.....

.....

.....

.....

(2)

(c) Lithium reacts with water. Write an equation for the reaction and state **two** observations that could be made during the reaction.

.....

.....

.....

(3)
(Total 8 marks)

42. (a) State the meaning of the term *electronegativity*.

.....

.....

(1)

(b) State and explain the trend in electronegativity across period 3 from Na to Cl.

.....

.....

.....

.....

(2)

(c) Explain why Cl_2 rather than Br_2 would react more vigorously with a solution of I^-.

.....

.....

.....

.....

(2)
(Total 5 marks)