Chemistry

Higher level

Paper 1A

Practice paper

Topic: Periodicity (Topic 3 and 13 Subset)

1. Which equation represents the fourth ionization energy of aluminum?
   A. $Al(g) \rightarrow Al^{4+}(g) + 4e^-$
   B. $Al^{3+}(g) \rightarrow Al^{4+}(g) + e^-$
   C. $Al^{4+}(g) \rightarrow Al^{3+}(g) + e^-$
   D. $Al(g) + 4e^- \rightarrow Al^{4-}(g)$

2. Which evidence supports the idea that the 2p subshell is higher in energy than the 2s subshell?
   A. IE of B > Be
   B. IE of B < Be
   C. IE of N > O
   D. IE of N < O

3. Which element has the most endothermic first electron affinity?
   A. Oxygen
   B. Fluorine
   C. Neon
   D. Chlorine

4. Which of the following has the highest melting point?
   A. Na
   B. Mg
   C. Al
   D. Si

5. An element has successive IEs (kJ mol^{-1}): 578, 1817, 2745, 11577, 14842. In which group is it?
   A. Group 2
   B. Group 13
   C. Group 14
   D. Group 1

6. Which property shows a sharp increase between Group 17 and Group 18?
   A. Atomic radius
   B. Electronegativity
   C. First Ionization Energy
   D. Ionic radius

7. Why is the second electron affinity of oxygen endothermic?
   A. Oxygen is stable with 8 electrons

B. Energy is released when an electron is added to O^-
C. Repulsion occurs between the second electron and the negative O^- ion
D. Oxygen becomes a gas at higher temperatures

8. Which of the following is correct for the periodicity of melting points in Period 3?
A. Maximum at Ar
B. Maximum at Si due to giant covalent structure
C. Minimum at Al
D. Continuous increase from Na to Cl

9. Which factor most influences the decrease in ionic radius from P^{3-} to Cl^-?
A. Increasing shielding
B. Decreasing number of shells
C. Increasing nuclear charge
D. Decreasing mass number

10. Aluminum oxide reacts with sulfuric acid. What are the products?
A. $Al_2(SO_4)_3 + H_2O$
B. $AlSO_4 + H_2$
C. $Al_2O_3 + H_2SO_4$
D. $Al(OH)_3 + SO_3$

11. Which element's ionization energy dip is explained by 'spin-pairing repulsion'?
A. Boron
B. Carbon
C. Oxygen
D. Neon

12. What is the trend in melting points of Period 3 metals (Na, Mg, Al)?
A. Na > Mg > Al due to lattice size
B. Al > Mg > Na due to increasing number of delocalized electrons
C. Na = Mg = Al because they are in the same period
D. Mg > Na > Al due to atomic mass

13. Which of the following has the largest atomic radius?
A. Potassium
B. Calcium
C. Rubidium
D. Strontium

14. Successive IE data for X: 738, 1451, 7733, 10543, 13630. What is the formula of its oxide?

A. X_2O
B. XO
C. X_2O_3
D. XO_2

15. In a plot of 1st IE vs atomic number, where are the local maxima always found?

A. Group 1
B. Group 2
C. Group 17
D. Group 18

16. Which describes the electronegativity trend down group 1?

A. Increases because effective nuclear charge increases
B. Decreases because valence electrons are further from the nucleus
C. Increases because mass increases
D. Decreases because atomic number increases

17. Which oxides are purely acidic?

I. P_4O_{10}
II. SO_2
III. MgO
A. I and II only
B. I and III only
C. II and III only
D. I, II and III

18. Which explains why Ar has a lower melting point than S_8?

A. S_8 is a larger molecule with stronger London forces
B. Ar is a noble gas and chemically inert
C. S_8 is giant covalent
D. Ar has a full outer shell

19. Which element has the electron configuration [Ne] $3s^2$ $3p^4$?

A. Silicon
B. Phosphorus
C. Sulfur
D. Chlorine

20. Which statement is correct about the trend in ionic radii for isoelectronic ions?
A. Increases with atomic number
B. Decreases with atomic number
C. Stays constant
D. Increases with charge

21. Equation for the first electron affinity of Oxygen:
A. $O(g) + e^- \rightarrow O^-(g)$
B. $O(g) \rightarrow O^+(g) + e^-$
C. $O_2(g) + 2e^- \rightarrow 2O^-(g)$
D. $O^-(g) + e^- \rightarrow O^{2-}(g)$

22. Which element has the highest effective nuclear charge for its valence electrons?
A. Sodium
B. Aluminum
C. Sulfur
D. Chlorine

23. Which of the following is an amphoteric oxide?
A. Al_2O_3
B. SiO_2
C. Na_2O
D. P_4O_6

24. Melting point trend of P_4, S_8, Cl_2:
A. $P_4 > S_8 > Cl_2$
B. $S_8 > P_4 > Cl_2$
C. $Cl_2 > S_8 > P_4$
D. $S_8 > Cl_2 > P_4$

25. Successive IE jump from 3rd to 4th identifies an element in which group?
A. Group 3
B. Group 13
C. Group 14
D. Group 15

26. Which value is likely for the 1st IE of O if N is 1402 kJ mol^{-1}?
A. 1500
B. 1402
C. 1314

D. 1800

27. Atomic radius jump from Cl to K:
A. Sharp increase due to a new energy level
B. Sharp decrease due to higher nuclear charge
C. No change
D. Stays same because they are both in Period 3

28. Number of valence electrons in Argon:
A. 0
B. 2
C. 6
D. 8

29. Ionic radius of anions compared to their parent atoms:
A. Larger because of increased electron repulsion
B. Smaller because of increased nuclear attraction
C. Larger because of more shells
D. Smaller because electrons are lost

30. Which Period 3 oxide is a gas at room temperature?
A. Na_2O
B. Al_2O_3
C. SiO_2
D. SO_2

31. Which of the following does NOT have the same electron configuration as Sc^{3+}?
A. Ar
B. K^+
C. Ca^{2+}
D. Sc^+

32. Why does Silicon have a giant covalent structure while Sulfur is molecular?
A. Silicon can form 4 strong covalent bonds in a 3D network
B. Sulfur atoms are too large to bond together
C. Silicon is a metal
D. Sulfur has higher electronegativity

33. Identification of element by IE (kJ mol^{-1}): 496, 4562, 6912...
A. Na
B. Mg
C. Al
D. Si

34. Which element has the most negative first electron affinity?
A. Cl
B. F
C. O
D. N

35. Meaning of 'effective nuclear charge':
A. Total charge of the nucleus
B. Charge felt by valence electrons after shielding
C. Number of protons plus neutrons
D. Charge of an ion

36. Which species has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$?
A. S^-
B. Ar
C. Cl^-
D. All of the above

37. Ionic radii trend of group 1 cations down the group:
A. Increases
B. Decreases
C. Constant
D. Periodic

38. Product of SiO_2 + 2NaOH (aq):
A. $Na_2SiO_3 + H_2O$
B. $Si(OH)_4$ + Na
C. Na_2O + Si
D. No reaction

39. Element with highest 2nd IE in Period 3?
A. Sodium
B. Magnesium
C. Argon

D. Chlorine

40. Trend in basicity of Period 3 oxides:
A. Increases across period
B. Decreases across period
C. No trend
D. Maximum at Aluminum