Q1. Arrange the following atoms in order of increasing atomic radius.

K, Ca, As, Cs, Rb

A) As < Ca < K < Rb < Cs
B) As < Ca < Rb < K < Cs
C) Cs < Rb < K < Ca < As
D) Cs < Rb < K < As < Ca
E) As < K < Rb < Ca < As

Q2. Identify the element that corresponds to the following electron configuration,

[Kr] $5s^2$ $4d^{10}$ $5p^4$

A) Te

B) Sn

C) In

D) Sb

E) I

Q3. Which of the following statements is NOT correct?

A) The chemical bond in H-F molecule is an ionic bond.
B) An ionic compound is formed when a metal reacts with a nonmetal.
C) In covalent bonding, electrons are shared by nuclei of two bonded atoms.
D) Two atoms with different electronegativity form a polar covalent bond.
E) Two atoms with the same electronegativity form a covalent bond.

Q4. Arrange the following bonds in order of increasing ionic character.

N—O, B—F, C—F, Cl—Cl, K—F

A) Cl—Cl < N—O < C—F < B—F < K—F
B) K—F < B—F < C—F < N—O < Cl—Cl
C) Cl—Cl < C—F < N—O < B—F < K—F
D) K—F < B—F < N—O < C—F < Cl—Cl
E) B—F < K—F < C—F < N—O < Cl—Cl

Q5. Which of the following set of quantum numbers represents the unpaired electron in a Cl atom?

A) n = 3, l =1, $m_l = 1$ $m_s = +½$
B) n = 3, $l = –1$, $m_l = 0$, $m_s = –½$
C) n = 3, $l = 3$, $m_l = 0$, $m_s = +½$
D) n = 3, $l = 1$, $m_l = 2$, $m_s = –½$
E) n = 3, $l = 2$, $m_l = 0$, $m_s = +½$

Q6. Which of the following electron transitions in the hydrogen atom will produce light with the shortest wavelength?

A) n = 3 → n = 2
B) n = 4 → n = 3
C) n = 5 → n = 4
D) n = 6 → n = 5
E) n = 7 → n = 6

Q7. Which of the following is NOT correct?

A) Both the position and momentum of an electron at a given time can be determined accurately.
B) Electromagnetic radiation is quantized.
C) All matter display both particle and wave properties.
D) Niels Bohr developed a quantum model for the hydrogen atom.
E) The lowest possible energy state of a molecule or atom is called its ground state.

Q8. Which of the following electron configurations has the lowest first ionization energy?

A) $1s^2 2s^2 2p^6 3s^1$
B) $1s^2 2s^2 2p^6 3s^2$
C) $1s^2 2s^2 2p^6$
D) $1s^2 2s^2 2p^4$
E) $1s^2 2s^2 2p^5$

Q9. Arrange the following ions in order of increasing size.

I^-, Cs^+, Te^{2-}, Ba^{2+}

A) $Ba^{2+} < Cs^+ < I^- < Te^{2-}$
B) $Ba^{2+} < I^- < Cs^+ < Te^{2-}$
C) $Ba^{2+} < Cs^+ < Te^{2-} < I^-$
D) $Te^{2-} < I^- < Cs^+$, Ba^{2+}
E) $Te^{2-} < Cs^+ < I^- < Ba^{2+}$

Q10. Assign the formal charge for central atom of XeF_4.

A) 0
B) +1
C) +2
D) +3
E) +4

Q11. Use the following data to calculate the lattice energy for $MgF_2(s)$.

$\Delta H_f°$ for $MgF_2(s)$	-2088 kJ/mol
First ionization energy of Mg	735 kJ/mol
Second ionization energy of Mg	1445 kJ/mol
Electron affinity of F	-328 kJ/mol
Bond energy of F_2	154 kJ/mol
Enthalpy of sublimation of Mg	150 kJ/mol

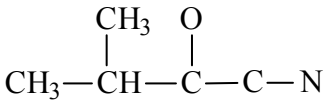
A) –3916 kJ/mol
B) + 68 kJ/mol
C) –68 kJ/mol
D) –1828 kJ/mol
E) –3181 kJ/mol

Q12. Use the following data to calculate the energy of an H–Cl bond.

	$\Delta H°$ (kJ)
$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$	–184
$H_2(g) \rightarrow 2H(g)$	432
$Cl_2(g) \rightarrow 2Cl(g)$	239

A) 428 kJ
B) 770 kJ
C) 856 kJ
D) 518 kJ
E) 326 kJ

Q13. Complete the Lewis structure for the molecule,



This molecule has _____ single bonds and _____ multiple bonds.

A) 11, 2
B) 4, 2
C) 6, 3
D) 11, 5
E) 13, 0

Q14. How many of the following molecules have all of their atoms in the same plane?

$BeCl_2, CO_2, NH_3, H_2C{=}CH_2$

A) 3
B) 0
C) 4
D) 1
E) 2

Q15. Which of the following statements is NOT correct?

A) The hybridization of boron in BF_3 is sp^3.
B) The hybridization of boron in BF_3 is sp^2.
C) The molecule HCN has two pi (π) bonds and two sigma (σ) bonds.
D) The nitrogen molecule has a sigma (σ) bond and two pi (π) bonds.
E) The hybridization of nitrogen in NH_3 is sp^3.

Q16. How many of the following molecules are polar?

$SF_2, SF_4, SF_6,$

A) 2
B) 0
C) 1
D) 3
E) 4

Q17. A sample of gas expands from 10.0 L to 75.0 L against an external pressure of 2.00 atm. At the same time 10.0 kJ of heat is absorbed by the gas. Calculate ΔE for the gas during this process. (1 L. atm = 101. 3 J)

A) –3.2 kJ
B) –23.2 kJ
C) –3.0 kJ
D) +23.2 kJ
E) +3.2 kJ

Q18.The energy of combustion of a compound of molecular formula $C_{10}H_{10}O_4$ is 4685 kJ/mol. If 1.000 g of this compound is combusted in a bomb calorimeter at 20.215 ^oC, what is the final temperature?
(Heat capacity of the calorimeter = 7.854 kJ/^oC)

A) 23.287 ^oC
B) 22.382 ^oC
C) 24.125 ^oC
D) 21.015 ^oC
E) 23.627 ^oC

Q19. Calculate the heat of formation of NO_2Cl from the following data.

$$NO_2Cl(g) \rightarrow NO_2(g) + 1/2\ Cl_2 \quad \Delta H = -114.0\ kJ$$
$$1/2\ N_2(g) + O_2(g) \rightarrow NO_2(g) \quad \Delta H = +33.2\ kJ$$

A) +147.2 kJ/mol
B) –80.8 kJ/mol
C) +80.8 kJ/mol
D) –147.2 kJ/mol
E) –47.6 k J/mol

Q20. Calculate the de Broglie wavelength for an electron (mass =9.11 x 10^{-31}kg) with a velocity of 10.% of the speed of light.

A) 2.4 x 10^{-11} m
B) 4.5 x 10^{-12} m
C) 1.3 x 10^{-10} m
D) 8.3 x 10^{-11} m
E) 7.2 x 10^{-9} m