

1091 2nd Midterm Exam _12/09/20 (A)

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) Screening of the nuclear charge by core electrons in atoms is _____.
- A) less efficient than that by valence electrons
 - B) more efficient than that by valence electrons
 - C) responsible for a general decrease in atomic radius going down a group
 - D) essentially identical to that by valence electrons
 - E) both essentially identical to that by valence electrons and responsible for a general decrease in atomic radius going down a group

Answer: B

- 2) Atomic radius generally increases as we move _____.
- A) up a group and from right to left across a period
 - B) down a group and from left to right across a period
 - C) down a group; the period position has no effect
 - D) up a group and from left to right across a period
 - E) down a group and from right to left across a period

Answer: E

- 3) Of the following, which gives the correct order for atomic radius for Ca, K, As, Ge and Kr?
- A) $\text{Kr} > \text{Ge} > \text{As} > \text{K} > \text{Ca}$
 - B) $\text{K} > \text{Ca} > \text{Ge} > \text{As} > \text{Kr}$
 - C) $\text{Ge} > \text{As} > \text{Kr} > \text{K} > \text{Ca}$
 - D) $\text{Ca} > \text{K} > \text{As} > \text{Ge} > \text{Kr}$
 - E) $\text{Kr} > \text{As} > \text{Ge} > \text{Ca} > \text{K}$

Answer: B

- 4) Which isoelectronic series is correctly arranged in order of increasing radius?
- A) $\text{Cl}^- < \text{Ar} < \text{K}^+ < \text{Ca}^{2+}$
 - B) $\text{Ca}^{2+} < \text{K}^+ < \text{Cl}^- < \text{Ar}$
 - C) $\text{Ca}^{2+} < \text{K}^+ < \text{Ar} < \text{Cl}^-$
 - D) $\text{Ca}^{2+} < \text{Ar} < \text{K}^+ < \text{Cl}^-$
 - E) $\text{K}^+ < \text{Ca}^{2+} < \text{Ar} < \text{Cl}^-$

Answer: C

- 5) Which of the following correctly represents the second ionization of calcium?
- A) $\text{Ca}^+ (\text{g}) + \text{e}^- \rightarrow \text{Ca} (\text{g})$
 - B) $\text{Ca}^+ (\text{g}) + \text{e}^- \rightarrow \text{Ca}^{2+} (\text{g})$
 - C) $\text{Ca} (\text{g}) \rightarrow \text{Ca}^+ (\text{g}) + \text{e}^-$
 - D) $\text{Ca}^- (\text{g}) + \text{e}^- \rightarrow \text{Ca}^{2-} (\text{g})$
 - E) $\text{Ca}^+ (\text{g}) \rightarrow \text{Ca}^{2+} (\text{g}) + \text{e}^-$

Answer: E

Consider the following electron configurations to answer the questions that follow:

- (i) $1s^2 2s^2 2p^6 3s^1$
- (ii) $1s^2 2s^2 2p^6 3s^2$
- (iii) $1s^2 2s^2 2p^6 3s^2 3p^1$
- (iv) $1s^2 2s^2 2p^6 3s^2 3p^4$
- (v) $1s^2 2s^2 2p^6 3s^2 3p^5$

6) The electron configuration belonging to the atom with the highest second ionization energy is _____.

A) (i) B) (ii) C) (iii) D) (iv) E) (v)

Answer: A

7) Of the following statements, _____ is not true for oxygen.

- A) Oxygen is a colorless gas at room temperature.
- B) The chemical formula of ozone is O_3 .
- C) The most stable allotrope of oxygen is O_2 .
- D) Dry air is about 79% oxygen.
- E) Oxygen forms peroxide and superoxide anions.

Answer: D

8) Which one of the following compounds produces a basic solution when dissolved in water?

- A) O_2 B) Na_2O C) OF_2 D) CO_2 E) SO_2

Answer: B

9) Which one of the following is not true about the alkali metals?

- A) They all have 2 electrons in their valence shells.
- B) They all readily form ions with a +1 charge.
- C) They are very reactive elements.
- D) They have the lowest first ionization energies of the elements.
- E) They are low density solids at room temperature.

Answer: A

10) In the generation of most anions, the energy change (kJ/mol) that _____ an electron is _____.

- A) adds, positive
- B) removes, negative
- C) removes, positive
- D) adds, negative
- E) None of the above is correct.

Answer: D

11) Which ion below has a noble gas electron configuration?

- A) Be^{2+} B) C^{2+} C) B^{2+} D) Li^{2+} E) N^{2-}

Answer: A

12) In ionic bond formation, the lattice energy of ions _____ as the magnitude of the ion charges _____ and the radii _____.

- A) decreases, increase, increase
- B) increases, increase, decrease
- C) increases, increase, increase
- D) increases, decrease, decrease
- E) increases, decrease, increase

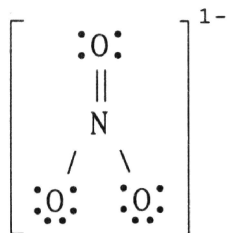
Answer: B

13) A valid Lewis structure of _____ cannot be drawn without violating the octet rule.

- A) SeF_4 B) PO_4^{3-} C) CF_4 D) NF_3 E) SiF_4

Answer: A

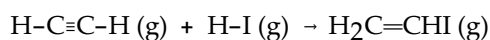
14) The formal charge on nitrogen in NO_3^- is _____.



- A) +2 B) +1 C) 0 D) -1 E) -2

Answer: B

15) Using the table of average bond energies below, the ΔH for the reaction is _____ kJ.

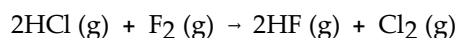


Bond:	$\text{C}\equiv\text{C}$	$\text{C}=\text{C}$	H-I	C-I	C-H
D (kJ/mol):	839	614	299	240	413

- A) +129 B) +506 C) -931 D) -129 E) -506

Answer: D

16) Using the table of bond dissociation energies, the ΔH for the following reaction is _____ kJ.



Bond	D (kJ/mol)
H-Cl	431
F-F	155
H-F	567
Cl-Cl	242

- A) 223 B) -223 C) 208 D) -359 E) 359

Answer: D

17) Which two bonds are least similar in polarity?

- A) O-F and Cl-F
B) C-Cl and Ge-Cl
C) B-F and Cl-F
D) I-Br and Si-Cl
E) Al-Cl and I-Br

Answer: E

18) How many equivalent resonance structures can be drawn for the molecule of SO_3 without having to violate the octet rule on the sulfur atom?

- A) 2 B) 1 C) 5 D) 3 E) 4

Answer: D

19) Given the electronegativities below, which covalent single bond is most polar?

Element:	H	C	N	O
Electronegativity:	2.1	2.5	3.0	3.5

- A) N—H B) O—N C) O—H D) C—H E) O—C

Answer: C

20) What is the electron configuration for the Co^{2+} ion?

- A) $[\text{Ar}]4s^13d^6$
B) $[\text{Ar}]3d^7$
C) $[\text{Ne}]3s^23p^{10}$
D) $[\text{Ar}]4s^23d^9$
E) $[\text{Ar}]3d^5$

Answer: B

21) The value of ΔE for a system that performs 111 kJ of work on its surroundings and gains 89 kJ of heat is _____ kJ.

- A) -200 B) 22 C) 200 D) -22 E) -111

Answer: D

22) Which one of the following is an endothermic process?

- A) water freezing
B) boiling soup
C) Both A and C
D) Hydrochloric acid and barium hydroxide are mixed at 25 °C: the temperature increases.
E) ice melting

Answer: C

23) Which of the following statements is false?

- A) The enthalpy change for a reaction depends on the state of the reactants and products.
B) Internal energy is a state function.
C) The enthalpy of a reaction is equal to the heat of the reaction.
D) The enthalpy change for a reaction is equal in magnitude, but opposite in sign, to the enthalpy change for the reverse reaction.
E) Enthalpy is an intensive property.

Answer: E

24) The temperature of a 12.58 g sample of calcium carbonate $[\text{CaCO}_3 (\text{s})]$ increases from 23.6 °C to 38.2 °C. If the specific heat of calcium carbonate is 0.82 J/g-K, how many joules of heat are absorbed?

- A) 5.0 B) 151 C) 410 D) 0.82 E) 7.5

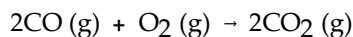
Answer: B

25) For which one of the following reactions is $\Delta H^\circ_{\text{rxn}}$ equal to the heat of formation of the product?

- A) $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightarrow 2\text{NH}_3 (\text{g})$
B) $6\text{C} (\text{s}) + 6\text{H} (\text{g}) \rightarrow \text{C}_6\text{H}_6 (\text{l})$
C) $\text{P} (\text{g}) + 4\text{H} (\text{g}) + \text{Br} (\text{g}) \rightarrow \text{PH}_4\text{Br} (\text{l})$
D) $6\text{C} (\text{g}) + 11\text{H}_2 (\text{g}) + 11\text{O} (\text{g}) \rightarrow \text{C}_6\text{H}_{22}\text{O}_{11} (\text{g})$
E) $(1/2)\text{N}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow \text{NO}_2 (\text{g})$

Answer: E

- 26) The value of ΔH° for the reaction below is -482 kJ . Calculate the heat (kJ) released to the surroundings when 38.5 g of $\text{O}_2 (\text{g})$ reacts with excess CO .



- A) 210. B) 2.65×10^3 C) 65.7 D) 580. E) 482

Answer: D

- 27) For which one of the following reactions is the value of $\Delta H^\circ_{\text{rxn}}$ equal to ΔH_f° for the product?

- A) $2\text{Ca} (\text{s}) + \text{O}_2 (\text{g}) \rightarrow 2\text{CaO} (\text{s})$
B) $3\text{Mg} (\text{s}) + \text{N}_2 (\text{g}) \rightarrow \text{Mg}_3\text{N}_2 (\text{s})$
C) $\text{C} (\text{diamond}) + \text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g})$
D) $\text{C}_2\text{H}_2 (\text{g}) + \text{H}_2 (\text{g}) \rightarrow \text{C}_2\text{H}_4 (\text{g})$
E) $2\text{C} (\text{graphite}) + \text{O}_2 (\text{g}) \rightarrow 2\text{CO} (\text{g})$

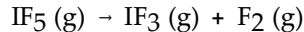
Answer: B

- 28) Which one of the following conditions would always result in an increase in the internal energy of a system?

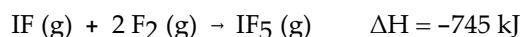
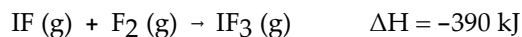
- A) The system loses heat and has work done on it by the surroundings.
B) The system gains heat and does work on the surroundings.
C) The system loses heat and does work on the surroundings.
D) The system gains heat and has work done on it by the surroundings.
E) None of the above is correct.

Answer: D

- 29) ΔH for the reaction



is _____ kJ, give the data below.



- A) +35 B) -1135 C) -35 D) +355 E) +1135

Answer: D

- 30) A 22.44 g sample of iron absorbs 180.8 J of heat, upon which the temperature of the sample increases from 21.1°C to 39.0°C . What is the specific heat of iron?

- A) 0.900 B) 0.820 C) 0.140 D) 0.840 E) 0.450

Answer: E

- 31) Of the following transitions in the Bohr hydrogen atom, the _____ transition results in the emission of the lowest-energy photon.

- A) $n = 6 \rightarrow n = 1$ B) $n = 1 \rightarrow n = 4$ C) $n = 6 \rightarrow n = 3$ D) $n = 1 \rightarrow n = 6$ E) $n = 3 \rightarrow n = 6$

Answer: C

- 32) The uncertainty principle states that _____.
- A) there can only be one uncertain digit in a reported number
 - B) it is impossible to know anything with certainty
 - C) matter and energy are really the same thing
 - D) it is impossible to know how many electrons there are in an atom
 - E) it is impossible to know the exact position and momentum of an electron

Answer: E

- 33) Which one of the following represents an acceptable set of quantum numbers for an electron in an atom? (arranged as $n, l, m_l,$ and m_s)
- A) 3, 3, 3, $-1/2$ B) 5, 4, - 5, $1/2$ C) 3, 3, 3, $1/2$ D) 2, 2, -1, $-1/2$ E) 1, 0, 0, $1/2$

Answer: E

- 34) The energy (J) required for an electronic transition in a Bohr hydrogen atom from $n = 2$ to $n = 3$ is _____ J.
- A) 4.00×10^{-19}
 - B) -3.00×10^{-19}
 - C) 3.00×10^{-19}
 - D) -7.90×10^{-19}
 - E) 4.60×10^{14}

Answer: C

- 35) The de Broglie wavelength of an electron with a velocity of 6.00×10^6 m/s is _____ m. The mass of the electron is 9.11×10^{-28} g. Here, $h=6.626 \times 10^{-34}$ J-s
- A) 1.21×10^{-16}
 - B) 8.25×10^{12}
 - C) 1.21×10^{-10}
 - D) 8.25×10^9
 - E) 1.21×10^{-13}

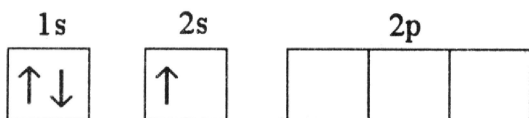
Answer: C

- 36) The wavelength of light that has a frequency of $1.20 \times 10^{13} \text{ s}^{-1}$ is _____ m.
- A) 2.5 B) 25.0 C) 2.50×10^{-5} D) 0.0400 E) 12.0

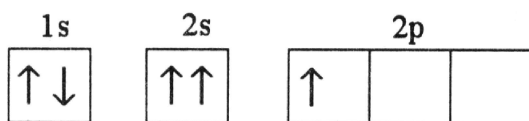
Answer: C

37) Which electron configuration represents a violation of the Pauli exclusion principle?

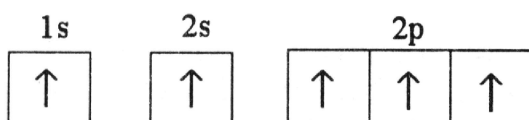
A)



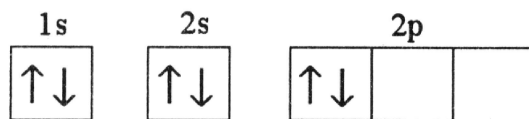
B)



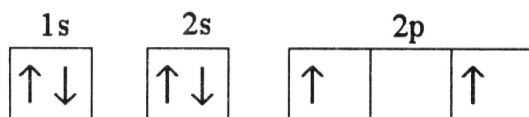
C)



D)



E)



Answer: B

38) The ground state electron configuration of Fe is _____.

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

Answer: D

39) The condensed electron configuration of silicon, element 14, is _____.

- A) $[\text{He}]2s^4 2p^6$
- B) $[\text{He}]2s^4$
- C) $[\text{Ne}]3s^2 3p^2$
- D) $[\text{He}]2s^6 2p^2$
- E) $[\text{Ne}]2p^{10}$

Answer: C

40) Which group in the periodic table contains elements with the valence electron configuration of $ns^2 np^1$?

- A) 1A (1)
- B) 2A (2)
- C) 3A (13)
- D) 4A (14)
- E) 8A (18)

Answer: C