1061-2nd Chem Exam-1061206(A)

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

1) An FM radio station broadcasts electromagnetic radiation at a frequency of 100.6 MHz. The wavelength of this radiation is _____ m.

A) 3.018×10^{10} B) 2.982×10^{6} C) 2.982 D) 3.018×10^{16} E) 0.3353

Answer: C

2) It takes 261 kJ/mol to eject electrons from a certain metal surface. What is the longest wavelength of light (nm) that can be used to eject electrons from the surface of this metal via the photoelectric effect?

A) 165 B) 552 C) 233 D) 458 E) 725

Answer: D

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

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

Answer: D

4) What is the de Broglie wavelength (m) of a 25-g object moving at a speed of 5.0 m/s?

A) 3.32×10^{-36} B) 6.6×10^{-36} C) 1.9×10^{32} D) 5.3×10^{-33} E) 3.02×10^{45}

Answer: D

5) Which set of three quantum numbers (n, l, m_l) corresponds to a 3p orbital?

A) 3,0,1 B) 3,1,0 C) 3,3,1 D) 3,0,0 E) 3,2,0
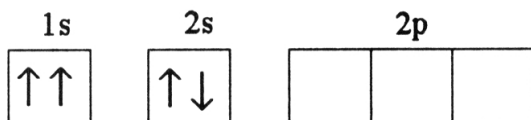
Answer: B

6) Which one of the following represents an acceptable possible set of quantum numbers (in the order n, l, m_l, m_s) for an electron in an atom?

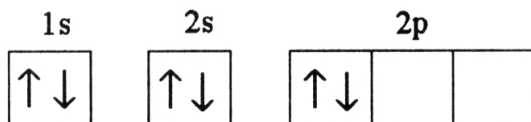A) 2, 1, 0, 0 B) 2, 0, 2, +1/2 C) 2, 2, 0, 1/2 D) 2, 0, 1, -1/2 E) 2, 1, -1, 1/2

Answer: E

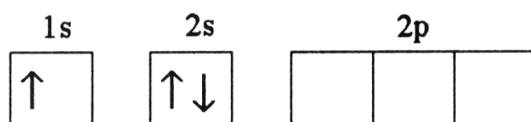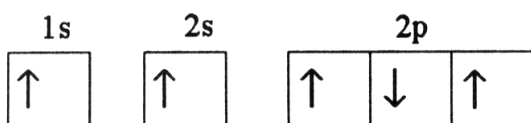7) Which electron configuration denotes an atom in its ground state?

A)

1s	2s	2p

$\uparrow$ $\uparrow$ | $\uparrow\downarrow$ | | | |

B)

1s	2s	2p

$\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow$ | | |

C)

1s	2s	2p

$\uparrow$ | $\uparrow\downarrow$ | | | |

D)

1s	2s	2p

$\uparrow$ | $\uparrow$ | $\uparrow$ | $\downarrow$ | $\uparrow$ |

E)

1s	2s	2p

$\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow$ | | $\uparrow$ |
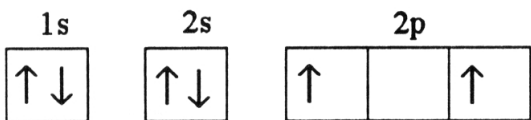
Answer: E

8) The element that has a valence configuration of $4s^1$ is _____.
   A) Rb   B) Na   C) Cs   D) K   E) Li

Answer: D

9) The complete electron configuration of gallium, element 31, is _____.
   A) $1s^2 2s^2 2p^{10} 3s^2 3p^{10} 4s^2 3d^3$
   B) $1s^4 2s^4 2p^{10} 3s^4 3p^9$
   C) $1s^4 2s^4 2p^8 3s^4 3p^8 4s^3$
   D) $1s^4 2s^4 2p^6 3s^4 3p^6 4s^4 3d^3$
   E) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$

Answer: E

10) The ground-state electron configuration of the element _____ is $[Kr]5s^1 4d^5$.
    A) Mo   B) Nb   C) Tc   D) Mn   E) Cr

Answer: A

11) In which set of elements would all members be expected to have very similar chemical properties?
    A) Ne, Na, Mg   B) S, Se, Si   C) Na, Mg, K   D) O, S, Se   E) N, O, F

Answer: D

12) Screening of the nuclear charge by core electrons in atoms is _____.
   A) responsible for a general decrease in atomic radius going down a group
   B) less efficient than that by valence electrons
   C) more efficient than that by valence electrons
   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: C

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) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

13) 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

14) The electron configuration of the atom with the most negative electron affinity is _____.
   A) (i)   B) (ii)   C) (iii)   D) (iv)   E) (v)

   Answer: E

15) Which equation correctly represents the electron affinity of calcium?
   A) Ca (g) →Ca⁻ (g) + e⁻
   A) $Ca\ (g) \rightarrow Ca^- (g) + e^-$
   B) $Ca\ (g) + e^- \rightarrow Ca^- (g)$
   C) $Ca^+ (g) + e^- \rightarrow Ca\ (g)$
   D) $Ca\ (g) \rightarrow Ca^+ (g) + e^-$
   E) $Ca^- (g) \rightarrow Ca\ (g) + e^-$

   Answer: B

16) The list that correctly indicates the order of metallic character is _____.
   A) F > Cl > Br
   B) Li > Na > K
   C) O > Se > S
   D) Sr > Ca > Mg
   E) C > Ge > Si

   Answer: D

17) Of the hydrogen halides, only _____ is a weak acid.
   A) HBr (aq)
   B) HF (aq)
   C) HI (aq)
   D) HCl (aq)
   E) They are all weak acids.

   Answer: B

18) The reaction of alkali metals with oxygen produce _____.
   A) oxides
   B) superoxides
   C) peroxides
   D) all of the above
   E) none of the above
   Answer: D

19) Hydrogen is unique among the elements because _____.
   1. It has only one valence electron.
   2. It is the only element that can emit an atomic spectrum.
   3. Its electron is not at all shielded from its nucleus.
   4. It is the lightest element.
   5. It is the only element to exist at room temperature as a diatomic gas.
   A) 1, 2, 3, 4, 5   B) 2, 3, 4   C) 3, 4   D) 1, 3, 4   E) 1, 2, 3, 4
   Answer: C

20) Na reacts with element X to form an ionic compound with the formula Na_3X. Ca will react with X to form

   _____.
   A) Ca_3X B) Ca_2X_3 C) CaX_2 D) Ca_3X_2 E) CaX
   Answer: D

21) Which of the following statements is <u>false</u>?
   A) The enthalpy change for a reaction is equal in magnitude, but opposite in sign, to the enthalpy change for the reverse reaction.
   B) Internal energy is a state function.
   C) Enthalpy is an intensive property.
   D) The enthalpy change for a reaction is equal to the heat change of the reaction under conditions of constant pressure.
   E) The enthalpy change for a reaction depends on the state of the reactants and products.
   Answer: C

22) The change in the internal energy of a system that absorbs 2,500 J of heat and that does 7,655 J of work on the surroundings is _____ J.
   A) 10,155   B) -10,155   C) 5,155   D) -5,155   E) 1.91×10^7
   Answer: D

23) Which of the following is a statement of the first law of thermodynamics?
   A) Energy lost by the system must be gained by the surroundings.
   B) $E_k = \frac{1}{2}mv^2$

   C) A negative ΔH corresponds to an exothermic process.
   D) $\Delta E = E_{final} - E_{initial}$
   E) 1 cal = 4.184 J (exactly)
   Answer: A

24) What is the enthalpy change (in kJ) of a chemical reaction that raises the temperature of 250.0 mL of solution having a density of 1.25 g/mL by 7.80 °C? (The specific heat of the solution is 3.74 joules/gram-K.)
   A) -12.51   B) 6.51   C) -9.12   D) -7.43   E) 8.20
   Answer: C

25) An 8.29 g sample of calcium carbonate [$CaCO_3$ (s)] absorbs 50.3 J of heat, upon which the temperature of the sample increases from 21.1 °C to 28.5 °C. What is the specific heat of calcium carbonate?

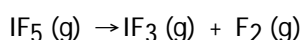   A) 1.1   B) 4.2   C) 2.2   D) .63   E) .82

   Answer: E

26) The value of $\Delta H°$ for the reaction below is -790 kJ. The enthalpy change accompanying the reaction of 0.95 g of S _____ kJ.
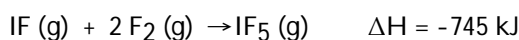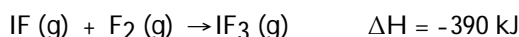
   $$2S \ (s) \ + \ 3O_2 \ (g) \ \rightarrow 2SO_3 \ (g)$$
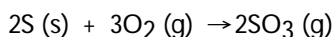
   A) -12   B) 12   C) -23   D) 23   E) -790

   Answer: A

27) ΔH for the reaction

   $$IF_5 \ (g) \ \rightarrow IF_3 \ (g) \ + \ F_2 \ (g)$$

   is _____ kJ, give the data below.

   $$IF \ (g) \ + \ F_2 \ (g) \ \rightarrow IF_3 \ (g) \qquad \Delta H = -390 \ kJ$$

   $$IF \ (g) \ + \ 2 \ F_2 \ (g) \ \rightarrow IF_5 \ (g) \qquad \Delta H = -745 \ kJ$$

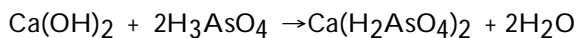   A) +35   B) +355   C) -35   D) -1135   E) +1135

   Answer: B

28) For which one of the following reactions is the value of $\Delta H°_{rxn}$ equal to $\Delta H°_f$ for the product?

   A) $2 \ H_2 \ (g) \ + \ O_2 \ (g) \ \rightarrow 2 \ H_2O \ (l)$
   B) $2 \ H_2 \ (g) \ + \ O_2 \ (g) \ \rightarrow 2 \ H_2O \ (g)$
   C) $N_2 \ (g) \ + \ O_2 \ (g) \ \rightarrow 2 \ NO \ (g)$
   D) $2 \ C \ (s, graphite) \ + \ 2 \ H_2 \ (g) \ \rightarrow C_2H_4 \ (g)$
   E) $H_2O \ (l) \ + \ 1/2 \ O_2 \ (g) \ \rightarrow H_2O_2 \ (l)$

   Answer: D

29) Given the data in the table below, $\Delta H°_{rxn}$ for the reaction

   $$Ca(OH)_2 \ + \ 2H_3AsO_4 \ \rightarrow Ca(H_2AsO_4)_2 \ + \ 2H_2O$$

   is _____ kJ.

Substance	$\Delta H_f°$ (kJ/mol)
$Ca(OH)_2$	-986.6
H_3AsO_4	-900.4
$Ca(H_2AsO_4)_2$	-2346.0
H_2O	-285.9

   A) -4519   B) -76.4   C) -130.4   D) -4219   E) -744.9

   Answer: C

30) Given the data in the table below and $\Delta H°_{rxn}$ for the reaction

$$SO_2Cl_2 \text{ (g)} + 2H_2O \text{ (l)} \rightarrow H_2SO_4 \text{ (l)} + 2HCl \text{ (g)} \qquad \Delta H° = -62 \text{ kJ}$$
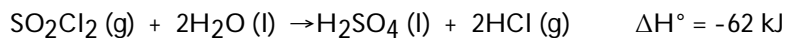
$\Delta H°_f$ of HCl (g) is _____ kJ/mol.

Substance	$\Delta H_f°$ (kJ/mol)
SO_2 (g)	-297
SO_3 (g)	-396
SO_2Cl_2 (g)	-364
H_2SO_4 (l)	-814
H_2O (l)	-286

A) 60
B) -92
C) -184
D) 30
E) Insufficient data are given.

Answer: B

31) In which of the molecules below is the carbon-carbon distance the shortest?
A) $H-C\equiv C-H$
B) $H_2C=C=CH_2$
C) H_3C-CH_3
D) $H_3C-CH_2-CH_3$
E) $H_2C=CH_2$

Answer: A

32) Which of the following has the bonds correctly arranged in order of increasing polarity?
A) N—F, Be—F, Mg—F, O—F
B) Be—F, Mg—F, N—F, O—F
C) Mg—F, Be—F, N—F, O—F
D) O—F, N—F, Be—F, Mg—F
E) O—F, Be—F, Mg—F, N—F

Answer: D

33) The Lewis structure of N_2H_2 shows _____.
A) each nitrogen has one nonbonding electron pair
B) a nitrogen-nitrogen single bond
C) a nitrogen-nitrogen triple bond
D) each nitrogen has two nonbonding electron pairs
E) each hydrogen has one nonbonding electron pair

Answer: A

For the questions that follow, consider the BEST Lewis structures of the following oxyanions:

(i) NO_2^- (ii) NO_3^- (iii) SO_3^{2-} (iv) SO_4^{2-} (v) BrO_3^-

34) There can be four equivalent best resonance structures of _____.
   A) (i)   B) (ii)   C) (iii)   D) (iv)   E) (v)
   Answer: D

35) A valid Lewis structure of _____ cannot be drawn without violating the octet rule.
   A) NI_3 B) ICl_5 C) SO_2 D) SiF_4 E) CO_2
   Answer: B

36) The Lewis structure of PF_3 shows that the central phosphorus atom has _____ nonbonding and _____ bonding electron pair(s).
   A) 1, 2   B) 3, 1   C) 3, 3   D) 2, 2   E) 1, 3
   Answer: E

37) In the Lewis structure of HCO_3^-, the formal charge on H is _____, and the formal charge on C is _____.
   A) 0, -1   B) +1, -1   C) 0, 0   D) -1, +1   E) -1, -1
   Answer: C

38) How many equivalent resonance forms can be drawn for CO_3^{2-}? (Carbon is the central atom.)
   A) 2   B) 4   C) 0   D) 1   E) 3
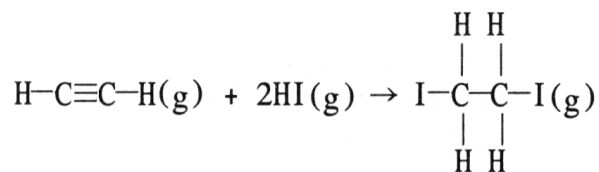   Answer: E

39) Of the following, _____ cannot accommodate more than an octet of electrons.
   A) Ni   B) Os   C) Sb   D) Sc   E) Be
   Answer: E

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

$$H-C{\equiv}C-H(g) \ + \ 2HI(g) \ \rightarrow \ I-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-I(g)$$

Bond:	C≡C	C-C	H-I	C-I	C-H
D (kJ/mol):	839	348	299	240	413

   A) +160   B) -160   C) +63   D) -217   E) -63
   Answer: D