1041_2nd Exam_1041202(A)

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

1) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as
    A) Ideal Gas Law
    B) Avogadro's Law
    C) Boyle's Law
    D) Charles's Law
    E) Dalton's Law

Answer: E

2) A gas sample has a volume of 178 mL at 0.00 °C. The temperature is raised (at constant pressure) until the volume reaches 211 mL. What is the temperature of the gas sample in °C at this volume?
(R = 0.082 atm·L / Mol·K)
    A) 324 °C   B) - 43 °C   C) 51 °C   D) 0.00 °C

Answer: C

3) What is the density of a sample of argon gas at 55 °C and 765 mmHg?
    A) 2.99 g/L   B) 8.91 g/L   C) 1.13×10^3 g/L   D) 1.49 g/L

Answer: D

4) A 255 mL gas sample contains argon and nitrogen at a temperature of 65 °C. The total pressure of the sample is 725 mmHg and the partial pressure of argon is 231 mmHg. What mass of nitrogen is present in the sample?
    A) 0.324 g nitrogen   B) 0.0837 g nitrogen   C) 0.167 g nitrogen   D) 0.870 g nitrogen

Answer: C

5) Rank the gases Ar, N_2 , CH_4 , and C_2H_6 in order of increasing density at STP.
    A) $CH_4 < C_2H_6 < N_2 < Ar$ B) $CH_4 < N_2 < Ar < C_2H_6$
    C) $CH_4 < N_2 < C_2H_6 < Ar$ D) $Ar < C_2H_6 < N_2 < CH_4$

Answer: C

6) A sample of Xe takes 75 seconds to effuse out of a container. An unknown gas takes 37 seconds to effuse out of the identical container under identical conditions. What is the most likely identity of the unknown gas?
    A) Br   B) Kr   C) He   D) O_2

Answer: D

7) Calculate the root mean square velocity of I_2 (g) at 373 K.
    A) 191 m/s   B) 19.0 m/s   C) 6.05 m/s   D) 99.1 m/s

Answer: A

8) A compound is found to be 30.45% N and 69.55 % O by mass. If 1.63 g of this compound occupy 389 mL at 0.00°C and 775 mm Hg, what is the molecular formula of the compound?
    A) N_4O_2 B) N_2O C) N_2O_4 D) N_2O_5 E) NO_2

Answer: C

9) Give the definition for diffusion.
    A) average distance between collisions
    B) gas molecules mix unequally
    C) gas molecules spread out in a concentration gradient
    D) gas molecules escape from a container into a vacuum through a small hole
    E) gas molecules mix equally

   Answer: C

10) Which statement is TRUE about kinetic molecular theory?
    A) The size of the particle is large compared to the volume.
    B) The collisions of particles with one another is completely elastic.
    C) A single particle does not move in a straight line.
   D) The average kinetic energy of a particle is not proportional to the temperature.

   Answer: B

11) Using the graph below, determine the gas that has the lowest density at STP.
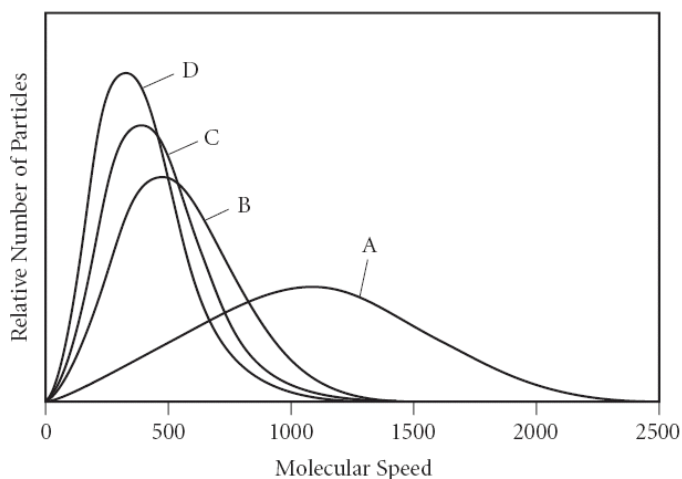
    A) C
    B) D
    C) B
    D) A
   E) All of the gases have the same density at STP.

   Answer: D

12) The following reaction is used to generate hydrogen gas in the laboratory. If 243 mL of gas is collected at 25°C and has a total pressure of 745 mm Hg, what mass of hydrogen is produced? A possibly useful table of water vapor pressures is provided below.

$$Mg(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

T (°C)	P (mm Hg)
20	17.55
25	23.78
30	31.86
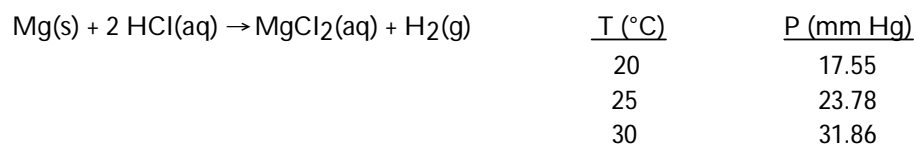
   A) 0.0190 g H_2 B) 0.0196 g H_2 C) 0.0717 g H_2 D) 0.0449 g H_2 E) 0.0144 g H_2

   Answer: A

13) Determine the volume of O_2 (at STP) formed when 50.0 g of $KClO_3$ decomposes according to the following reaction. The molar mass for $KClO_3$ is 122.55 g/mol.

$$2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$$
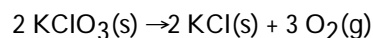
A) 13.7 L   B) 9.14 L   C) 8.22 L   D) 12.3 L   E) 14.6 L

Answer: A

14) Calculate the frequency of an electron traveling at 1.85×10^7 m/s. ($m_e = 9.1 \times 10^{-31}$ kg, $\lambda = h / mv$)

A) 1.18×10^{-2} s^{-1} B) 1.31×10^{-19} s^{-1} C) 7.63×10^{18} s^{-1} D) 3.93×10^{-11} s^{-1}

Answer: C

15) How much energy (in J) is contained in 1.00 mole of 552 nm photons? ($h = 6.626 \times 10^{-34}$ J·s, $c = 3 \times 10^8$ m / s)

A) 3.60×10^{-19} J   B) 2.17×10^5 J   C) 5.98×10^{-43} J   D) 3.60×10^{-28} J

Answer: B

16) Which electron transition produces light of the highest frequency in the hydrogen atom?

A) $5p \rightarrow 1s$ B) $2p \rightarrow 1s$ C) $4p \rightarrow 1s$ D) $3p \rightarrow 1s$

Answer: A

17) Calculate the wavelength of light emitted when an electron in the hydrogen atom makes a transition from an orbital with n = 5 to an orbital with n = 3. ($R_H = 2.179 \times 10^{-18}$ J)

A) 1.28×10^{-6} m   B) 1.55×10^{-19} m   C) 6.04×10^{-7} m   D) 2.28×10^{-6} m

Answer: A

18) When waves of equal amplitude from two sources are in phase when they interact, it is called _____.
A) destructive interference
B) amplitude
C) effusion
D) diffraction
E) constructive interference

Answer: E

19) Which of the following colors of electromagnetic radiation has the shortest wavelength?
A) violet   B) yellow   C) green   D) orange   E) blue

Answer: A

20) How many photons are contained in a flash of green light (525 nm) that contains 189 kJ of energy?
A) 4.99×10^{23} photons
B) 5.67×10^{23} photons
C) 7.99×10^{30} photons
D) 2.01×10^{24} photons
E) 1.25×10^{31} photons

Answer: A

21) What are all the possible orbitals for $n = 3$?
A) s, p, d, f   B) s   C) s, p, d   D) s, p

Answer: C

22) Which of the following statements is TRUE?
    A) Part of the Bohr model proposed that electrons in the hydrogen atom are located in "stationary states" or particular orbits around the nucleus.
    B) An orbital is the volume in which we are most likely to find an electron.
    C) The uncertainty principle states that we can never know both the exact location and speed of an electron.
    D) The emission spectrum of a particular element is always the same and can be used to identify the element.
    E) All of the above are true.

Answer: E

23) Which of the following statements is TRUE?
    A) The angular momentum quantum number (l) describes the the size and energy associated with an orbital.
    B) The magnetic quantum number (m_l) describes the orientation of the orbital.
    C) An orbital is the path that an electron follows during its movement in an atom.
    D) The principal quantum number (n) describes the shape of an orbital.
    E) All of the above are true.

Answer: B

24) Give the numbers for m_l for an s orbital.
    A) 0   B) -1, 0, 1   C) -1/2, 0, 1/2   D) -2, -1, 0, 1, 2

Answer: A

25) Determine the energy change associated with the transition from $n = 2$ to $n = 5$ in the hydrogen atom. ($R_H = 2.179 \times 10^{-18}$ J)
    A) -1.53×10^{-19} J
    B) -2.18×10^{-19} J
    C) $+3.76 \times 10^{-19}$ J
    D) $+4.58 \times 10^{-19}$ J
    E) $+6.54 \times 10^{-19}$ J

Answer: D

26) A chemical system produces 155 kJ of heat and does 22 kJ of work. What is ΔE for the *surroundings*?
    A) -133 kJ   B) 177 kJ   C) -177 kJ   D) 133 kJ
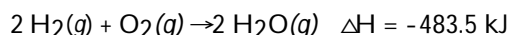
Answer: B

27) How much heat must be absorbed by a 15.0 g sample of water to raise its temperature from 25.0 °C to 55.0 °C ? (For water, $C_S = 4.18$ J/g °C.)
    A) 3.45 kJ   B) 107 J   C) 1.88 kJ   D) 1.57 kJ

Answer: C

28) Hydrogen gas reacts with oxygen to form water.

$$2\ H_2(g) + O_2(g) \rightarrow 2\ H_2O(g) \quad \Delta H = -483.5\ kJ$$

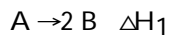Determine the minimum mass of hydrogen gas required to produce 226 kJ of heat.
    A) 0.935 g   B) 1.88 g   C) 0.942 g   D) 8.63 g

Answer: B

29) Consider the reactions :

$$A \rightarrow 2\,B \quad \Delta H_1$$
$$A \rightarrow 3\,C \quad \Delta H_2$$

What is ΔH for the reaction $2\,B \rightarrow 3\,C$?
   A) $\Delta H_1 + \Delta H_2$ B) $\Delta H_1 - \Delta H_2$ C) $2 \times (\Delta H_1 + \Delta H_2)$ D) $\Delta H_2 - \Delta H_1$

Answer: D

30) Which process is endothermic?
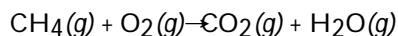   A) The combustion of natural gas in a stove.
   B) The burning of candle wax.
   C) The evaporation of water from the skin.
   D) The oxidation of iron in a chemical hand warmer.

Answer: C

31) Natural gas burns in air to form carbon dioxide and water, releasing heat.

$$CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$$
$$\Delta H°_{rxn} = -802.3 \text{ kJ}$$

What minimum mass of CH_4 is required to heat 55 g of water by 25 °C? (Assume 100% heating efficiency.)
   A) 8.70 g   B) 0.115 g   C) 115 g   D) 2.25×10^3 g

Answer: B

32) Which of the following statements is TRUE?
   A) State functions do not depend on the path taken to arrive at a particular state.
   B) ΔH_{rxn} can be determined using constant pressure calorimetry.
   C) Energy is neither created nor destroyed, excluding nuclear reactions.
   D) ΔE_{rxn} can be determined using constant volume calorimetry.
   E) All of the above are true.

Answer: E

33) The temperature rises from 25.00°C to 29.00°C in a bomb calorimeter when 3.50 g of sucrose undergoes combustion in a bomb calorimeter. Calculate ΔE_{rxn} for the combustion of sucrose in kJ/mol sucrose. The heat capacity of the calorimeter is 4.90 kJ/°C. The molar mass of sugar is 342.3 g/mol.
   A) $- 1.23 \times 10^3$ kJ/mole   B) 2.35×10^4 kJ/mole
   C) 1.92×10^3 kJ/mole   D) $- 1.92 \times 10^3$ kJ/mole

Answer: D

34) Two substances, A and B, of equal mass but at different temperatures come into thermal contact. The specifi c heat capacity of substance A is twice the specifi c heat capacity of substance B. Which statement is true of the temperature of the two substances when they reach thermal equilibrium?
(Assume no heat loss other than the thermal transfer between the substances.)
   A) The final temperature of both substances will be closer to the initial temperature of substance B than the initial temperature of substance A.
   B) The final temperature of both substances will be closer to the initial temperature of substance A than the initial temperature of substance B.
   C) The final temperature of both substances will be exactly midway between the initial temperatures of substance A and substance B.
   D) The final temperature of substance B will be greater than the fi nal temperature of substance A.

Answer: B

35) Which of the following signs on q and w represent a system that is doing work on the surroundings, as well as gaining heat from the surroundings?
   A) $q = -, w = +$
   B) $q = +, w = +$
   C) $q = -, w = -$
   D) $q = +, w = -$
   E) None of these represent the system referenced above.

Answer: D

36) How much energy is <u>required</u> to decompose 765 g of PCl_3, according to the reaction below? The molar mass of PCl_3 is 137.32 g/mol and may be useful.
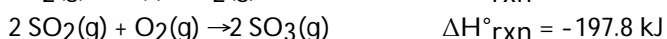
$$4\, PCl_3(g) \rightarrow P_4(s) + 6\, Cl_2(g) \qquad \Delta H°_{rxn} = +1207\ kJ$$
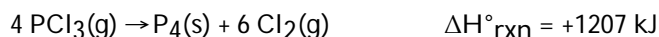
   A) 2.31×10^3 kJ   B) 1.68×10^3 kJ   C) 6.72×10^3 kJ   D) 4.33×10^3 kJ   E) 5.95×10^3 kJ

Answer: B

37) Use the standard reaction enthalpies given below to determine $\Delta H°_{rxn}$ for the following reaction:

$$2\, S(s) + 3\, O_2(g) \rightarrow 2\, SO_3(g) \qquad \Delta H°_{rxn} = ?$$

Given:
$$SO_2(g) \rightarrow S(s) + O_2(g) \qquad \Delta H°_{rxn} = +296.8\ kJ$$
$$2\, SO_2(g) + O_2(g) \rightarrow 2\, SO_3(g) \qquad \Delta H°_{rxn} = -197.8\ kJ$$
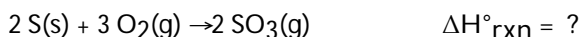
   A) -692.4 kJ   B) -293.0 kJ   C) 1583 kJ   D) -791.4 kJ   E) -494.6 kJ

Answer: D

38) When filling degenerate orbitals, electrons fill them singly first, with parallel spins is known as
   A) Heisenberg uncertainty principle   B) Hund's rule
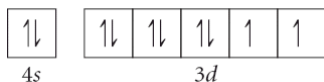   C) Pauli exclusion principle   D) Aufbau principle

Answer: B

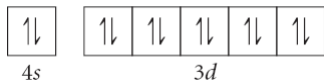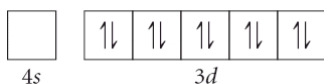39) Choose the valence orbital diagram that represents the ground state of Zn.

A)

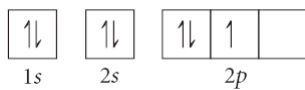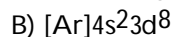| ↑↓ |
|---|
| 4s |

B)

↑↓		↑↓	↑↓	↑↓	↑	↑
4s				3d		

C)

↑↓		↑↓	↑↓	↑↓	↑↓	↑↓
4s				3d		

D)

		↑↓	↑↓	↑↓	↑↓	↑↓
4s				3d		

E)

↑↓		↑↓		↑↓	↑	
1s		2s		2p		

Answer: C

40) Choose the ground state electron configuration for Zn^{2+}.

A) $[Ar]4s^23d^6$ B) $[Ar]4s^23d^8$ C) $[Ar]3d^8$ D) $[Ar]3d^{10}$ E) $[Ar]$
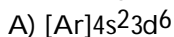
Answer: D

41) Which set of four quantum numbers corresponds to an electron in a 4 p orbital?

A) $n = 4, l = 1, m_l = 0, m_s = \frac{1}{2}$ B) $n = 4, l = 4, m_l = 3, m_s = -\frac{1}{2}$

C) $n = 4, l = 2, m_l = 0, m_s = \frac{1}{2}$ D) $n = 4, l = 3, m_l = 3, m_s = -\frac{1}{2}$

Answer: A

42) Which statement is true about effective nuclear charge?

   A) Effective nuclear charge increases as you move to the right across a row in the periodic table and decreases as you move down a column.
   B) Effective nuclear charge decreases as you move to the right across a row in the periodic table and decreases as you move down a column.
   C) Effective nuclear charge increases as you move to the right across a row in the periodic table and increases as you move down a column.
   D) Effective nuclear charge decreases as you move to the right across a row in the periodic table and increases as you move down a column.

Answer: A

43) Which statement is true about electron shielding of nuclear charge?

   A) Outermost electrons effi ciently shield core electrons from nuclear charge.
   B) Core electrons effi ciently shield outermost electrons from nuclear charge.
   C) Core electrons effi ciently shield one another from nuclear charge.
   D) Outermost electrons effi ciently shield one another from nuclear charge.

Answer: B

44) Arrange these atoms and ions in order of increasing radius: Cs^+, Xe, I^-.

    A) $Cs^+ <$ Xe $< I^-$ B) Xe $< Cs^+ < I^-$ C) $I^- < Cs^+ <$ Xe   D) $I^- <$ Xe $< Cs^+$
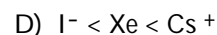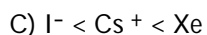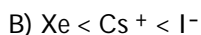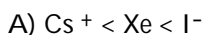
    Answer: A

45) The ionization energies of an unknown third period element are shown below. Identify the element.

    $IE_1 = 786$ kJ/mol; $IE_2 = 1580$ kJ/mol; $IE_3 = 3230$ kJ/mol;

    $IE_4 = 4360$ kJ/mol; $IE_5 = 16{,}100$ kJ/mol

    A) Mg   B) P   C) Si   D) Al

    Answer: C

46) Which statement is true about trends in metallic character?

    A) Metallic character *increases* as you go to the right across a row in the periodic table and *increases* as you go down a column.
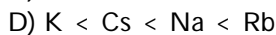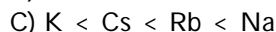
    B) Metallic character *decreases* as you go to the right across a row in the periodic table and *increases* as you go down a column.
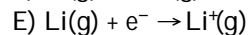
    C) Metallic character *decreases* as you go to the right across a row in the periodic table and *increases* as you go down a column.

    D) Metallic character *decreases* as you go to the right across a row in the periodic table and *decreases* as you go down a column.
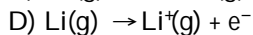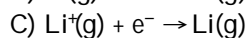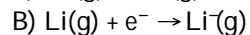
    Answer: B, C

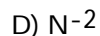47) Place the following in order of increasing metallic character.

        Rb   Cs   K   Na

    A) Na $<$ Rb $<$ Cs $<$ K
    B) Na $<$ K $<$ Rb $<$ Cs
    C) K $<$ Cs $<$ Rb $<$ Na
    D) K $<$ Cs $<$ Na $<$ Rb
    E) Cs $<$ Rb $<$ K $<$ Na
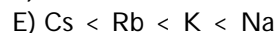
    Answer: B

48) Which reaction below represents the <u>electron affinity</u> of Li?

    A) $Li^+(g) \rightarrow Li(g) + e^-$
    B) $Li(g) + e^- \rightarrow Li^-(g)$
    C) $Li^+(g) + e^- \rightarrow Li(g)$
    D) $Li(g) \rightarrow Li^+(g) + e^-$
    E) $Li(g) + e^- \rightarrow Li^+(g)$
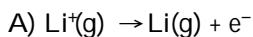
    Answer: B

49) Identify the species that has the smallest radius.

    A) N^{+1} B) N^{-5} C) N^{+3} D) N^{-2} E) N^0

    Answer: C

50) Give the ground state electron configuration for I.

  A) $[Kr]5s^25p^6$
  B) $[Kr]5s^24d^{10}5p^5$
  C) $[Kr]5s^25d^{10}5p^6$
  D) $[Kr]5s^24d^{10}5p^6$
  E) $[Kr]4d^{10}5p^6$

Answer: B