

Name _____

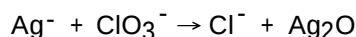
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) When 0.215 mol NH_3 is formed from nitrogen and hydrogen, 9.91 kJ of heat is released as heat. Assuming constant pressure is maintained, what is the ΔH for this reaction per mole of NH_3 formed?

A) 9.91 kJ B) -9.91 kJ C) -2.13 kJ D) 46.1 kJ E) -46.1 kJ

Answer: E

- 2) What is the sum of the stoichiometric coefficients on the left hand side of the following equation after it has been balanced?



A) 3 B) 10 C) 13 D) 2 E) 7

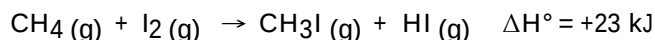
Answer: E

- 3) Given a 1.00 g sample of each of the following metals at 50°C , which would raise 100 g of water at 25°C to the highest temperature?

A) copper (sp heat = $0.385 \text{ J g}^{-1} ^\circ\text{C}^{-1}$)
 B) silver (sp heat = $0.235 \text{ J g}^{-1} ^\circ\text{C}^{-1}$)
 C) stainless steel (sp heat = $0.50 \text{ J g}^{-1} ^\circ\text{C}^{-1}$)
 D) lead (sp heat = $0.128 \text{ J g}^{-1} ^\circ\text{C}^{-1}$)
 E) iron (sp heat = $0.449 \text{ J g}^{-1} ^\circ\text{C}^{-1}$)

Answer: C

- 4) Consider the following thermochemical equation:



What energy change occurs when 2.4 mole of CH_4 reacts?

A) 9.6 kJ is absorbed
 B) 23 kJ is absorbed
 C) 55 kJ is absorbed
 D) 23 kJ is released
 E) 55 kJ is released

Answer: C

- 5) A gas sample containing N_2 and O_2 was found to contain 72% (v/v) N_2 . If the pressure of the sample was 2.0 atm, what is the partial pressure of O_2 ?

A) 0.56 atm B) 0.72 atm C) 0.28 atm D) 0.43 atm E) 1.44 atm

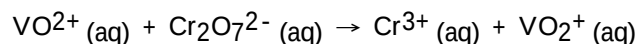
Answer: A

- 6) If a balloon contains 0.75 mol of O_2 at 28°C and has a volume of 2.8 L, what will be the volume, in L, if an additional 16 g of O_2 is added at the same temperature and pressure?

A) 1.7 B) 4.7 C) 3.3 D) 4.4 E) 3.8

Answer: B

- 7) When the following reaction is balanced in acidic solution with lowest ratio coefficients, what is the coefficient of H₂O and on which side is the water?



- A) 1 on left
- B) 2 on right
- C) 2 on left
- D) 0, H₂O doesn't appear in the balanced equation.
- E) 1 on right

Answer: E

- 8) In an effusion experiment measuring distance as a function of time, an unknown gas moved 3.42 m in 60 s while O₂ under identical conditions moved 4.84 m. Calculate the molar mass of the unknown gas.

- A) 48
- B) 64
- C) 128
- D) 45
- E) 16

Answer: B

- 9) An oxidizing agent

- A) must contain oxygen.
- B) becomes oxidized.
- C) increases its oxidation number.
- D) loses electrons.
- E) none of these

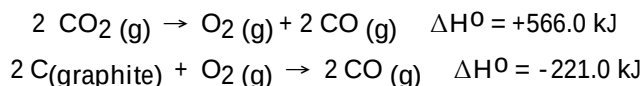
Answer: E

- 10) Volume and temperature are directly proportional. If T is plotted in °C, what is the temperature when the volume is negligible?

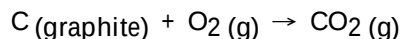
- A) 100
- B) -273
- C) -40
- D) 0
- E) depends on the gas

Answer: B

- 11) Based on the following equations:



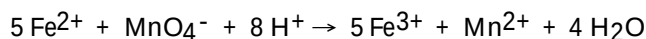
Determine the enthalpy change (ΔH°) for the following reaction:



- A) -787.0 kJ/mol
- B) -393.5 kJ/mol
- C) 345.0 kJ/mol
- D) 172.5 kJ/mol
- E) 393.5 kJ/mol

Answer: B

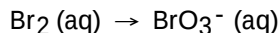
- 12) A 1.45 g sample of an iron ore is dissolved in acid and the iron obtained is $\text{Fe}^{2+}(\text{aq})$. To titrate the solution, 21.6 mL of 0.102 M $\text{KMnO}_4^- (\text{aq})$ is required. What is the percent of iron in the ore?



- A) 42.4 B) 61.5 C) 8.6 D) 57.6 E) 84.8

Answer: A

- 13) When the following half reaction (unbalanced) occurs, the number of electrons transferred per mole of Br_2 is:



- A) 5. B) 10. C) 8. D) 2. E) 1.

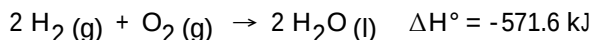
Answer: B

- 14) Calculate the volume, in milliliters, of 0.600 M HCl required to titrate 25.0 mL 0.350 M KOH.

- A) 14.6 B) 0.938 C) 5.25 D) 15.6 E) 42.9

Answer: A

- 15) Given the following equation,



which statement is incorrect?

- A) The standard heat of formation of liquid water is -571.6 kJ/mol.
B) ΔH° for the reverse reaction is +571.6 kJ/mol.
C) ΔH° for the reaction of one-half mole of oxygen is -285.8 kJ/mol.
D) The equation forming gaseous water would have a different ΔH° .
E) ΔH° for forming one mole of liquid water is -285.8 kJ/mol.

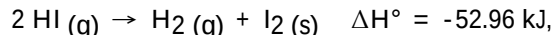
Answer: A

- 16) A diver reaches a depth of 10. m. What pressure, in atm, is exerted by water at that depth?

- A) 0.232 B) 34 C) 8.36 D) 1.0 E) 7.26

Answer: D

- 17) Given the thermochemical equation:



what is the heat of formation of $\text{HI}(\text{g})$, in kJ/mol?

- A) -52.96 B) 52.96 C) 26.48 D) -105.92 E) -26.48

Answer: C

- 18) The pressure in an oxygen tank stored at 25.0°C is 15.0 atm. What pressure will develop in the tank if it is heated in an oven to 450°C?

- A) 6380 atm B) 6.18 atm C) 54.6 atm D) 36.4 atm E) 270 atm

Answer: D

19) Five 22.4 L containers each hold a different gas at STP. The container holding which gas would have the greatest mass, in grams?

- A) N₂ B) He C) O₂ D) H₂ E) CO₂

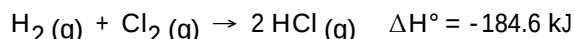
Answer: E

20) In a reaction, a reducing agent

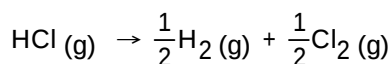
- A) is a spectator ion.
B) is reduced in a reaction.
C) causes the oxidation of another compound.
D) gains electrons.
E) lowers the oxidation number of another compound.

Answer: E

21) Given the following thermochemical equation:



calculate ΔH° for the reaction:



- A) +184.6 kJ B) +92.3 kJ C) -92.3 kJ D) -369.2 kJ E) +369.2 kJ

Answer: B

22) Which of the following best describes an unopened can of ice-cold pop?

- A) a system at thermal equilibrium
B) an isolated system
C) a closed system
D) the surroundings
E) an open system

Answer: C

23) What is the oxidation number of chromium in Cr₂O₇²⁻ ?

- A) +2 B) -3 C) +4 D) +6 E) +3

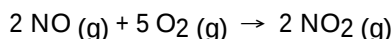
Answer: D

24) What is the pressure exerted by a mixture of 0.250 moles of N₂ and 0.400 moles of He at 27.0°C in a 3.00 L container?

- A) 3.28 atm B) 1.23 atm C) 2.05 atm D) 5.33 atm E) 16.0 atm

Answer: D

25) Calculate ΔH° for the following reaction using the given enthalpies of formation.



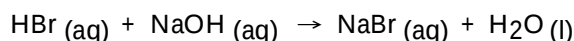
$$\Delta H_f^\circ \text{NO}(\text{g}) = 90.25 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ \text{NO}_2(\text{g}) = 33.18 \text{ kJ mol}^{-1}$$

- A) -57.07 kJ B) +66.36 kJ C) +57.07 kJ D) -114.14 kJ E) +114.14 kJ

Answer: D

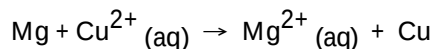
- 26) A volume of 50.0 mL of 0.400 M HBr at 24.35° C is added to 50.0 mL of 0.400 NaOH, also at 24.35°C. The final temperature is 27.06°C. Calculate the enthalpy change, ΔH , in kJ, for the reaction:



- A) 27.4 B) 42.8 C) 56.7 D) 140 E) 12.8

Answer: C

- 27) Regarding the following reaction, what statement is incorrect?



- A) Mg is oxidized.
B) Mg^{2+} could be an oxidizing agent.
C) Cu^{2+} is the oxidizing agent.
D) Cu^{2+} is oxidized.
E) Mg is the reducing agent.

Answer: D

- 28) Dalton's atomic theory is based on several assumptions which are listed below. Which of these assumptions is strictly correct?

- I) All atoms of the same element are identical.
II) Atoms are indivisible and unchangeable.
III) Chemical changes are the result of the combination, separation, and rearrangement of atoms.
A) I and II are correct.
B) I, II, and III are correct.
C) I and III are correct.
D) III is correct.
E) II and III are correct.

Answer: D

- 29) Which of the pairs of substances would produce a precipitate when equal volumes of 0.5 M aqueous solutions of each are mixed?

- A) BaCl_2 and KNO_3
B) AgNO_3 and NaCl
C) $(\text{NH}_4)_2\text{CO}_3$ and K_2SO_4
D) $\text{Pb}(\text{NO}_3)_2$ and NaNO_3
E) NaOH and HCl

Answer: B

- 30) A closed system differs from an isolated system in that

- A) the isolated system exchanges energy with its surroundings and the closed system does not.
B) the closed system exchanges matter with its surroundings and the isolated system does not.
C) the closed system exchanges energy with its surroundings and the isolated system does not.
D) the closed system exchanges both matter and energy with its surroundings and the isolated system does not.
E) the closed system exchanges neither matter nor energy with the surroundings.

Answer: C

31) An endothermic reaction is carried out in a coffee-cup calorimeter. Which statement is incorrect for this process?

- A) The temperature of the water decreases.
- B) The enthalpy change for the reaction equals $q_{\text{H}_2\text{O}}$.
- C) Heat is absorbed from the water.
- D) The products have higher enthalpy than the reactants.
- E) The enthalpy change for the reaction is positive.

Answer: B

32) Consider four identical 1.0-L flasks containing the following gases each at 25°C and 1 atm pressure. Which gas has the highest density?

- A) H_2
- B) O_2
- C) NH_3
- D) SO_2
- E) same for all gases

Answer: D

33) The following elements are grouped with either a maximum or a minimum oxidation state and their redox function. Which combination is incorrect?

- A) Se, +6, oxidizing agent
- B) N, +5, reducing agent
- C) Cl, +7, oxidizing agent
- D) Br, -1, reducing agent
- E) S, -2, reducing agent

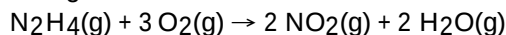
Answer: B

34) Which statement is not correct?

- A) Heat is given off to the surroundings in an exothermic reaction.
- B) Heat and work are state functions.
- C) Enthalpy is a state function.
- D) The enthalpy change is the heat of reaction at constant pressure.
- E) Internal energy, E , is a state function.

Answer: B

35) Consider the gaseous reaction:



If the above reaction has a percent yield of 98.5%, what mass in grams of oxygen is needed to produce 49.0 g of $\text{NO}_2(\text{g})$?

- A) 23.1 g
- B) 50.4 g
- C) 51.9 g
- D) 11.5 g
- E) 25.9 g

Answer: C

36) A cylinder of argon gas contains 125 mol at a pressure of 150 atm and a temperature of 27°C. After some of the argon has been used, the pressure is 136 atm at 27°C. What mass of argon remains in the cylinder?

- A) $5.00 \times 10^3 \text{ g}$
- B) 113 g
- C) $4.23 \times 10^3 \text{ g}$
- D) $5.52 \times 10^3 \text{ g}$
- E) $4.52 \times 10^3 \text{ g}$

Answer: E

37) How many liters of a 3.85 M solution of Fe^{2+} are needed to titrate 250.0 mL of a 0.125 M CrO_4^{2-} solution?



- A) 0.0487 B) 8.12 C) 4.87 D) 0.0244 E) 4.06

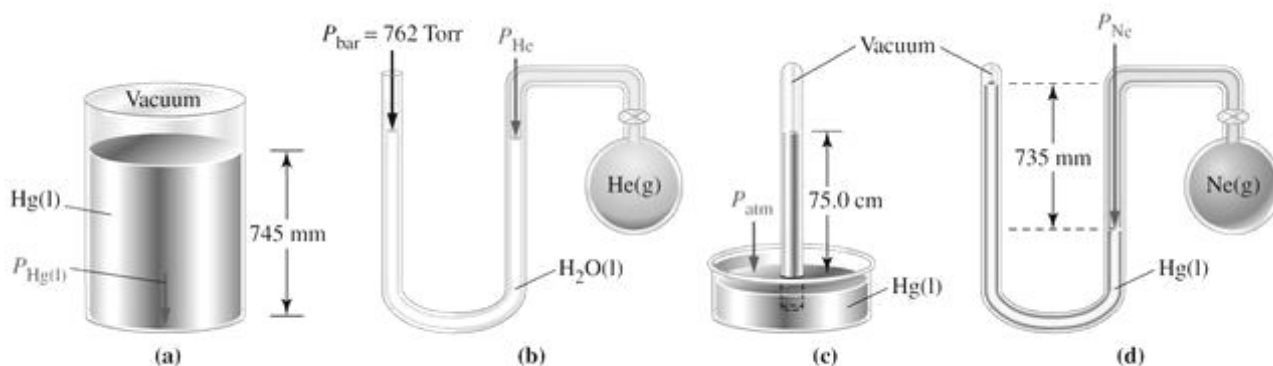
Answer: D

38) Which reaction type is incorrectly labeled?

- A) $\text{Zn (s)} + 2 \text{H}^+ \text{(aq)} \rightarrow \text{Zn}^{2+} \text{(aq)} + \text{H}_2 \text{(g)}$, oxidation-reduction
 B) $\text{Ba}^{2+} \text{(aq)} + \text{SO}_4^{2-} \text{(aq)} \rightarrow \text{BaSO}_4 \text{(s)}$, neutralization
 C) $\text{CH}_4 \text{(g)} + 2 \text{O}_2 \text{(g)} \rightarrow \text{CO}_2 \text{(g)} + 2 \text{H}_2\text{O (g)}$, oxidation-reduction
 D) $\text{Al}^{3+} \text{(aq)} + \text{PO}_4^{3-} \text{(aq)} \rightarrow \text{AlPO}_4 \text{(s)}$, precipitation
 E) $\text{NH}_3 \text{(aq)} + \text{H}^+ \text{(aq)} \rightarrow \text{NH}_4^+ \text{(aq)}$, neutralization

Answer: B

39) *without doing calculations*, arrange the drawings in Figure so that the pressures denoted in red are in increasing order.

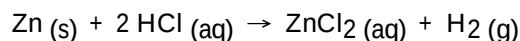


▲ FIGURE

- A) (c)<(b)<(a)<(d) B) (d)<(a)<(b)<(c) C) (c)<(b)<(d)<(a) D) (d)<(a)<(c)<(b)

Answer: D

40) If a 10.0 g sample of Zn(s) is treated with excess HCl , what volume of hydrogen gas is evolved at STP?



- A) 6.85 L B) 347 L C) 146 L D) 7.36 L E) 3.43 L

Answer: E

41) What is the final volume, in L, of 2.0L of an ideal gas at 1.0atm, if the pressure is decreased to 0.25atm?

- A) 1.0 B) 4.0 C) 6.0 D) 0.13 E) 8.0

Answer: E

42) In which of the compounds shown below is the sulfur most oxidized?

- A) NaSO_3 B) Na_2SO_4 C) H_2S D) S_2Cl_2 E) S_8

Answer: B

43) Which of the following is not a weak electrolyte?

- A) HCOOH B) CH_3NH_2 C) CH_3COOH D) HNO_3 E) NH_3

Answer: D

44) Hg lies below H_2 in the activity series. Which of the following statements is correct?

- A) Hg^{2+} will react with H_2 .
B) H^+ will react with Hg^{2+} .
C) Hg will react with H_2 .
D) H_2 will react with Hg^{2+} .
E) Hg will react with H^+ .

Answer: A

45) Which of the following species is a weak base in water?

- A) $\text{Mg}(\text{OH})_2$ B) $\text{CH}_3\text{CO}_2\text{H}$ C) $\text{B}(\text{OH})_3$ D) NH_3 E) KOH

Answer: D

46) Which of the following is not true for gases?

- A) strong intermolecular forces of attraction
B) flow easily
C) individual particles in constant random motion
D) fill the entire volume of a container
E) easily compressed

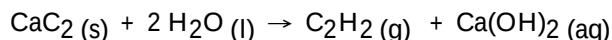
Answer: A

47) The assumptions of the kinetic-molecular theory are most likely to be correct under what conditions?

- A) high temperature-high pressure
B) low temperature-high pressure
C) low temperature-low pressure
D) high temperature-low pressure
E) always correct

Answer: D

48) Acetylene gas, C_2H_2 , can be produced by the reaction of calcium carbide and water.



How many liters of acetylene at 742 mm Hg and 26°C can be produced from 2.54 g $\text{CaC}_2(\text{s})$?

- A) 0.0870 L B) 1.00 L C) 0.315 L D) 0.0156 L E) 3.37×10^{-4} L

Answer: B

49) Equal moles of H_2 , N_2 , O_2 , and He are placed into separate containers at the same temperature. Assuming each gas behaves ideally, which container has the highest pressure?

- A) O_2
B) H_2
C) N_2
D) He
E) They would all exhibit the same pressure.

Answer: E

- 50) A student measuring the density of a solution ($d = 1.233 \text{ g/mol}$) reported the following results: 1.285, 1.287, 1.284, 1.279. Which of the following is the best description of the student's data?
- A) precise, but with a systematic error
 - B) precise, accurate
 - C) precise, inaccurate
 - D) not precise, inaccurate
 - E) not precise, accurate

Answer: A