Choose the correct answer for each question and write the letter of the correct answer in the table provided on page one.

Chapter. 4 reaction in aqueous sulostion

Q1. What is the oxidation number of phosphorous in the compound FrH_2PO_4?

A) -2 B) -5 C) +5 D) +7

Q2. In the following reaction:

$$3HNO_3(aq) + Cr(OH)_3(s) \longrightarrow Cr(NO_3)_3(aq) + 3H_2O(l)$$

Which of the following is/are the spectator ion(s)?

A) Cr^{3+} and NO_3^- B) NO_3^- C) Cr^{3+} D) NO_3^- and OH^-

Q3. The type of the following reaction is ..

$$3NO_2(g) + H_2O(l) \longrightarrow 2H^+(aq) + 2NO_3^-(aq) + NO(g)$$

A) Disproportionation B) Neutralization C) Precipitation D) Combination

Q4. The concertation of NaCl in a typical blood serum is about 0.14 M. What volume (in milliters) of blood contains 0.1 g of NaCl?

A) 818.3 B) 714.3 C) 122.2 D) 12.2

Q5. A flask contains a solution with an unknown amount of HCl. This solution is titrated with 0.195 M NaOH. It takes 4.75 mL NaOH to complete the reaction. What is the mass (in grams) of the HCl?

A) 0.034 B) 0.068 C) 0.195 D) 4.75

Chapter. 5 Gasses

Q6. How many moles of He gas atoms are present in a 450 mL container at 35°C and 740 mmHg?

A) 0.152 B) 1.144 C) 0.017 D) 1.505

Q7. What is the density of argon (Ar) at STP?

A) 0.016 B) 0.018 C) 1.634 D) 1.784

Q8. A 0.271 g sample of an unknown vapor occupies 294 mL at 140°C and 847 mmHg. The empirical formula of the compound is CH_2. What is the molecular formula of the compound?

A) CH_2 B) C_3H_6 C) C_2H_4 D) C_4H_8

Q9. A sample of hydrogen gas was collected over water at 21°C and 685 mmHg. The volume of the container was 7.80 L. Calculate the mass (in grams) of H_2 gas collected. The vapor pressure of water at 21°C is 18.6 mmHg.

A) 0.286 B) 0.571 C) 217 D) 434

Chapter. 6 theromdynamic

Q10. How many liters of chlorine gas at 25°C and 0.950 atm can be produced by the reaction of 12.0 g of MnO_2 with excess HCl(aq) according to the following chemical equation?

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$$

A) 0.138 B) 0.282 C) 3.09 D) 3.55

Q11. Consider the following reaction:

$$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s) \qquad \Delta H = -1652 \text{ kJ}$$

How much heat (in kJ) is released when 63.83 g iron are reacted with excess O_2?

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$$B_2H_6(g) + 3O_2(g) \longrightarrow B_2O_3(s) + 3H_2O(l)$$

If the change in internal energy (ΔE) for this reaction at 25°C is -2143.2 kJ, what is the change in enthalpy (in kJ) at the same temperature?

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Q13. If 335 g of water at 67.5°C loses 9700 J of heat, what is the final temperature (in °C) of the water? [Specific heat of water = 4.184 J/g·°C]

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Q14. A piece of a metal having a mass of 36 g at 62.64°C was placed in a constant-pressure calorimeter of negligible heat capacity containing 107 mL of water. The water temperature rose from 21.30°C to 22.07°C. What is the specific heat (in J/g·°C) of the metal?

A) 0.236 B) 0.158 C) 0.345 D) 0.444

Q15. Given the following data:

$$P_4(s) + 6Cl_2(g) \longrightarrow 4PCl_3(g) \qquad \Delta H = -1225.6 \text{ kJ}$$
$$P_4(s) + 5O_2(g) \longrightarrow P_4O_{10}(s) \qquad \Delta H = -2967.3 \text{ kJ}$$
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Calculate ΔH (in kJ) for the reaction:

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Ch. 5 – Gases

Q6

of moles = n = ? ; V = 450 ml

T = 35 + 273 = 308 K

P = $\frac{740 \text{ mmHg}}{760 \text{ mmHg}}$ = 0.97 atm

⇒ حوّل

PV = nRT ⇒ $n = \frac{0.450 L \times 0.97 \text{ atm}}{0.082 \times 308 K}$

n = 0.017 mol

Q7

d = Ar ? at STP

$d = \frac{P M_{wt}}{RT} = \frac{1 \text{ atm} \times 39.95 \text{ g/mol}}{0.0821 \times 273.15 K}$

= 1.78 g/L

Q8

m (mass of unknown vapor) = 0.271 g

V = 294 ml → (÷1000) → 0.294 L

T = 140 °C → (+273) → 413 K

P = 847 mmHg → (÷760) → 1.11 atm

→ حوّل

Emperical Formula = CH_2 = 14 g/mol

Molecular formula = ? المطلوب إيجاده

$M_w = \frac{dRT}{P}$

$d = \frac{m(g)}{V(L)} = \frac{0.271}{0.2944} = 0.921$ g/L

$M_w = \frac{0.921 \times 0.0821 \times 413 K}{1.11 \text{ atm}}$

M_w = Molecular formula = 28 g/mol

∴ $x = \frac{\text{Molecular}}{\text{Emperical}} = \frac{28}{14} = 2$

∴ 2 × CH_2 = C_2H_4 = Molecular formula ✓

Q9

T = 21 °C → 294 K

$P_{tot} = \frac{685 \text{ mmHg}}{760}$ = 0.9 atm

m_{H_2} = ? ; V = 7.8 L

$P_{water} = \frac{18.6 \text{ mmHg}}{760}$ = 0.027 atm

PV = nRT ⇒ $PV = \frac{m}{M_w} RT$

⇒ $m_{(H_2)} = \frac{P V M_w}{RT}$ (P ?)

$P_{tot} = P_{H_2} + P_{H_2O}$

$P_{H_2} = P_{tot} - P_{H_2O}$

$P_{H_2} = 0.9 - 0.027$

P_{H_2} = 0.87 atm

now, $m = \frac{0.87 \text{ atm} \times 7.8 L \times 2 \text{ g/mol}}{0.082 \times 294 K}$

$m_{(H_2)}$ = 0.57 g ✓

Q10

V_{Cl_2} = ? ; T = 25 °C → 298 K

P = 0.950 atm

$m_{(MnO_2)}$ = 12 g → limiting Reagent and HCl excess

$V = \frac{nRT}{P}$

$n = \frac{12}{86.94}$ = 0.13 mol (MnO_2)

$V = \frac{0.13 \times 0.82 \times 298}{0.95}$ = 3.35 L ✓

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Ch. 6 — Thermodynamics

Q11

$\Delta H = kJ$? = ⊖ release?

$4\,Fe_{(s)} + 3O_2 \rightarrow 2\,Fe_2O_3(s)\quad \Delta H = -1652\ kJ$

limiting Reagen: Fe — 63.83 g of Fe — with excess of O_2

$4\,Fe : 2\,Fe_2O_3$

$2 : 1$

$4\,Fe \quad \Delta H = -1652\ kJ$

$n = \frac{m}{Mwt} = \frac{63.83}{55.84} = 1.143$ mol of Fe

$4\,Fe \quad \Delta H = -1652\ kJ$

$1.143\ mol \quad \Delta H = ?$

$\Delta H \approx 472\ kJ$

Q12

$\Delta H = ?\quad \Delta E = -2143.2\ kJ$

$\Delta H = \Delta E + P\Delta V$

$\Delta H = \Delta E + RT\Delta n$

$B_2H_{6(g)} + 3O_{2(g)} \rightarrow B_2O_{3(s)} + 3H_2O_{(l)}$

$\Delta n = 0 - 4 = -4$

of ⓝ of products gases − # of ⓝ of reactant gases

$\Delta H = -2143.2 + 8.314(298)(-4)\ \frac{1\ kJ}{1000\ J}$

J/k.mol

$\Delta H = -2153.1\ kJ/mol$

Q13

$\Delta T = T_f - T_i$; $q = m \times s \times \Delta T$

$T_f - T_i$

$q = m \times s \times \Delta T$

$-9700\ J = 335\ g \times 4.184\ J/g.^\circ C \times \Delta T$

$\Delta T \approx -6.92^\circ C \Rightarrow \Delta T = T_f - T_i$

$T_f = \Delta T + T_i \Rightarrow T_f = -6.9 + 67.5 = 60.6^\circ C$

T_i ; ΔT for H_2O

Q14

heat gained by water:

$q = ms\Delta T$ (water)

$m_{H_2O} = 107\ ml \rightarrow 0.107\ L$

$s = 4.184\ J/g.^\circ C$

$\Delta T = 22.07 - 21.3 = 0.77^\circ C$

$q_{H_2O} = 107 \times 4.184 \times 0.77$

$\approx 374\ J$

H_2O gained ∴ metal lose

so $q_{metal} = \ominus 374\ J$

now $s_{metal} = \frac{q}{m\Delta T}$?

$\Delta T = 62.64 - 22.07$ (metal)

$= 40.57^\circ C$

$s = \frac{q}{m\Delta T}$

$s = \frac{\ominus 374}{36g(40.57)}$

$\approx 0.25\ J/g.^\circ C$

≈ 0.23 ✓

Q15

to Calculate ΔH for the next reaction:

$P_4O_{10} + 6\,PCl_5 \rightarrow 10\,Cl_3PO$

we use given rxns to do so.

$P_4O_{10} \rightarrow P_4 + 5\,O_2$ - reverse rxn (change sign)

$\Delta H = \oplus 2967.3\ kJ$

- multiply by (6) and change sign)

$\Delta H = \oplus \times 6(84.2)\ kJ$

- multiply by 10

$\Delta H = -10(285.7) = -2857\ kJ$

- add up the first rxn

$\Delta H = -1225.6\ kJ$

So, $\Delta H = \oplus 2967.3 + 505.2 - 2857 - 1225.6$

$\Delta H = -610.1\ kJ$