

Activity: The Right Tool for the Right Job


Q1: Consider a balloon filled with 313 g of helium. The temperature of this balloon is decreased by 41.6°C as the volume decreases from 1910 L to 1643 L, with pressure remaining constant at 1.00 atm. Determine q, w and ΔE (in kJ/mol) for the compression of the balloon. $C(\text{He}) = 20.8\text{J}/^\circ\text{C}\cdot\text{mol}$.

Only use the appropriate tiles

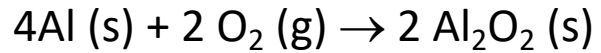
$w = -\Delta n.R.T$	$w = -P.\Delta V$	$q = m.c.\Delta T$
$\Delta E = q$	$\Delta E = q + w$	$\times \frac{101.3\text{J}}{\text{L}\cdot\text{atm}}$

Q2: When 0.500g of ethanol is burned in a bomb calorimeter surrounded by water, the temperature of both the water and the calorimeter rises by 9.15°C. Knowing that 250.0g of water is insulating the calorimeter and that the heat capacity of the calorimeter is 575 J/°C, calculate ΔH , ΔE and w at 25°C and 1.00 atm for this reaction per mole of C₂H₅OH.

Only use the appropriate tiles

$\Delta H = \Delta E + P.\Delta V$	$\Delta H = \Delta E + \Delta n.R.T$	$w = - \Delta n.R.T$	$q_{cal} = c_{cal} \cdot \Delta T$	$q_{H_2O} = m_{H_2O} \cdot c_{H_2O} \cdot \Delta T$
	$q_{v rxn} = q_{p rxn}$	$- q_{v rxn} = q_{cal} + q_{H_2O}$	$\Delta H = \Delta E$	$\Delta E =$
$C_2H_5OH (aq) + 3 O_2 (g) \rightarrow$ $2 CO_2 (g) + 3 H_2O (l)$	$\Delta n =$	$= 5mol - 4mol = 1mol$	$= 2mol - 3mol = -1mol$	$= \frac{q_{v rxn}}{n}$


Q3: Consider the following reaction:



For $\text{Al}_2\text{O}_2 \text{ (s)}$: $\Delta G^\circ_f = -1582 \text{ kJ/mol}$, $\Delta H^\circ_f = -1676 \text{ kJ/mol}$ and $S^\circ = 51 \text{ J/K.mol}$

- Determine K_P for this reaction at 25.0°C . What will be the equilibrium pressure of O_2 at 25.0°C ?
- Calculate ΔG , if the initial pressure of O_2 is 0.75 atm at 25.0°C .
- What will be the equilibrium pressure of O_2 at 55.0°C ?

Only use the appropriate tiles

$\Delta S^\circ_{\text{rxn}} = \sum n_P \cdot S^\circ(\text{P}) - \sum n_R \cdot S^\circ(\text{R})$		$\Delta G^\circ = -RT \ln(K)$	$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$	$K_P = \frac{1}{P_{\text{O}_2}^2}$
$\ln\left(\frac{K_1}{K_2}\right) = \frac{\Delta H^\circ}{R} \cdot \left(\frac{1}{T_2} - \frac{1}{T_1}\right)$	$\Delta G^\circ_{\text{rxn}} = \sum n_P \Delta G^\circ_f - \sum n_R \Delta G^\circ_f$	$\Delta H^\circ_{\text{rxn}} = \sum n_P \cdot \Delta H^\circ_f(\text{P}) - \sum n_R \cdot \Delta H^\circ_f(\text{R})$	$\Delta G = \Delta G^\circ + RT \ln(Q)$	$Q_P = \frac{1}{P_{\text{O}_2}^2}$

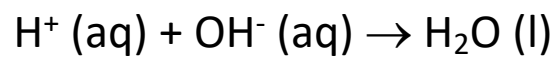
Q4: Calculate the pH for the following solution:

For each case, assign for tiles:

- a) When 0.0200 mol of HNO_3 is added to 100.0 mL 1.00 M NaNO_3
- b) When 0.0200 mol of HNO_3 is added to 100.0 mL of 1.00 M NaNO_2
- c) When 0.0200 mol of HNO_3 is added to 100.0mL of 0.200 M KOH
- d) When 0.0200 mol of HNO_3 is added to 100.0mL of 0.200 M HNO_2
- e) When 0.0200 mol of HNO_2 is added to 100.0 mL of 0.500 M NaNO_2

Strong acid + Neutral Salt	Strong acid + Weak base	Strong acid + Strong base
Mixture of 2 acids (strong + weak)	Weak acid and its conjugated base	pH < 7
Buffer	Neutralization	pH < 7

Buffer



	$\text{H}^+ (\text{aq}) + \text{NO}_2^- (\text{aq}) \rightarrow \text{HNO}_2 (\text{aq})$		
B(mol)	0.0200	0.100	0
A(mol)	0	0.080	0.0200

	$\text{HNO}_2 (\text{aq}) \rightleftharpoons \text{H}^+ (\text{aq}) + \text{NO}_2^- (\text{aq})$		
I(M)	0.200	0	0.500
E(M)	0.200-x	x	0.500 + x

pH dominated by HNO_3

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$$\text{pH} = \text{pKa} + \log \frac{[\text{NO}_2^-]}{[\text{HNO}_2]}$$

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$$\text{pH} = -\log [\text{H}^+] = -\log [\text{HNO}_3]$$

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$$\text{pH} = 7$$