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 (He) = 20.8J/°C.mol.

Only use the appropriate tiles

w = - Δn.R.T	w = -P.ΔV	q = m.c.ΔT
ΔE = q	ΔE = q + w	$\times \frac{101.3J}{L.atm}$

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 <u>per mole of C_2H_5OH.</u>

Only use the appropriate tiles

$\Delta H = \Delta E + P.\Delta V$	**$\Delta H = \Delta E + \Delta n.R.T$**	**$w = -\Delta n.R.T$**	**$q_{cal} = c_{cal} \cdot \Delta T$**	**$q_{H_2O} = m_{H_2O}.c_{H_2O}.\Delta T$**
	$q_{v\ rxn} = q_{p\ rxn}$	$-q_{v\ rxn} = q_{cal} + q_{H2O}$	$\Delta H = \Delta E$	$\Delta E =$
$C_2H_5OH\ (aq) + 3\ O_2\ (g) \rightarrow$ $2\ CO_2\ (g) + 3\ H_2O\ (l)$	$\Delta n =$	= 5mol – 4mol = 1mol	= 2mol – 3mol = -1mol	$= \dfrac{q_{v\ rxn}}{n}$

Q3: Consider the following reaction:

$4Al\ (s) + 2\ O_2\ (g) \rightarrow 2\ Al_2O_2\ (s)$

For Al_2O_2 (s): ΔG°_f = -1582 kJ/mol, ΔH°_f = -1676 kJ/mol and S° = 51 J/K.mol

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

Only use the appropriate tiles

$\Delta S^\circ_{rxn} = \sum n_P \cdot S^\circ(P) - \sum n_R \cdot S^\circ(R)$		$\Delta G^\circ = -RT\ln(K)$	$\Delta G^\circ = \Delta H^\circ - T\,\Delta S^\circ$	$K_P = \frac{1}{P_{O_2}^2}$
$ln\left(\frac{K_1}{K_2}\right) = \frac{\Delta H^o}{R}\cdot\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$	$\Delta G^\circ_{rxn} = \sum n_P \Delta G^\circ_f - \sum n_R \Delta G^o_f$	$\Delta H^\circ_{rxn} = \sum n_P \cdot \Delta H^\circ_f(P) - \sum n_R \cdot \Delta H^\circ_f(R)$	$\Delta G = \Delta G^\circ + RT\ln(Q)$	$Q_P = \frac{1}{P_{O_2}^2}$

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

$H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$

	$H^+ (aq)$ +	$NO_2^- (aq) \rightarrow$	$HNO_2 (aq)$
B(mol)	0.0200	0.100	0
A(mol)	0	0.080	0.0200

	$HNO_2 (aq) \rightleftharpoons$	$H^+ (aq)$ +	$NO_2^- (aq)$
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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$$pH = pKa + \log \frac{[NO_2^-]}{[HNO_2]}$$

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$pH = - \log [H^+] = - \log [HNO_3]$

pH = - log [H^+] = - log [HNO_3**]**	**pH = 7**