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INCORRECT SIG FIGS | INCORRECT UNITS

Unit 12 Exam
Free Response Review #2

Pre-AP Chemistry

Directions: The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

Question 1 [3 POINTS]

A 15 g iron nail is heated to 95.0°C and placed into a beaker of water. containing 10.5 g at 25.0 °C.

(a) Calculate the final temperature of the water if the amount of heat absorbed by the water is 0.251 kJ. The specific heat capacity of iron = 0.449 J/g° C, and the specific heat capacity of water = 4.18 J/g °C. **[3 POINTS]**

$q = mc\Delta T$

$q = 0.251\ kJ \times \frac{1000\ J}{1\ kJ} = 251\ J$

$251\ J = (10.5\ g)(4.18\ J/g°C)(T_f - 25.0°C)$

$5.72 = T_f - 25.0°C$

$\boxed{T_f = 30.7°C}$

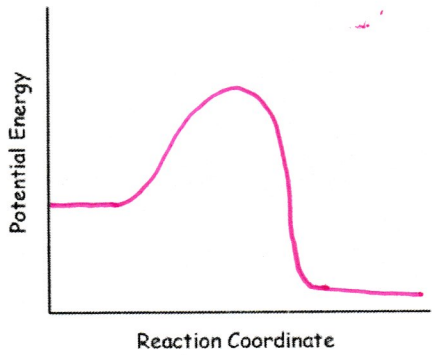
Question 2 [7 POINTS]

Hydrochloric acid and barium hydroxide undergo a neutralization reaction, with $\Delta H_{rxn} = -118\ kJ/mol_{rxn}$.

(a) Write the balanced thermochemical equation for this reaction. **[2 POINTS]**

$2HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2H_2O + 118\ kJ$

(b) Sketch a potential energy diagram for this reaction on the axis below. **[1 POINT]**



(c) When the two reactants are mixed, does the temperature of the water they're dissolved in increase, decrease, or stay the same? Justify your answer. **[1 POINT]**

Increase. The reaction is the system, so the water is the surroundings. Heat is leaving the reaction, so it must be entering the water.

(d) Given the heats of formation provided in the table, calculate ΔH_f of barium hydroxide. **[3 POINTS]**

Heats of Formation	
Hydrochloric acid	−167.2 kJ/mol
Water (*l*)	−286 kJ/mol
barium chloride	−855 kJ/mol

$$\Delta H^\circ_{rxn} = \sum \Delta H^\circ_f \text{ products} - \sum \Delta H^\circ_f \text{ reactants}$$

$$2\,HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2\,H_2O + 118\ kJ$$

$$-118\ kJ/mol = \left[(-855\ kJ/mol) + (2 \times -286)\right] - \left[(2 \times -167.2) + (1 \times \Delta H_f)\right]$$

$$-118 = -855 - 572 + 334.4 - \Delta H_f$$

$$\Delta H_f = -974.6$$

$$\boxed{\Delta H_f \approx -975\ kJ/mol}$$