Real AP Past Papers with Multiple-Choice Questions

1. $CH_3OH(l) \rightarrow CH_3OH(g)$

For the boiling of methanol, CH_3OH, ΔH = +37.6 kJ/mol and ΔS = +111 J/mol o K.

(a) (i) Why is the ΔH value positive for this process?

(ii) Why is the ΔS value positive for this process?

(b) What is the boiling point of methanol in degrees Celsius?

(c) How much heat is required to boil 50.0 mL of ethanol if the density of ethanol is 0.789 g/mL?

(d) What will happen to the temperature of the methanol as it boils? Explain.

(e) Would methanol be soluble with water? Why or why not?

(f) Would you expect the boiling point of ethanol, CH_3CH_2OH, to be less than, greater than, or the same as methanol? Justify your answer.

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2. Ammonia gas reacts with dinitrogen monoxide via the following reaction:

$$2NH_3(g) + 3N_2O(g) \rightarrow 4N_2(g) + 3H_2O(g)$$

The absolute entropy values for the varying substances are listed in the table below.

Substance	$S°$ (J/mol.K)
$NH_3(g)$	193
$N_2O(g)$	220
$N_2(g)$	192
$H_2O(g)$	189

(a) Calculate the entropy value for the overall reaction.

Several bond enthalpies are listed in the table below.

Bond	Enthalpy (kJ/mol)	Bond	Enthalpy (kJ/mol)
N–H	388	N=N	409
N–O	210	N≡N	941
N=O	630	O–H	463

(b) Calculate the enthalpy value for the overall reaction.

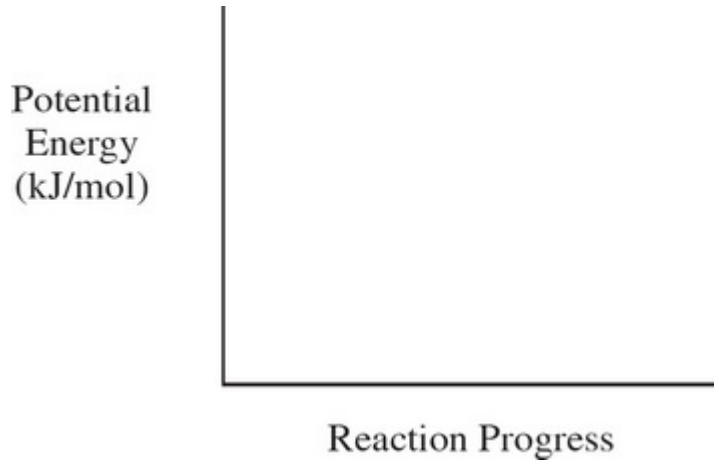
(c) Is this reaction thermodynamically favored at 25°C? Justify your answer.

(d) If 25.00 g of NH_3 reacts with 25.00 g of N_2O:

(i) Will energy be released or absorbed?

(ii) What is the magnitude of the energy change?

(e) On the reaction coordinates below, draw a line showing the progression of this reaction. Label both ΔH and E_a on the graph.



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3. A student designs an experiment to determine the specific heat of aluminum. The student heats a piece of aluminum with a mass of 5.86 g to various temperatures, and then drops it into a calorimeter containing 25.0 mL of water. The following data is gathered during one of the trials:

Initial Temperature of Al (C)	Initial Temperature of H_2O (C)	Final Temperature of Al+ H_2O (C)
109.1	23.2	26.8

(a) Given that the specific heat of water is 4.18 J/g·°C and assuming its density is exactly 1.00 g/mL, calculate the heat gained by the water.

(b) Calculate the specific heat of aluminum from the experimental data given.

(c) Calculate the enthalpy change for the cooling of aluminum in water in kJ/mol.

(d) If the accepted specific heat of aluminum is 0.900 J/g·°C, calculate the percent error.

(e) Suggest two potential sources of error that would lead the student's experimental value to be different from the actual value. Be specific in your reasoning and make sure any identified error can be quantitatively tied to the student's results.

Show Answer