1.Design an experiment to collect data that supports the claim that a 1.0 *M* NaCl solution is a ***homogeneous*** mixture. Describe the steps, the data you would collect, and how the data support the claim. Laboratory equipment for your experiment should be taken from the list below. (You may not need all of the equipment.)

50 – mL beakers	Drying oven
Volumetric pipets (5 mL, 10 mL and 25 mL	Hot plate
Stirring rod	balance
100 mL of 1.0 *M* NaCl	Fume hood

NOTE: This question was released by the CollegeBoard in 2011 as a sample questions for the new AP Chemistry exam.

The remaining questions were developed by John Gelder.

2. Design an experiment to collect data that supports the claim that the pressure exerted by an ideal gas is independent of the molar mass of the gas. Describe the steps, the data you would collect, and how the data support the claim. Laboratory equipment for your experiment should be taken from the list below. (You may not need all of the equipment.)

Gas dispensing bottles each containing Carbon dioxide, nitrogen, oxygen gases
Evacuated constant volume containers;
Water bath
Hot plate
Thermometer
Pressure transducer
Balance

3. Dimethylamine, $(CH_3)_2NH$ is also a weak base. A 25.0 mL sample of 0.350 M $(CH_3)_2NH$ is titrated with 0.500 M HCl. The value of K_b for $(CH_3)_2NH$ is 5.4×10^{-4}.

a) Calculate the volume of 0.500 M HCl that must be added to reach the equivalence point of the titration. (4)

b) A student claims the $[OH^-] = K_b$ at the half-equivalence point of the titration. Provide evidence that supports the claim. (6)

c) The pH at the equivalence point of the titration is 5.59. Show the calculation that produces this pH. (8)

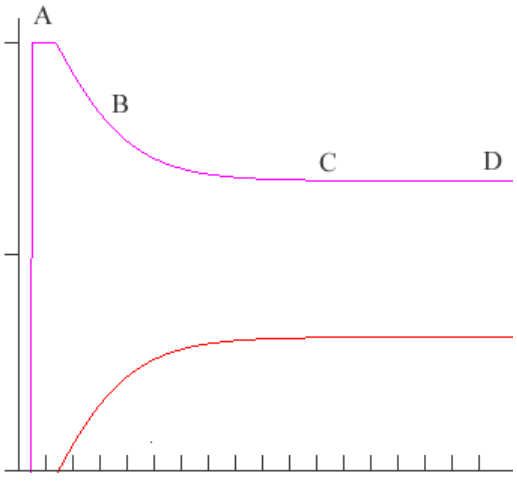
4. Which of the following compounds would you expect to more soluble in hexane?

$CH_3CH_2CH_2CH_2CH_3$ or CH_3CH_2OH

Support your claim with a discussion in terms of the intermolecular attractive forces that exists between the solute and solvent. (6)

b) Provide a thermodynamic argument that describes the solution process for the mixture you feel is homogeneous. (10)

5. In the graph below the endothermic reaction BR*(g)* $\rightleftharpoons$ B*(g)* + R*(g)* is represented. Initially only BR*(g)* is present in the reaction vessel. The marks along the *x*-axis are in 1 minute increments. The initial [BR] (*y-axis)* is 2.0 M. The reactions begins about 1.5 minutes in this case.

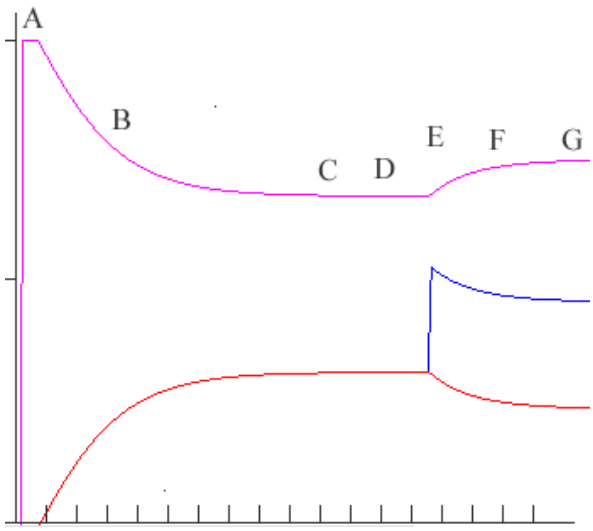


a) At what point (indicate a letter) does the reaction attain equilibrium? NOTE: You can also label the graph if your prefer. (2)

b) Indicate whether K for the reaction is greater than 1, less than 1 or equal to1. Explain. (5)

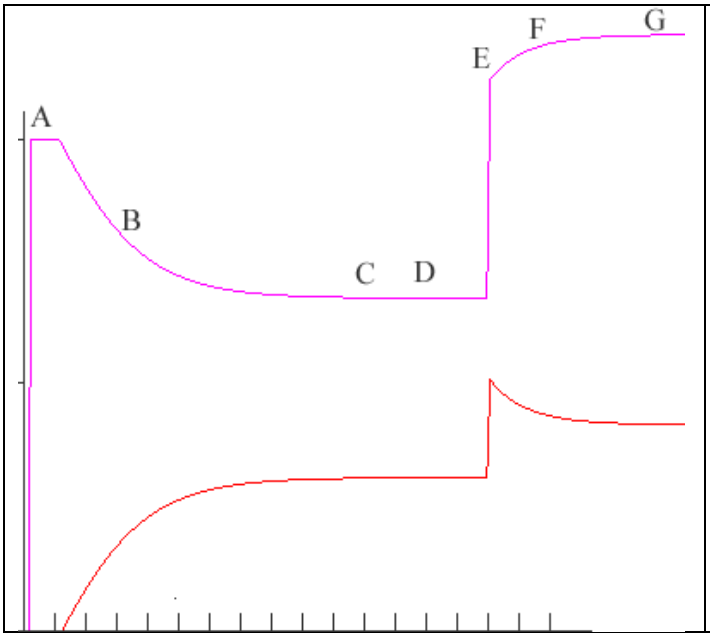
c) At point 'B' indicate how Q compares to K. Explain. (4)

d) In this new view the same reaction has occurred. Indicate the stress (at point E) that was imposed on the system, and explain how the system changed as a response to the stress. (5)



Explain:

e) In this new view the same reaction has occurred. Indicate the stress (at E) that was imposed on the system, and explain how the system changed as a response to the stress. (5)



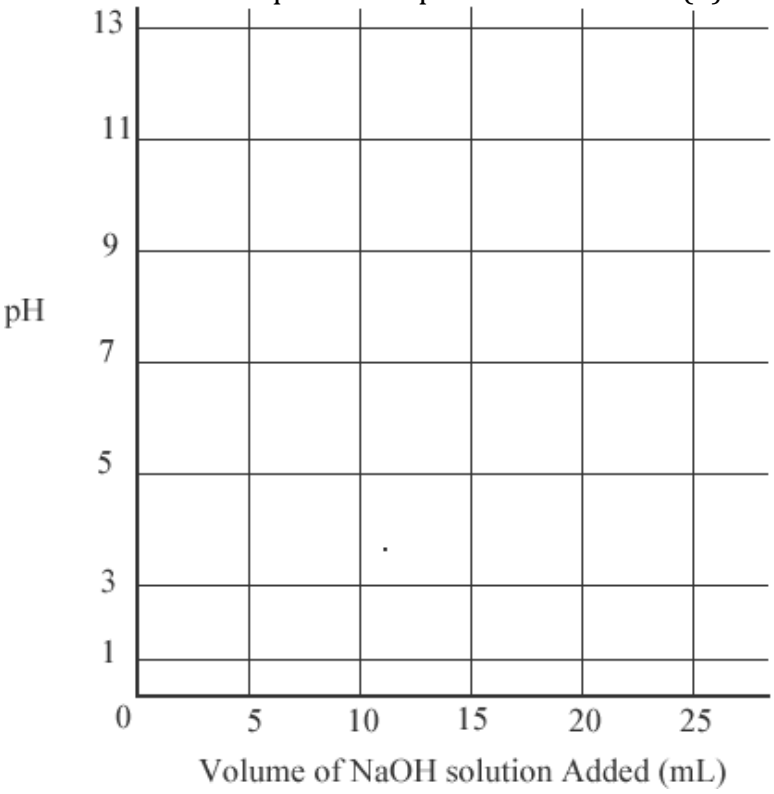
Explain:

6. A solution of NaOH with an approximate concentration of 0.1 *M* is to be standardized by titration. Assume that the following materials are available.

Clean, dry 25 mL buret 125 mL Erlenmeyer flask Wash bottle filled with distilled water	Analytical balance Phenolphthalein indicator solution Potassium hydrogen phthalate, KHP (*MM* = 204 g mol^{-1}), solid monoprotic acid (to be used as a primary standard)

a) Briefly describe the steps you would take, using the materials listed above, to standardize the NaOH solution. Indicate the data you must collect, and how the data is used to calculate the concentration of the NaOH solution. (10)

b) After the NaOH is standardized (to 3 significant figures) it is used to titrate a weak monoprotic acid, HX. The equivalence point is reached after adding 15.0 mL of the NaOH solution. In the space below sketch a titration curve, showing the pH changes that occur as the volume of NaOH solution added increases from 0 to 25 mL. Clearly label the equivalence point on the curve. (6)



c) Describe how the value of the acid dissociation equilibrium constant, K_a, for the weak acid, HX, could be determined from the titration curve you drew in part b. (4)