ChemCollective Virtual Labs
Thermochemistry Coolant Problem

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Reference: Pre-written Problem available on ChemCollective Virtual lab interface:
Open ChemCollective Vlabs interface go to File>>Load Homework>>Thermochemistry>>Coolant1 problem

Abstract:

The experiment describes the determination of the **Specific Heat Capacity** of an unknown compound. The experiment is useful in designing the more effective engine coolant in comparison to the traditional coolant like ethylene glycol. For a compound to be an efficient engine cooler it should have higher heat capacity, which means it should dissipate heat much faster when compared to ethylene glycol.

The required chemicals and problem statement are provided in the ChemCollective virtual lab interface **File>>Load Homework>>Thermochemistry>>Coolant1**

The methodology uses the method of mixtures to determine the Specific Heat Capacity of the unknown compound provided in the interface. Density of unknown compound Y is provided in the problem description. Distilled water is also provided in the Stockroom Explorer.

Aim of the experiment: To determine the Specific Heat Capacity of the unknown compound Y and compare it with Specific Heat Capacity of ethylene glycol.

Introduction:

Ethylene glycol is most commonly used in the cooling of a car radiator as an antifreeze during the winter because it has a much lower freezing point than water. Its specific heat capacity is 2.2 J/g ^{0}C. Its role in an automobile is to absorb heat from the engine. When the temperature of the coolant increases to its boiling point, the system boils over.

Efficient heat transfer and overall **corrosion protection** have always been the key criteria for engine coolants. The coolant with a higher specific heat capacity serves as an efficient cooling agent.

In this experiment we will determin the specific heat capacity of compound Y using the chemicals and apparatus provided in the Stockroom Explorer for this specific problem.

Calculations:

The method of mixtures is used here for the determination of unknown specific heat capacity.

Heat of reaction = $M \times C_{sp} \times (T_f - T_i)$

$M_Y \times C_Y \times (T_f - T_1) = M_W \times C_W \times (T_f - T_2)$

M = Mass of the compound (W = water, Y = Unknown Compound)

C_{sp} = Specific Heat Capacity (W = water, Y = Unknown Compound)

$(T_f - T_i)$ = Temperature difference

Apparatus required: Two 250 ml beakers from the glassware tool.

Chemicals required from Stockroom Explorer: Distilled water, Compound Y.

Procedure:

1. Open ChemCollective Vlab interface.
2. Double click on distilled water can and Compond Y in the stockroom explorer to place them on workbench. (Refer to Image 1)
3. From the glassware menu take 250 mL beaker and duplicate it. Now we will have two beakers. Rename them as “Water” and “Compound Y” (Refer to Image 2)
4. Take 100 gms of **water** in an insulated “Water” beaker, set at 100 ^oC.
5. Take 10 gms (3.6 mL) of **Compound Y** in 250 mL insulated “Compound Y”beaker.
6. Pour 100 gms of **water** which is at 100 ^oC from “Water” beaker into “Compound Y”beaker containing 10 gms of **compound Y**. (Refer to Image 3)
7. Allow the temperature to come to equilibrium.(Refer to Image 4)
8. Note the equilibrium temperature and calculate the Specific Heat Capacity.
9. Caculate the heat capacity of Compound Y as shown below.

$M_Y \times C_Y \times (T_f - T_1) = M_W \times C_W \times (T_f - T_2)$

M_Y = Mass of Compound Y= 10 gms
C_Y = Specific Heat Capacity of Compound Y
$(T_f - T_1)$ = Temperature change
M_W = Mass of water = 100 gms
C_W = 4.18 J/g ^oC
T_f = 93.86 ^oC
T_1 = 25 ^oC
T_2 = 100^oC

$10 \times C_Y (93.86 - 25.0) = 100 \times 4.2 (100 - 93.86)$

$10 \times C_Y \times 68.86 = 100 \times 4.2 \times 6.14$

$688.6 \times C_Y = 2578.8$

$C_Y = 3.74$

Specific heat capacity of Compound Y = **3.74 J/g ºC**

Result: We determined the Specific heat capacity of Compound Y using ChemCollective vlab as **3.74 J/g ºC**

Conclusion: Compound Y is a better coolant than Ethylene Glycol which has a heat capacity of **2.20 J/g ºC**

References: **http://chemcollective.org/vlabs**

https://spoken-tutorial.org/tutorial-search/?search_foss=ChemCollective+Virtual+Labs&search_language=English

Image 1: Place distilled water, Compound Y and beakers on the workbench.

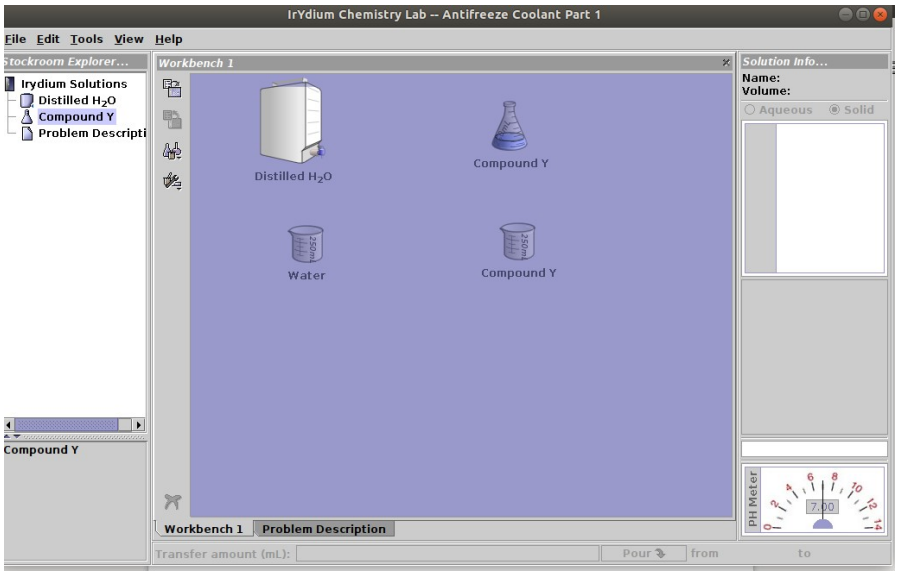


Image 2: Rename the beakers.

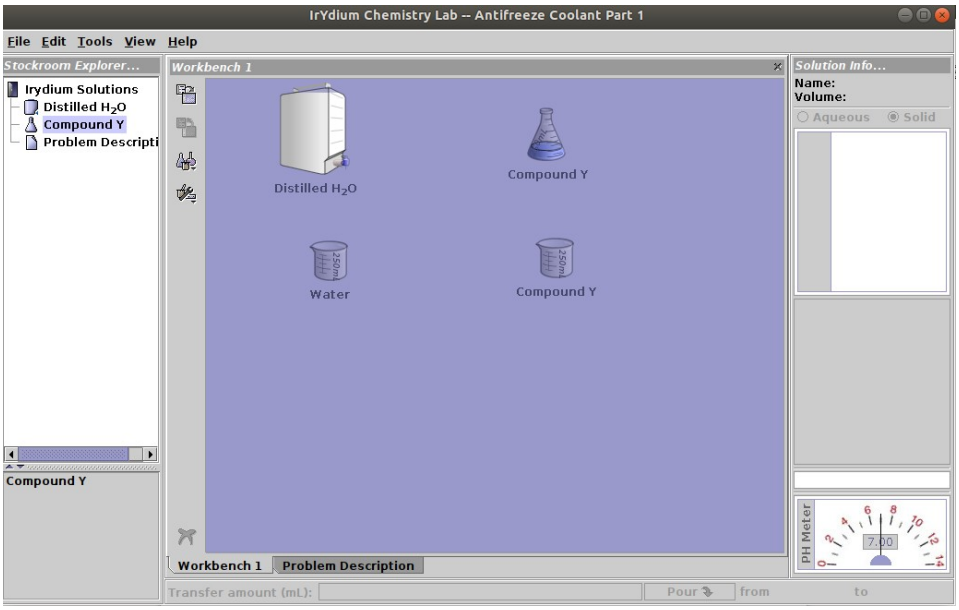


Image 3: Pour 100 gms of water into 10 gms of Compound Y.

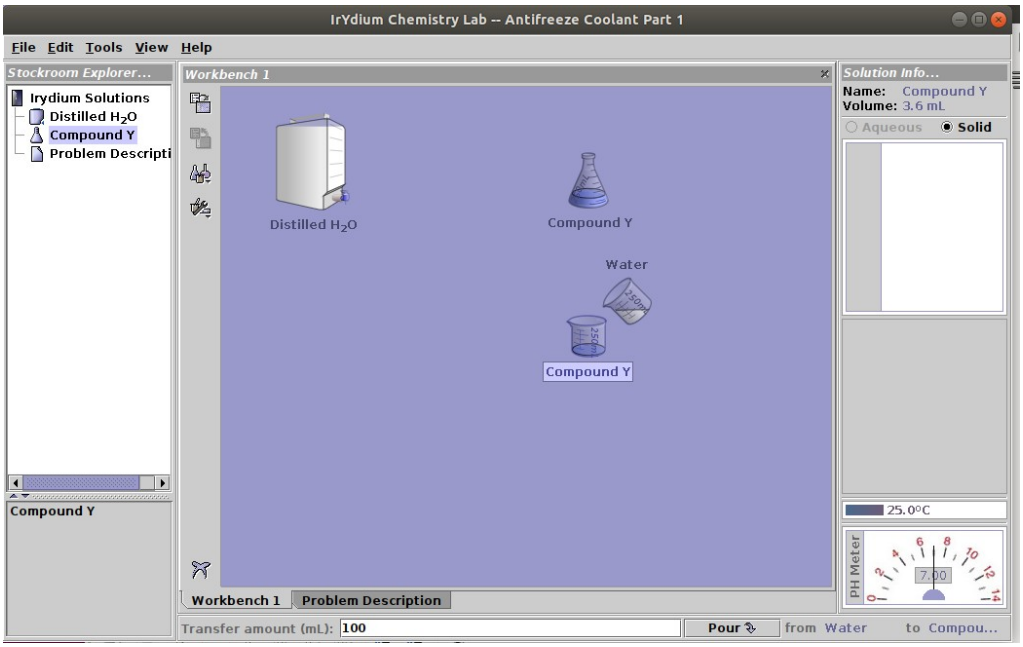
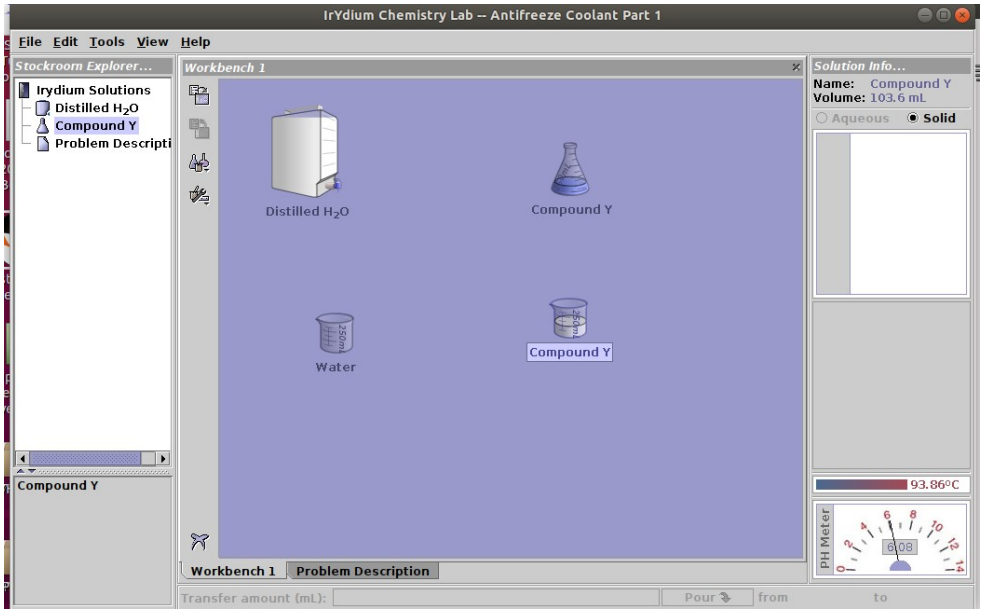


Image4: Allow mixture of liquids to come to equilibrium temperature.


IrYdium Chemistry Lab -- Antifreeze Coolant Part 1
File Edit Tools View Help
Stockroom Explorer...
Irydium Solutions
Distilled H2O
Compound Y
Problem Descripti
Compound Y
Workbench 1
Distilled H2O
Compound Y
Water
Compound Y
Workbench 1
Problem Description
Solution Info...
Name: Compound Y
Volume: 103.6 mL
Aqueous
Solid
93.86°C
PH Meter
6.08
Transfer amount (mL):
Pour
from
to