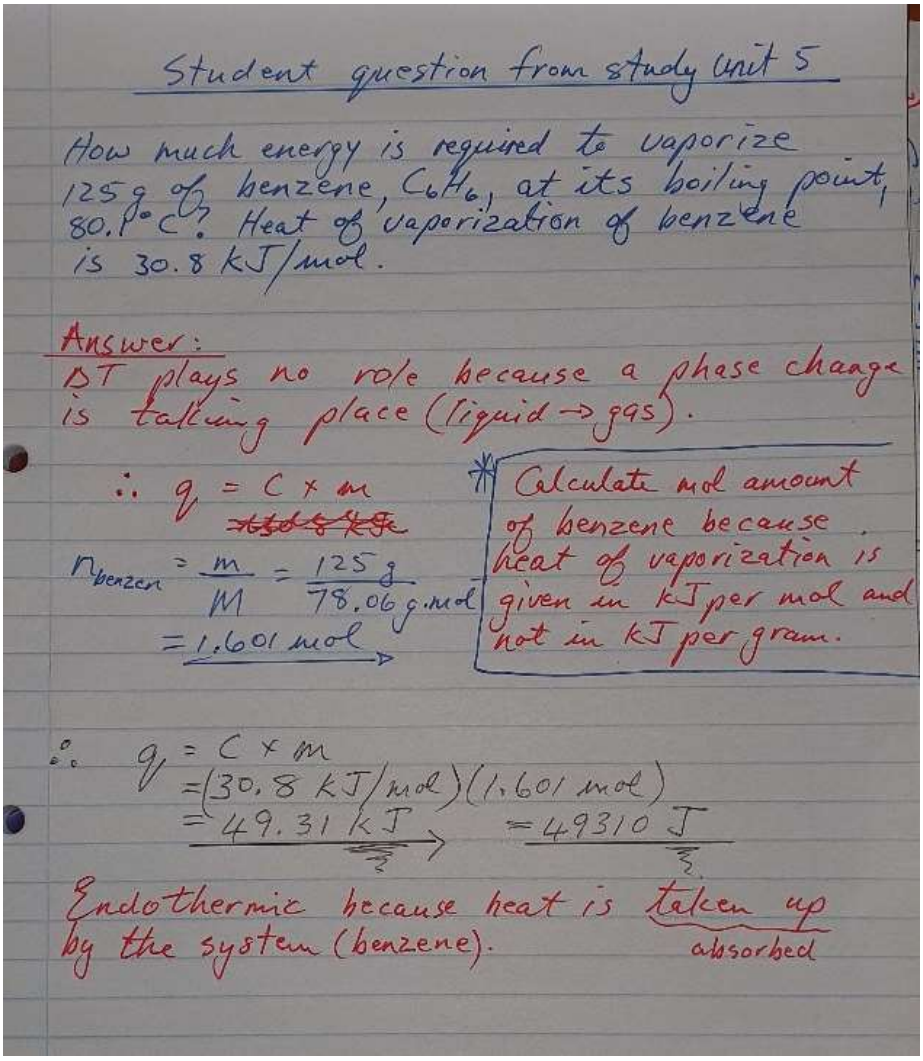
Student questions for Study Unit 5



Student question from study Unit 5

How much energy is required to vaporize 125 g of benzene, C_6H_6, at its boiling point, 80.1°C? Heat of vaporization of benzene is 30.8 kJ/mol.

Answer:
ΔT plays no role because a phase change is taking place (liquid → gas).

∴ $q = C \times m$

$n_{benzene} = \frac{m}{M} = \frac{125\ g}{78.06\ g.mol^{-1}}$

$= 1.601\ mol$

* Calculate mol amount of benzene because heat of vaporization is given in kJ per mol and not in kJ per gram.

∴ $q = C \times m$

$= (30.8\ kJ/mol)(1.601\ mol)$

$= 49.31\ kJ$ $= 49310\ J$

Endothermic because heat is taken up (absorbed) by the system (benzene).

Student questions for Study Unit 5

Freezing point of Mercury is $-38.8^{\circ}C$. What quantity of energy, in joule, is released to the surroundings if 1.00 mL of mercury is cooled from $23^{\circ}C$ to $-38.8^{\circ}C$ and then frozen to a solid?

* Density of Mercury = $13.6\ g/cm^3$, Its specific heat capacity = $0.140\ J/g.K$ and its heat of fusion is $11.4\ J/g$!

* Revise study section 5.3.

Answer:

There are two steps...

1) Cooling Hg from $23^{\circ}C$ to $-38.8^{\circ}C$ and
2) freezing all the Hg at $-38.8^{\circ}C$.

1) Cooling: $\Delta T = T_f - T_i = -38.8^{\circ}C - 23^{\circ}C$

$= -61.8^{\circ}C\ (-61.8K)$

m_{Hg} = density × Volume

$= (13.6\ g.mL^{-1})(1.00\ mL)$

$= 13.6\ g\ Hg$

$\therefore q_1 = C \times m \times \Delta T = (0.140\ J/g.K)(13.6\ g)(-61.8K)$

$= -117.67\ J$

2) Freezing: Remember that the temp. stays constant during a phase change.

$\therefore q_2 = C \times m = (-11.4\ J/g)(13.6g) = -155.04\ J$

→ negative is used because heat is expelled to freeze-exoth.

* Total energy: $q_{total} = q_1 + q_2 = -117.67J - 155.04J$

$= -272.71\ J$