Chemistry 141 Name

Cary Willard

Quiz 9a (20 points) May 5, 2013

All work must be show to receive credit. Remember, significant figures are important!

$ln\frac{P\_{2}}{P\_{1}}=\frac{-∆H\_{vap}}{R}\left(\frac{T\_{1}-T\_{2}}{T\_{1}T\_{2}}\right)$, R=0.0821 L atm/mol K = 8.314 J/mol K

1. (12 points) Butanol has a heat of vaporization of 46.4 kJ/mol and a normal boiling point of 117oC.
	1. What is the vapor pressure of butanol at 25oC?

$$ln\frac{P\_{2}}{P\_{1}}=\frac{-∆H\_{vap}}{R}\left(\frac{T\_{1}-T\_{2}}{T\_{1}T\_{2}}\right)$$

$$ln\frac{\left(760 torr\right)}{P\_{1}}=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{298 K-390 K}{\left(390 K\right)\left(298 K\right)}\right)=4.42$$

$$\frac{\left(760 torr\right)}{P\_{1}}=e^{4.42}=83.10$$

$$P\\_1=(760 torr)/(10.63)=9.14 torr (0.0120atm)$$

* 1. What is the boiling temperature of butanol on Pikes Peak, where the atmospheric pressure is 540 torr?

$$ln\frac{\left(760 torr\right)}{\left(540 torr\right)}=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)\left(390 K\right)}\right)$$

$$0.34=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)\left(390 K\right)}\right)=\left(\frac{-5580 K}{390 K}\right)\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)}\right)$$

$$-0.0237=\frac{ \left(T\_{1}-390 K\right)}{T\_{1}}=\frac{T\_{1}-390 K}{T\_{1}}$$

$$-0.0237 T\_{1}= T\_{1}-390 K $$

$$-1.0237 T\_{1}=-390 K$$

$$T\_{1}=381 K or 108℃$$

1. (8 points) A newly formulated substance has a normal boiling point of 461oC, a normal freezing point of 51oC, a triple point at 460 torr and 42oC, and a critical point at 8500 torr and 803oC. Draw a phase diagram for this substance, labeling the liquid, gas, and solid phases, the triple point, the critical point, and the supercritical fluid.

7302

Pressure (torr)

Which is more dense for this substance, the liquid or the solid state? Explain how you arrived at this answer.

Critical point

liquid

The liquid is less dense because the liquid converts to a solid when pressure is applied

solid

760

603

314

16 29

Temperature (oC)

gas

Triple point

460

Chemistry 141 Name

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Quiz 10b (20 points) May 5, 2013

All work must be show to receive credit. Remember, significant figures are important!

$ln\frac{P\_{2}}{P\_{1}}=\frac{-∆H\_{vap}}{R}\left(\frac{T\_{1}-T\_{2}}{T\_{1}T\_{2}}\right)$, R=0.0821 L atm/mol K = 8.314 J/mol K

1. (12 points) Butanol has a heat of vaporization of 46.4 kJ/mol and a normal boiling point of 117oC.
	1. What is the vapor pressure of butanol at 35oC?

$$ln\frac{P\_{2}}{P\_{1}}=\frac{-∆H\_{vap}}{R}\left(\frac{T\_{1}-T\_{2}}{T\_{1}T\_{2}}\right)$$

$$ln\frac{\left(760 torr\right)}{P\_{1}}=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{308 K-390 K}{\left(390 K\right)\left(308 K\right)}\right)=3.81$$

$$\frac{\left(760 torr\right)}{P\_{1}}=e^{3.81}=45.2$$

$$P\\_1=(760 torr)/(6.414 )=16.8 torr (0.0221atm)$$

* 1. What is the boiling temperature of butanol under the ocean, where the atmospheric pressure is 1577 torr?

$$ln\frac{\left(760 torr\right)}{\left(1577 torr\right)}=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)\left(390 K\right)}\right)$$

$$-0.730=\frac{-46400\frac{J}{mol}}{8.31\frac{J}{mol K}}\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)\left(390 K\right)}\right)=\left(\frac{-5580 K}{390K}\right)\left(\frac{T\_{1}-390 K}{\left(T\_{1}\right)}\right)$$

$$0.0510=\frac{ \left(T\_{1}-390 K\right)}{T\_{1}}=\frac{T\_{1}-390 K}{T\_{1}}$$

$$0.0510 T\_{1}= T\_{1}-390 K $$

$$-0.949 T\_{1}=-390 K$$

$$T\_{1}=410 K or 138℃$$

1. (8 points) A newly formulated substance has a normal boiling point of 274oC, a normal freezing point of 21oC, a triple point at 260 torr and 54oC, and a critical point at 8674 torr and 815oC. Draw a phase diagram for this substance, labeling the liquid, gas, and solid phases, the triple point, the critical point, and the supercritical fluid.

7302

Pressure (torr)

Which is more dense for this substance, the liquid or the solid state? Explain how you arrived at this answer.

liquid

Critical point

The liquid is more dense because the solid converts to a liquid when pressure is applied.

Temperature (oC)

53 68

solid

760

603

531

gas

Triple point

460