You may use any calculator. You may NOT use cell phone or tablet.

CHEM 1101 B MIDTERM 2 November 2016 – 70 MINUTES

- **PRINT** your name and student number on your booklet. **UNDERLINE YOUR FAMILY NAME.**
- **SPACE OUT YOUR ANSWERS** – we will mark answers on the lined side of the page only – you can use the other side for rough work if you wish

20% 1. Q1 from this midterm was covered on the first midterm this year – so NOTE – this would only be a one-hour midterm. I will make yours somewhat longer, but the topics will be the same. Make sure you study the class notes and the sample problems for a more complete idea of question types. This is just an example of an old midterm to give you an idea of style.

20% 2. a) Draw and label a band diagram for calcium ***(use at least ⅓ of a page)***
b) Draw and label a band diagram for silicon ***(use at least ⅓ of a page)***
c) Draw and label a band diagram for silicon doped with phosphorous ***(use at least ⅓ of a page)***
d) Indicate whether the semiconductor in part c is an n-type or a p-type semiconductor, and explain your choice based on the valence of phosphorous.

20% 3. You have 3.25 kg of xenon gas in a 5.00 L cylinder at 21°C.
a) Determine its pressure if it is behaving ideally
b) Determine its real pressure given that for xenon gas, a=4.194 L^2atm/mol^2; b=0.0515 L/mol
c) Determine the percent error (indicate if it is high or low) that arises if you use the ideal gas equation instead of the van der Waals equation to determine the pressure of xenon at these conditions.

20% 4. You need to be able to heat liquid water to a boiling point of 297°C. Given $\Delta H°_{vap}(H_2O)$ = 40.67 kJ/mol, determine the pressure necessary, in atmospheres**.**

20% 5. a) Draw and label a Born-Haber diagram for chromium (III) oxide. (***Use at least half a page!***)
b) Given the data on the data page, determine the crystal lattice energy of chromium (III) oxide.

Data and Equations:

$PV = nRT$

$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H^0_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$R = 8.314\ J/K{\cdot}mol$

$\left[P + \frac{an^2}{V^2}\right][V - nb] = nRT$

$T(K) = T(^0C) + 273$

$R = 0.08206\ L{\cdot}atm/K{\cdot}mol$

Data continued on back of page

$I.E._1(Cr)$	=	652.9 kJ/mol	$E.A._1$ (O)	=	−142 kJ/mol
$I.E._2(Cr)$	=	1590.6 kJ/mol	$E.A._2$ (O)	=	247 kJ/mol
$I.E._3(Cr)$	=	2987 kJ/mol	$B.D.E.(O_2)$	=	495 kJ/mol
$I.E._4(Cr)$	=	4743 kJ/mol	$\Delta H_f°$ (Cr_2O_3)	=	– 1139.69 kJ/mol
$\Delta H°_{sub}$ (Cr)	=	396.6 kJ/mol			