Physical Chemistry I
Fall, 2018
Quiz 1

Name: Key

Physical quantity	*Name of SI unit*	*Symbol for SI unit*
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

p. 71, *Quantities, Units, and Symbols in Physical Chemistry* 2nd ed., IUPAC, Blackwell Science.

$1\ J = 1\ kg\ m^2 / s^2$
$1\ Pa = 1\ J / m^3$
$1\ bar = 10^5\ Pa$

Questions adopted from Vallance group, U. Oxford (http://vallance.chem.ox.ac.uk).

1) There are 10 cm in one dm. How many dm^3 are there in one m^3?

$10\ cm = 1\ dm$

$$1\ m^3 \times \left(\underbrace{\frac{100\ cm}{m} \times \frac{1\ dm}{10\ cm}}_{10\ \frac{dm}{m}}\right)^3 = 10^3\ dm^3$$

2) The ideal gas constant, R, can be calculated from R = pV/(n T) under low pressure conditions.

a. Find the SI units for R

$$units(R) = \frac{units(P) \cdot units(V)}{units(n)\ units(T)} = \underbrace{\frac{Pa \cdot m^3}{mol \cdot K}}_{SI\text{-}OK} = \frac{J/m^3 \cdot m^3}{mol \cdot K} = \underbrace{\frac{kg \cdot m^2}{s^2\ mol\ K}}_{base\ units.}$$

b. Calculate R given that 1 mol of gas occupies 24.8 m^3 at 298 K and 1.00 mbar.

$1\ bar = 10^5\ Pa$

$$R = \frac{PV}{nT} = \frac{10^{-3}\ bar \cdot 24.8\ m^3}{1\ mol \cdot 298\ K} = \underbrace{\frac{24.8 \cdot 10^2}{298}}_{8.32} \underbrace{\frac{Pa \cdot m^3}{mol \cdot K}}_{J/mol \cdot K}$$

c. What is the concentration of the gas (in mol/dm^3)?

$$Conc. = \frac{1\ mol}{24.8\ m^3} \times \frac{1\ m^3}{10^3\ dm^3} = 4.03 \cdot 10^{-5}\ \frac{mol}{dm^3}$$

3) Sketch a plot of the function V(T) (volume vs. temperature) using the ideal gas law above at constant pressure and number of moles. Label both axes and the point (0,0) – no other labels or numbers are required.

$$V(T) = \frac{R \cdot n}{P} T$$

const.