HW 1 Book Problems

CH 1 24
CH 3 4, 6

CH 1

(24)

(A)

$\times (10^{-19} C)$

Drop	Charge	Difference	e^- #
1	$6.563 \times 10^{-19} C$		4
2	$8.204 \times 10^{-19} C$	1.641	5
3	$11.50 \times 10^{-19} C$	3.296	7
4	$13.13 \times 10^{-19} C$	1.630	8
5	$16.48 \times 10^{-19} C$	3.350	10
6	$18.08 \times 10^{-19} C$	1.60	11
7	$19.71 \times 10^{-19} C$	1.63	12
8	$22.89 \times 10^{-19} C$	3.18	14
9	$26.18 \times 10^{-19} C$	3.29	16

$1e^- \approx 1.602 \times 10^{-19} C$ our value $= 1.60 \times 10^{-19} C$ (least difference)

Ex Calc. $\frac{6.563 \times 10^{-19} C}{1.602 \times 10^{-19} C} = 4.097$ electrons

(B) Take the average of the Charge/# of e^-

$10^{-19} C \times ($ ① $1.64075 +$ ② $1.6408 +$ ③ $1.64286 +$ ④ $1.64125 +$ ⑤ $1.648 +$ ⑥ $1.6436 +$ ⑦ $1.6425 +$ ⑧ $1.635 +$ ⑨ $1.63625) / 9$ (# of measurements) $=$ **$1.6412 \times 10^{-19} C$**

(C) Yes, We took the least difference between the 9 measurements to equal $1e^-$, so if we searched for droplets with the least charge we could confirm this value using far more than 9 measurements.

Ch 3

(4) Predict the Binary Compound H forms with: Ge, F, Te, Bi

4 valence	Ge ≈ C	$= H_4Ge$
7 valence	F	$= HF$
6 valence	Te ≈ O	$= H_2Te$
5 valence	Bi ≈ N	$= H_3Bi$

(6) Au = Nucleus 79 Protons

(A) Calculate Force P. 60 $F(r) = \frac{q_1 q_2}{4\pi \varepsilon_0 r^2}$

Nucleus = $q_1 = 79 \times 1.602 \times 10^{-19} C$

$1e^-$ = $q_2 = -1 \times 1.602 \times 10^{-19} C$

$\varepsilon_0 = 8.854 \times 10^{-12} C^2 J^{-1} M^{-1}$

$r = 2 \times 10^{-10}$ meters

$$F = \frac{-(79)(1.602 \times 10^{-19} C)^2}{4(\pi)(8.854 \times 10^{-12} C^2 J^{-1} M^{-1})(2 \times 10^{-10} M)^2}$$

$F = -4.56 \times 10^{-7} N$ or $\frac{J}{M}$

(6)
(B) Potential energy : $V(r) = \frac{q_1 q_2}{4\pi\varepsilon_0 r}$

$$\frac{-(79)(1.602\times10^{-19}C)^2}{4\pi(8.854\times10^{-12}C^2J^{-1}m^{-1})(2\times10^{-10}m)} = \boxed{-9.11\times10^{-17}J}$$

Other Problems

$$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{1}_{0}n + ^{4}_{2}He$$

(1) Masses: $^{2}_{1}H = 2.014101778\ u$

$^{3}_{1}H = 3.016049268\ u$

$^{1}_{0}n = 1.0086649158\ u$

$^{4}_{2}He = 4.002603250\ u$

$$^{2}_{1}H \quad + \quad ^{3}_{1}H \quad \rightarrow \quad ^{1}_{0}n \quad + \quad ^{4}_{2}He$$

$2.014101778\ u + 3.016049268\ u \rightarrow 1.0086649158\ u + 4.002603250\ u$

(React.) $5.030151046\ u \rightarrow 5.011268166\ u$ (Prod.)

React − Prod $= 0.01888288\ u = \Delta$ mass

Conversion: $1\ u = 1.66053886 \times 10^{-27}\ Kg$

$$0.01888288\ u \left(\frac{1.66053886 \times 10^{-27}\ Kg}{1\ u}\right) = 3.1355756 \times 10^{-29}$$

Kg per He atom. (loss)

(J) = (Kg) (M/s)

$E = MC^2 \qquad C = 2.9979 \times 10^{8}\ M/s$

$$\left(\frac{3.1355756 \times 10^{-29}\ Kg}{\text{atom of He}}\right)\left(\frac{6.022142 \times 10^{23}\ \text{atoms}}{1\ \text{mole}}\right) = \frac{Kg}{\text{mole}}$$

$$(-1.888288151 \times 10^{-5}\ Kg)(2.9979 \times 10^{8}\ M/s)^2 =$$

$-1.697080926 \times 10^{12}\ J$ for 1 mole of isotope fusion

$-1.697 \times 10^{9}\ KJ$ for 1 mole of He isotope fusion

1.697×10^9 KJ/mole = He fusion

436 KJ/mole = Covalent bond formation,

$E = MC^2$

Covalent bond formation

$\frac{436{,}000 J}{(2.9979 \times 10^8 \, M/S)^2} = M = 4.8512337 9 \times 10^{-12}$ Kg/mole

loss of mass

Isotopic fusion mass loss
1.888×10^{-5} Kg/mole

Much more mass is lost during fusion.

(2) $Au = 19.3\ g/cm^3$
$Au = 196.966569\ g/mol$

first obtain the mass per atom
Avogadro: 6.022142×10^{23} atoms/mole

$$\left(\frac{196.966569 \text{ grams}}{1 \text{ mole}}\right)\left(\frac{1 \text{ mole}}{6.022142 \times 10^{23} \text{ atoms}}\right) = 3.266 \times 10^{-22}\ g/atom$$

$$\left(\frac{3.26570994 \times 10^{-22}\ g}{1 \text{ atom}}\right)\left(\frac{1\ cm^3}{19.3\ g}\right) = \boxed{1.6921 \times 10^{-23}\ \frac{cm^3}{atom}}$$

atomic Radius of gold = 144 pm

$$144\ pm\left(\frac{1\ cm}{1 \times 10^{10}\ pm}\right) = 1.44 \times 10^{-8}\ cm$$

Volume of a Sphere $= \frac{4}{3}\pi r^3$

Known value

$$\frac{4}{3} \cdot \pi \cdot (1.44 \times 10^{-8}\ cm)^3 = \boxed{1.2507 \times 10^{-23}\ \frac{cm^3}{atom}}$$

The values are fairly Close.

(3) $V = \frac{q_1 q_2}{4\pi \varepsilon_0 r}$

$V = J$

$1 Å = 1 \times 10^{-10}$ M

$\varepsilon_0 = 8.854 \times 10^{-12}$ C²/J M

$q_1 = +79 \cdot e^-$

$q_2 = -e^- = -1.602 \times 10^{-19}$ C

at ∞ r, V=0

$$V = \frac{-(79)\cdot(1.602 \times 10^{-19} C)^2}{4\cdot\pi\cdot(8.854 \times 10^{-12})\cdot(1 \times 10^{-10} M)} = \frac{-2.0274592 \times 10^{-36} C}{1.11262645 \times 10^{-20} C/J}$$

$\Delta V = -1.82222812 \times 10^{-16}$ J = Potential energy of e^-

$\Delta \bar{E} = \frac{1}{2}\Delta \bar{V} = -9.1111406 \times 10^{-17}$ J = total energy change

$\Delta T = -\frac{1}{2}\Delta \bar{V} = 9.1111406 \times 10^{-17}$ J = Kinetic energy change

$M_e = 9.1093826 \times 10^{-31}$ Kg

$9.1111406 \times 10^{-17}$ J $= \frac{1}{2}(9.1093826 \times 10^{-31}$ Kg$) V^2$

electron velocity

$\Delta v = 14,143,500$ Meters/s

~~$1.4 \cdot 10^7$ almost the speed of light!~~

$C = 2.9979 \times 10^8$ M/S

Simplification

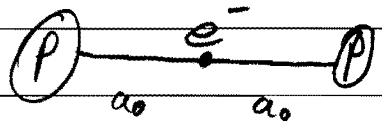
(4) $V = \frac{q_1 q_2}{4\pi\varepsilon_0 r}$

$e^- = -1$

Proton $= +1$

$4\pi\varepsilon_0 = 1$

$r = a_0 = 1$



2 Protons Separated by $2a_0$

Repulsive + attractive 1 + attractive 2

$$\frac{(1)(1)}{(1)(2)} + \frac{(-1)(1)}{(1)(1)} + \frac{(-1)(1)}{(1)(1)}$$

$0.5 - 1 - 1 = -1.5$ = equal distance (highest V)

Rep. + att. 1 + att. 2

$$\frac{(1)(1)}{(1)(2)} + \frac{(-1)(1)}{(1)(0.5)} + \frac{(-1)(1)}{(1)(1.5)} = -2.166$$

Lower V: -2.166 Closer to 1 nucleus