

Answers to Part 3 Final Review

(1)

1. electron-matter-use de Broglie equation. $\lambda = \frac{h}{mu}$
 $m \text{ of } e^- = 9.11 \times 10^{-31} \text{ kg}$
 $\lambda = \frac{6.626 \times 10^{-34} \text{ J.sec}}{(9.11 \times 10^{-31} \text{ kg})(1.0 \times 10^6 \text{ m/sec})} = 7.27 \times 10^{-10} \text{ m} = 7.3 \times 10^{-10} \text{ m}$

units: $J = \frac{\text{kg} \cdot \text{m}^2}{\text{sec}^2}$ so $\frac{\frac{\text{kg} \cdot \text{m}^2}{\text{sec}^2} \cdot \text{sec}}{\text{kg} \cdot \text{m/sec}} = \text{m}$

energy = Kinetic energy! $KE = \frac{1}{2} mu^2 = \frac{1}{2} (9.11 \times 10^{-31} \text{ kg})(1.0 \times 10^6 \text{ m/sec})^2$
 $KE = 4.6 \times 10^{-19} \text{ J per photon } e^-$
 $\left(\frac{4.6 \times 10^{-19} \text{ J}}{e^-} \right) \left(\frac{1 \text{ kJ}}{1000 \text{ J}} \right) \left(\frac{6.022 \times 10^{23} \text{ e}^-}{1 \text{ mole } e^-} \right) = 274 \text{ kJ/mol}$ 270 kJ/mol

2. photon $E=h\nu$ $c=\nu\lambda$

$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8 \text{ m/sec}}{2.15 \times 10^{15} \text{ sec}} = 1.395 \times 10^{-7} \text{ m} = 140. \text{ nm}$

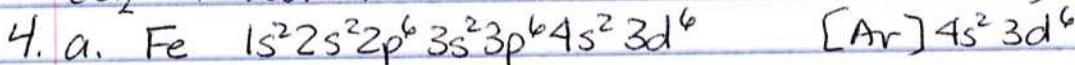
$E = h\nu = (6.626 \times 10^{-34} \text{ J.sec})(2.15 \times 10^{15} \text{ sec}) = 1.42 \times 10^{-18} \text{ J per photon}$
 $\left(\frac{1.42 \times 10^{-18} \text{ J}}{\text{photon}} \right) \left(\frac{1 \text{ kJ}}{1000 \text{ J}} \right) \left(\frac{6.022 \times 10^{23} \text{ photons}}{1 \text{ mole}} \right) = 858 \text{ kJ/mol}$

This photon has a shorter λ than those in the visible region (400-700 nm). It is probably UV.
 (check p. 242 - it is in UV.)

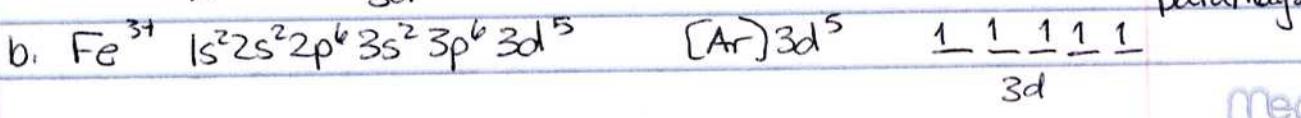
3. $U_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3(8.314 \text{ J/mol.K})(373 \text{ K})}{44.01 \times 10^{-3} \text{ kg/mol}}} = 460. \text{ m/sec}$

units: $\sqrt{\frac{\text{kg} \cdot \text{m}^2}{\text{sec}^2 \text{ mol} \cdot \text{K}}} = \sqrt{\frac{\text{m}^2}{\text{sec}^2}} = \text{m/sec}$

O_2 at the same T would have a higher U_{rms} (it's lighter)
 CO_2 at room T would ~~be too~~ have a lower U_{rms} (T is lower)



$\frac{1s}{4s} \frac{1s}{3d} \frac{1}{1} \frac{1}{1} \frac{1}{1}$ paramag.



Mead

$$(1.953 \text{ kg ethanol}) \left(\frac{1000 \text{ g eth}}{1 \text{ kg}} \right) \left(\frac{1 \text{ mol eth}}{46.068 \text{ g eth}} \right) \left(\frac{1 \text{ mol C}_6\text{H}_{12}\text{O}_6}{2 \text{ mol eth}} \right) \left(\frac{180.156 \text{ g C}_6\text{H}_{12}\text{O}_6}{1 \text{ mol}} \right)$$

③

$$= 3879 \text{ g sugar} = 3.82 \text{ kg C}_6\text{H}_{12}\text{O}_6$$

10. 65°F $^\circ\text{C} = \frac{65 - 32}{1.8} = 18.3^\circ\text{C}$

look up $v_p \text{ H}_2\text{O}$ @ $18.3^\circ\text{C} \Rightarrow$ at 18°C , $v_p = 15.48 \text{ torr}$

lets just use 15.5 torr . $15.5 \times .52 = 8.06 \text{ torr}$

Find T at which v_p of water = 8 torr. This is the T at which excess moisture will condense as dew. (see table of v_p) — about 8°C .

$$\text{In } ^\circ\text{F}: (8^\circ\text{C})(1.8) + 32 \approx 46^\circ\text{F}$$

11. Each atom has its own unique spacing of energy levels. light is emitted when e^- drop from higher to lower levels.

$$\Delta E_{\text{electron}} = E_{\text{photon}}$$

They emit only certain wavelengths because only certain energy levels are possible.

12. For 3f, $n=3$, $\ell=3$ No ℓ can't = n

7f. $n=7$, $\ell=3$ yes they exist (but known ground state atoms don't have any e^- in 7f orbitals. Electrons could be excited to 7f orbitals.

Set of f orbitals: $m_l = -3, -2, -1, 0, 1, 2, 3$ 7 possible values, so 7 possible orientations. Each of the 7 orbitals can contain up to $2e^-$. Total capacity = $14 e^-$

13. $\begin{array}{c} \text{CH}_2 \\ | \\ \text{CH}-\text{C}_2\text{H}_5 \\ | \\ \text{OH} \end{array}$ each C has an OH group. This will have very strong IMFs — can form lots of H-bonds between glycerol molecules. \Rightarrow viscous.

14. Look up v_p of about 465 mmHg.

(Water will boil when its v_p = atmospheric pressure)

at 468.7 torr, $T = 87^\circ\text{C}$ bp — about 87°C

(4)

15. a. Water has a density of 1.00 g/mL. Dilute aqueous solutions will also have ρ close to 1.00 g/mL, since they are mostly water. Also can use units of 1.00 kg/L

$$M = \frac{\text{# moles solute}}{1 \text{ L solution}}$$

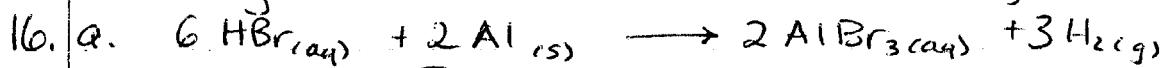
$$m = \frac{\text{# moles solute}}{1 \text{ kg H}_2\text{O}(\text{solvent})} \text{ so for dilute aq. solutions}$$

1 L solution contains

b. If the solvent isn't water, it won't approx 1 kg H₂O.

have a density of 1.00 g/mL, so 1 L solution \neq 1 kg solvent.

c. If the solution is concentrated, it won't have a density of 1.00 g/mL. Therefore 1 L solution \neq 1 kg solvent.



b. LR problem. Find moles of each.

$$(11.2 \text{ in}^3 \text{ Al}) \left(\frac{2.54 \text{ cm}^3}{1 \text{ in}} \right) \left(\frac{2.70 \text{ g}}{1 \text{ cm}^3} \right) \left(\frac{1 \text{ mol Al}}{26.98 \text{ g}} \right) = 18.367 \text{ mol Al}$$

$$(10.0 \text{ L}) \left(\frac{6.00 \text{ mol HBr}}{1 \text{ L}} \right) = 60.0 \text{ mol HBr}$$

need $\frac{6 \text{ HBr}}{2 \text{ Al}} = \frac{3 \text{ HBr}}{1 \text{ Al}}$ have $\frac{60.0 \text{ mol HBr}}{18.367 \text{ mol Al}} = \frac{3.267 \text{ mol HBr}}{1 \text{ mol Al}}$

plenty of HBr, so Al is LR.

$$(18.367 \text{ mol Al}) \left(\frac{3 \text{ mol H}_2}{2 \text{ mol Al}} \right) = 27.5505 \text{ mol H}_2$$

$$PV=nRT \quad V = \frac{nRT}{P} = \left(27.5505 \text{ mol} \right) \left(0.08206 \frac{\text{L atm}}{\text{K mol}} \right) \left(295 \text{ K} \right)$$

0.97895 atm

V = 681 L of gas.

$$\text{C. } (0.0500 \text{ L HBr}) \left(\frac{2.50 \text{ mol HBr}}{1 \text{ L HBr}} \right) \left(\frac{3 \text{ mol H}_2}{6 \text{ mol HBr}} \right) \left(\frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol H}_2} \right) = \\ = (3.76 \times 10^{22} \text{ molecules})$$