(1) $PV = nRT$

$P_{H_2} = 745\ mmHg - 23.8\ mmHg = 721.2\ mmHg = 0.9489\ atm$

$0.9489\ atm \cdot 0.0900\ L = n \cdot 0.0821 \frac{atm \cdot L}{mol \cdot K} \cdot 298.15\ K$

$\boxed{n_{H_2} = 3.49 \cdot 10^{-3}\ mol}$

(B) $P_{H_2O} = 23.8\ mmHg = 3.13 \cdot 10^{-2}\ atm$

$3.13 \cdot 10^{-2}\ atm \cdot 0.0900\ L = n \cdot 0.0821 \frac{atm \cdot L}{mol \cdot K} \cdot 298.15\ K$

$n_{H_2O} = \boxed{1.15 \cdot 10^{-4}\ mol}$

(C) $\frac{U_{H_2}}{U_{H_2O}} = \sqrt{\frac{M_{H_2O}}{M_{H_2}}} = \sqrt{\frac{18.01}{2.016}} = \boxed{2.99}$

(2) A) $P_{H_2} = \frac{nRT}{V} = \frac{2.50\ mol \cdot 0.0821 \frac{atm \cdot L}{mol \cdot K} \cdot 400\ K}{8.20\ L} = 10.0\ atm\ H_2$

$P_{O_2} = \frac{nRT}{V} = \frac{0.500\ mol \cdot 0.0821 \frac{atm \cdot L}{mol \cdot K} \cdot 400\ K}{8.20\ L} = 2.00\ atm\ O_2$

$P_T = P_{H_2} + P_{O_2} + P_{Ar} = 10.0\ atm + 2.00\ atm + 2.00\ atm = \boxed{14.0\ atm}$

B) $\chi_{H_2} = \frac{n_{H_2}}{n_T} = \frac{P_{H_2}}{P_T} = \frac{10.0}{14.0} = \boxed{0.714}$

(2) c) $2.50 \text{ mol } H_2 \cdot \frac{2.016 g}{1 \text{ mol } H_2} = 5.04 g\ H_2$

$0.500 \text{ mol } O_2 \cdot \frac{32.00 g}{1 \text{ mol } O_2} = 16.0 g\ O_2$

$0.500 \text{ mol } Ar \cdot \frac{39.95 g}{1 \text{ mol } Ar} = 20.0 g\ Ar$

$\frac{41.04 g \text{ total}}{8.20 L} = 5.00 \frac{g}{L}$

(2) d) $0.500 \text{ mol } O_2 \cdot \frac{2 H_2}{1 O_2} = 1.00 \text{ mol } H_2$ used so $1.50 \text{ mol } H_2$ left

$0.500 \text{ mol } O_2 \cdot \frac{2 H_2O}{1 O_2} = 1.00 \text{ mol } H_2O$ produced

$n_T = 1.50 \text{ mol } H_2 + 1.00 \text{ mol } H_2O + 0.500 \text{ mol } Ar = 3 \text{ mol}$

$\frac{1.5 \text{ mol } H_2}{3.0 \text{ mol}} = 0.5\ H_2$ $\frac{1.00 \text{ mol } H_2O}{3.0 \text{ mol}} = 0.33\ H_2O$ $\frac{0.500 \text{ mol } Ar}{3.0} = 0.16\ Ar$

(3) A) Particle size dosen't matter, all balloons would have the same number of moles. The kinetic molecular theory assumes that the size of the gass moleculess is much less than the size of the contaiver and is there fore irrelivent.

(5) B) Temperature is a direct measure of kinetic energy, since all the gases are at the same temperature they have the same average kinetic energy.

C) SF_6 is the largest gas in terms of both volume and number of atoms it will there for deviate the most from ideal behavior. The volume of the SF_6 molecules will be the largest of the three. Also SF_6 will be more polarizable and would have greater inter particular forces.

D) The size of the balloons will depend on the rates of effusion. The rate of effusion depends on the temperature and the mass of the particles. Since all the gases are at the same temperature the lighter the gas the greater the rate of effusion since H_2 is the lightest gas it will have the largest rate of effusion and the smallest size.

$$V_{H_2} < V_{Ne} < V_{SF_6}$$

(4) A) $6.19g\ PCl_5 \cdot \frac{1mol\ PCl_5}{208.2g\ PCl_5} = 2.97 \cdot 10^{-2} mol\ PCl_5$

$PV = nRT \quad P = \frac{2.97 \cdot 10^{-2} \cdot 0.0821 \cdot 525K}{2.00L} = 0.640 atm$

B) $P_T = P_{PCl_5} + P_{PCl_3} + P_{Cl_2} = 1.00$

$P_{PCl_3} = P_{Cl_2}$

$P_{PCl_5} = 0.640 - P_{Cl_2}$ ← This could be P_{PCl_3} instead.

$1.00 = (0.640 - P_{Cl_2}) + P_{Cl_2} + P_{Cl_2}$

$1.00 - 0.640 = -P_{Cl_2} + P_{Cl_2} + P_{Cl_2}$

$0.360 atm\ P_{Cl_2} = P_{PCl_3}$

$P_{PCl_5} = 0.640 - 0.360 = 0.280 atm$

(5) A) a corrects for the attractive forces between the particles.

B) b corrects for the volume of the particle

C) we would expect the H_2O to have a larger a value as H_2O molecules are polar and would attract each more than CO_2 which is non-polar.