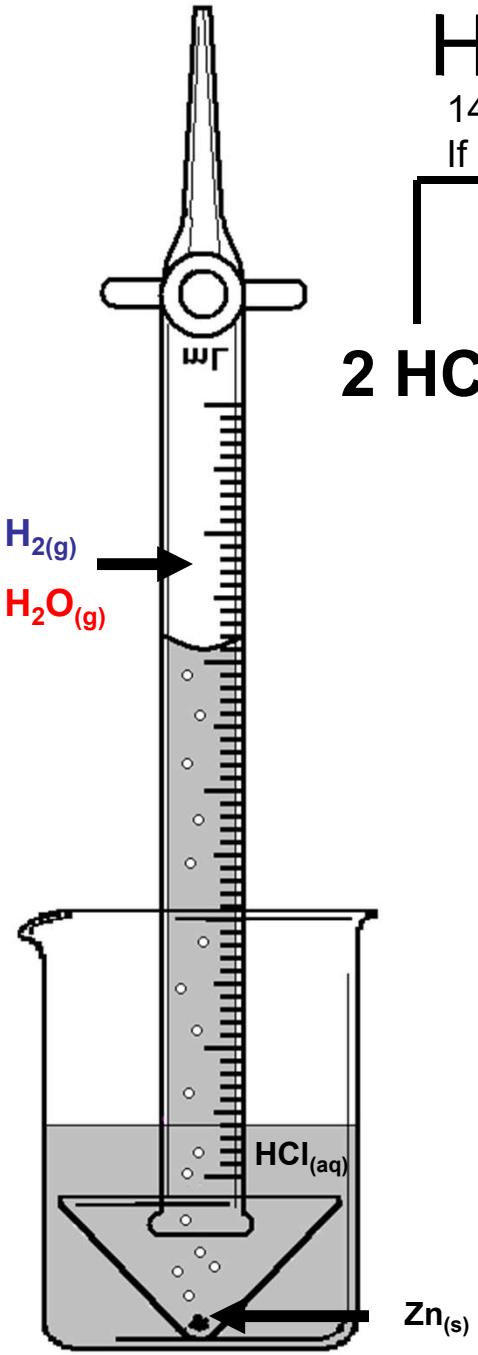
Hydrogen Collection Over Water

14.23 mL of H_2 gas is produced at 23.5°C by the following reaction.
If atmospheric pressure is 748.2 torr, how much Zn(s) is consumed?



Reduction

Oxidation

$$2\,HCl_{(aq)} + \overset{65.39}{Zn_{(s)}} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$$

grams_{Zn} ——— Moles_{Zn}

T = 23.5°C

V = 14.23 mL

P = ?

n = ____

Problem: The pressure in the collection tube is due to both $H_2O_{(g)}$ and $H_{2(g)}$

We need the pressure of $H_{2(g)}$

Dalton's Law of Partial Pressures

Total Pressure	=	H_2 Partial Pressure		H_2O Partial Pressure
P_{tot}	=	P_{H2}	+	P_{H2O}

i.e. the total pressure is also ATMOSPHERIC PRESSURE

P_{atm}	=	P_{H2}	+	P_{H2O}

Rearrange.....

P_{H2}	=	P_{atm}	-	P_{H2O}
		748.2 torr *(barometer)*		More Info Required

Partial Pressure of H_2O @ 23.5 °C

(Provided on Exams)

Vapor Pressure of Water (mm Hg)

T°C	P	T°C	P	T°C	P	T°C	P	T°C	P
-10	2.1	11	9.8	32	35.7	53	107.2	74	277.2
-9	2.3	12	10.5	33	37.7	54	112.5	75	289.1
-8	2.5	13	11.2	34	39.9	55	118.0	76	301.4
-7	2.7	14	12.0	35	42.2	56	123.8	77	314.1
-6	2.9	15	12.8	36	44.6	57	129.8	78	327.3
-5	3.2	16	13.6	37	47.1	58	136.1	79	341.0
-4	3.4	17	14.5	38	49.7	59	142.6	80	355.1
-3	3.7	18	15.5	39	52.4	60	149.4	81	369.7
-2	4.0	19	16.5	40	55.3	61	156.4	82	384.9
-1	4.3	20	17.5	41	58.3	62	163.8	83	400.6
0	4.6	21	18.7	42	61.5	63	171.4	84	416.8
1	4.9	22	19.8	43	64.8	64	179.3	85	433.6
2	5.3	23	21.1	44	68.3	65	187.5	86	450.9
3	5.7	24	22.4	45	71.9	66	196.1	87	468.7
4	6.1	25	23.8	46	75.7	67	205.0	88	487.1
5	6.5	26	25.2	47	79.6	68	214.2	89	506.1
6	7.0	27	26.7	48	83.7	69	223.7	90	525.8
7	7.5	28	28.3	49	88.0	70	233.7	91	546.1
8	8.0	29	30.0	50	92.5	71	243.9	92	567.0
9	8.6	30	31.8	51	97.2	72	254.6	93	588.6
10	9.2	31	33.7	52	102.1	73	265.7	94	610.9

T= 23°C P_{H2O} **= 21.1 torr**

T= 23.5°C P_{H2O} **= 21.75 torr**

T= 24°C P_{H2O} **= 22.4 torr**

ΔP = 1.3 torr

$$\frac{1.3 \text{ torr}}{2} = 0.65 \text{ torr}$$

P_{H2O} **= 21.1 torr + 0.65 torr = 21.75 torr**

Dalton's Law of Partial Pressures

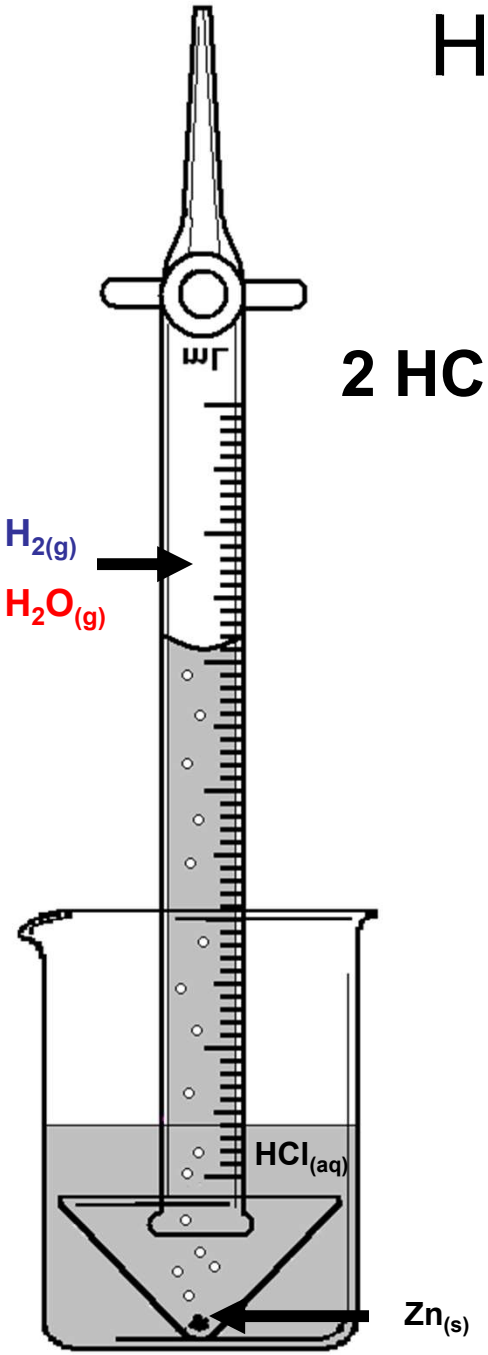
Total Pressure		H_2 Partial Pressure		H_2O Partial Pressure
P_{tot}	=	P_{H2}	+	P_{H2O}

i.e. the total pressure is the sum of all non-reactive gas partial pressures.

Total pressure = atmospheric pressure

P_{atm}	=	P_{H2}	+	P_{H2O}
P_{H2}	=	P_{atm}	-	P_{H2O}
		748.2 torr *(barometer)*	–	**21.75 torr** More Info Required
P_{H2}	=	**726.45 torr**		

Hydrogen Collection Over Water



$$2\,HCl_{(aq)} + \overset{65.39}{Zn_{(s)}} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$$

grams_{Zn}

Moles_{Zn}

T = 23.5°C

V = 14.23 mL

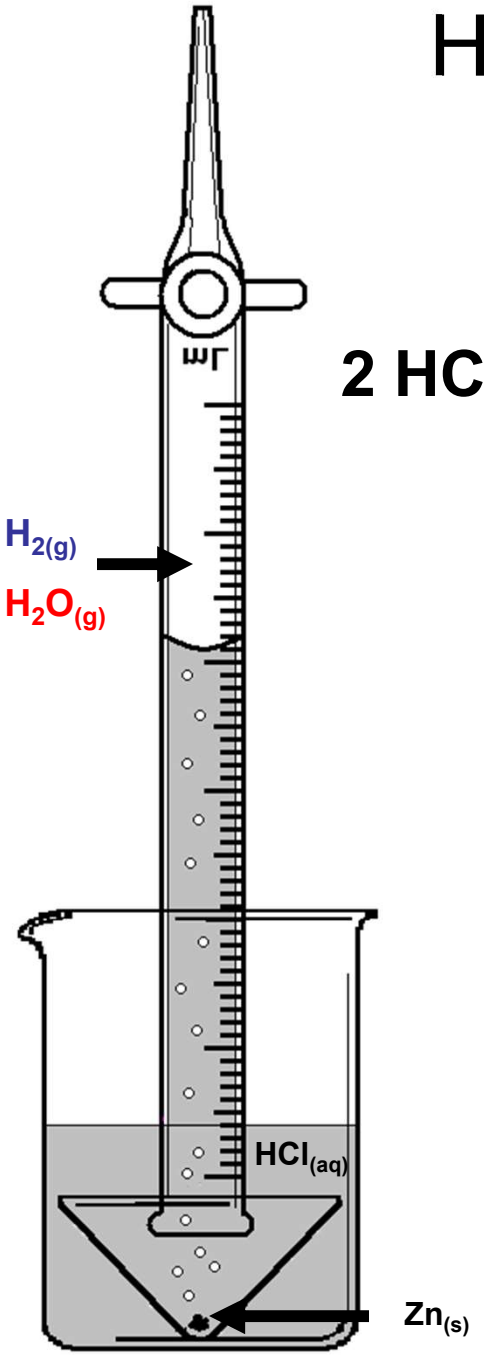
P = 726.45 torr

n = _____

Problem: The pressure in the collection tube is due to both $H_2O_{(g)}$ and $H_{2(g)}$

We need the pressure of $H_{2(g)}$

Hydrogen Collection Over Water



$$2\,HCl_{(aq)} + \overset{65.39}{Zn_{(s)}} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$$

3.664×10^{-2} grams$_{Zn}$ / 5.58769×10^{-4} Moles$_{Zn}$

1 mol $_{Zn}$: 1 mol $_{H2}$

296.65 K ..... T = 23.5°C

0.01423 L..... V = 14.23 mL

0.955855 atm..... P = 726.45 torr

n = 5.59769×10^{-4} mols

$$n = \frac{P\,V}{R\,T} = \frac{(0.955855\ atm)\ (0.01423\ L)}{(0.0820578\ (L\ atm)/(mol\ K))\ (296.65\ K)}$$

$$n = 5.58769 \times 10^{-4}\ moles_{H2}$$