Complete the following problems. Write your final answers in the blanks provided. You must show your work to receive full credit. Show numerical answers to the correct number of significant figures with the correct units.

1. Consider the precipitation reaction that occurs when aqueous calcium chloride and aqueous silver (I) nitrate are mixed. If 25.0 mL of 0.325 M calcium chloride is mixed with 50.0 mL of 0.225 M silver nitrate, what mass of precipitate will form? (9 pts)
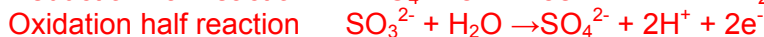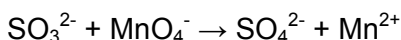
$$CaCl_2(aq) + 2AgNO_3(aq) \rightarrow 2AgCl(s) + Ca(NO_3)_2(aq)$$

0.0250 ~~L~~   x $\dfrac{0.325 \text{ mol } CaCl_2}{1 \text{ L}}$ x $\dfrac{2 \text{ mol } AgCl}{1 \text{ mol } CaCl_2}$ x $\dfrac{143.32 \text{ g } AgCl}{1 \text{ mol } AgCl}$ =   2.329 g AgCl

0.0500 ~~L~~   x $\dfrac{0.225 \text{ mol } AgNO_3}{1 \text{ L}}$ x $\dfrac{2 \text{ mol } AgCl}{2 \text{ mol } AgNO_3}$ x $\dfrac{143.32 \text{ g } AgCl}{1 \text{ mol } AgCl}$ =   1.612 g AgCl
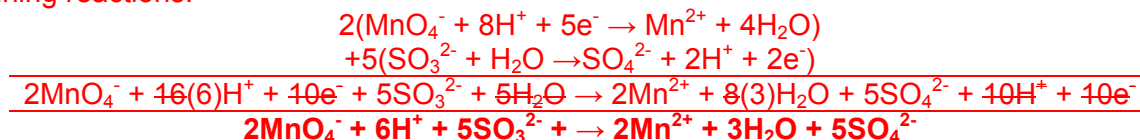
Therefore, $AgNO_3$ is the limiting reactant and the theoretical yield is 1.61 g AgCl

Answer__1.61 g AgCl _____

2. Balance the reaction below in acidic aqueous solution and answer the following questions regarding the reaction.   (8 pts)

$$SO_3^{2-} + MnO_4^- \rightarrow SO_4^{2-} + Mn^{2+}$$

Reduction half reaction $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
Oxidation half reaction $SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-$

Combining reactions:

$2(MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O)$
$+5(SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e^-)$
_____
$2MnO_4^- + \text{~~16~~}(6)H^+ + \text{~~10e~~}^- + 5SO_3^{2-} + \text{~~5H}_2\text{O~~} \rightarrow 2Mn^{2+} + \text{~~8~~}(3)H_2O + 5SO_4^{2-} + \text{~~10H~~}^+ + \text{~~10e~~}^-$
$2MnO_4^- + 6H^+ + 5SO_3^{2-} + \rightarrow 2Mn^{2+} + 3H_2O + 5SO_4^{2-}$

Balanced reaction:(6 pts) $2MnO_4^- + 6H^+ + 5SO_3^{2-} + \rightarrow 2Mn^{2+} + 3H_2O + 5SO_4^{2-}$

What is the oxidizing agent in the reaction? (1 pt)_____ MnO_4^- _____

What is the oxidation state for the sulfur in the sulfate ion? (1 pt)_____+6_____

3. A sample of gas (0.190 mol) is in a 5.00 L flask at 21.0°C and 697.0 mm Hg. The flask is now opened and more gas is added to the flask. The new pressure is 795.0 mm Hg and the temperature is now 26.0°C. How many moles of gas are now in the flask? (8 pts)

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

From the information given:
P_1 = 697.0 mm Hg, V_1 = 5.0 L, n_1 = 0.190 mol, T_1 = 21.0°C
P_2 = 795.0 mm Hg, V_2 = 5.0 L, n_2 = ??? mol, T_2 = 26.0°C

Converting units:

697.0 mm Hg x $\dfrac{1\ atm}{760\ mm\ Hg}$ =0.917_1 atm   795.0 mm Hg x $\dfrac{1\ atm}{760\ mm\ Hg}$ = 1.04_6 atm

21.0°C + 273.15 = 294.15 K   26.0°C + 273.15 = 299.15 K

Rearranging the relationship to solve for n_2 and inserting values

n_2 $\dfrac{P_2V_2n_1T_1}{P_1V_1T_2}$ = $\dfrac{(1.04_6\ atm)(5.00\ L)(0.190\ mol)(294.15\ K)}{(0.917_1\ atm)(5.00\ L)(299.15\ K)}$ = 0.213 mol

Answer_____0.213 mol _____

Possibly Useful Information

R = 0.08206 L atm mol^{-1} K^{-1}	K = °C + 273.15	$P_{total}V = n_{total}RT$
1 atmosphere = 760 Torr = 760 mm Hg	N_a = 6.02214 x 10^{23} mol^{-1}	$\dfrac{P_1V_1}{n_1T_1} = \dfrac{P_2V_2}{n_2T_2}$

1 1A	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H 1.00794																	2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.3050	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 †Ac 227.028	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Rg (272)							

*Lanthanide series		58 Ce 140.115	59 Pr 140.908	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.965	64 Gd 157.25	65 Tb 158.925	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.967
†Actinide series		90 Th 232.038	91 Pa 231.036	92 U 238.029	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

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