



# EXPERIMENT 4

THE MANY OXIDATION STATES OF  
VANADIUM (V)

DR. MIOY T. HUYNH // YALE UNIVERSITY  
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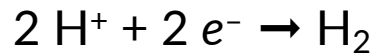
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# *Intro*

Oxidation: Loss of electron(s)



Reduction: Gain of electron(s)



Oxidation Number: Indication of how many electrons ( $e^{-}$ ) have been lost or gained by an atom in a chemical species *relative to the neutral atom*.

1 H																	2 He	
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
55 Cs	56 Ba	57 La	*	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	*	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
			*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
			*	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

# *Shades of Vanadium*

V 23  
50.9415

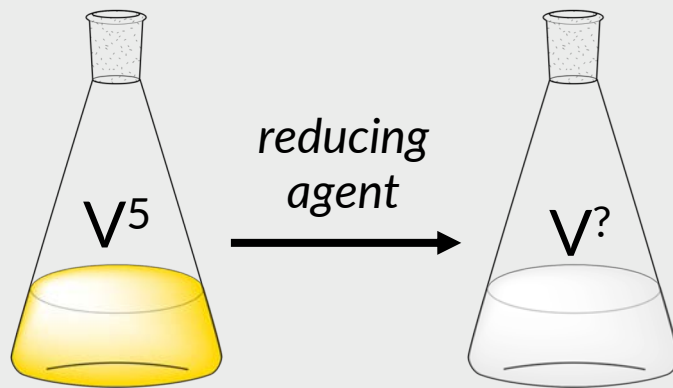


Vanadium

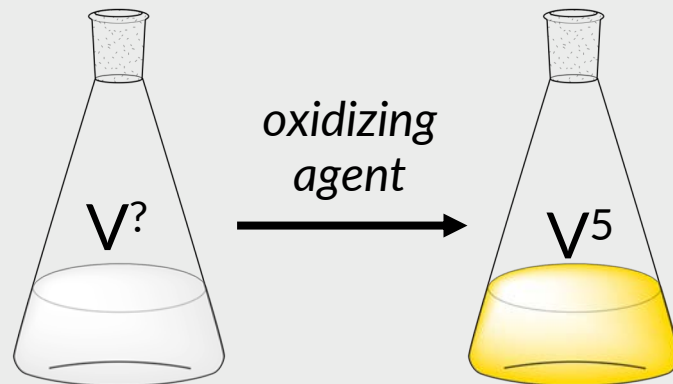


# Overview

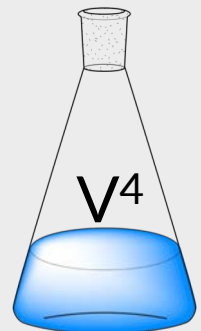
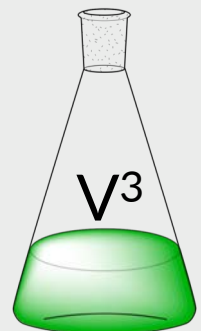
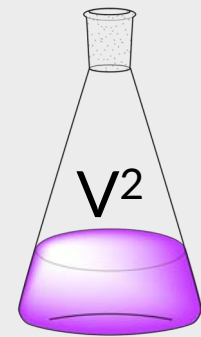
1



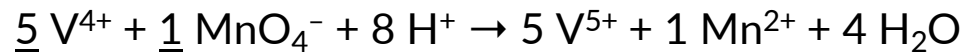
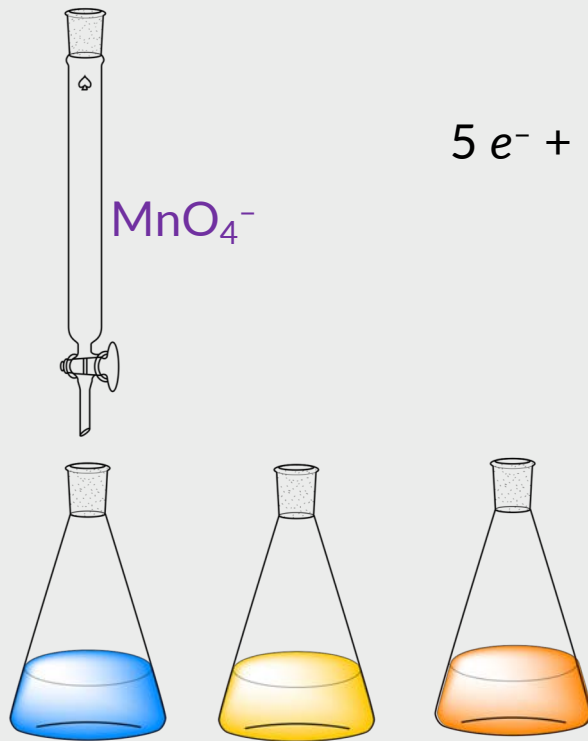
2



V?

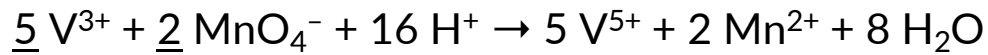
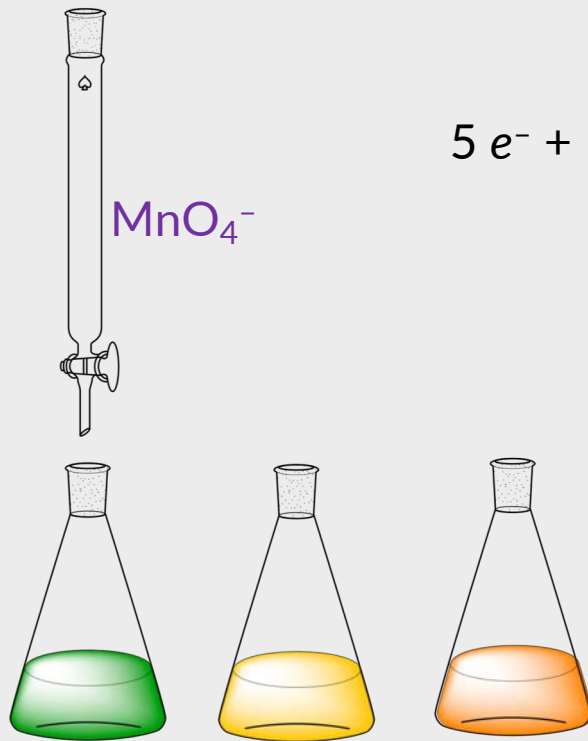


# Scenario 1



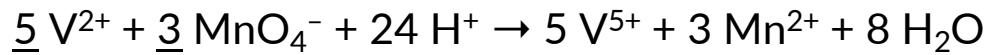
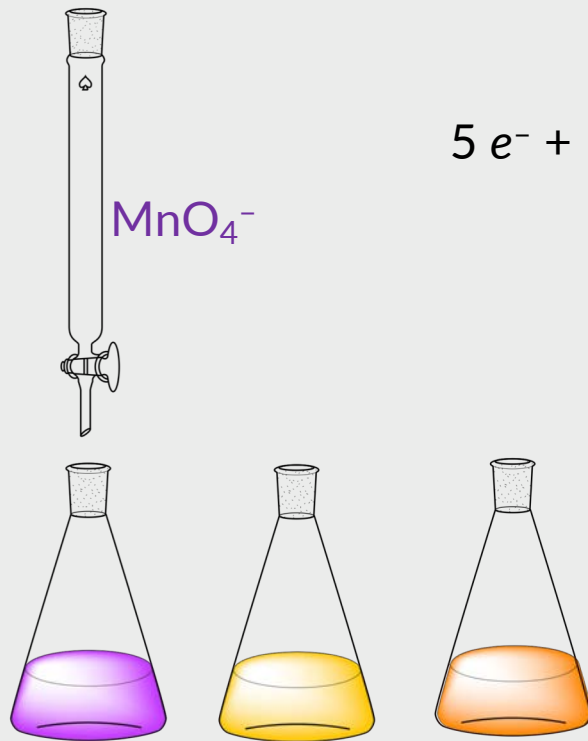
oxidation

## *Scenario 2*



oxidation

## *Scenario 3*

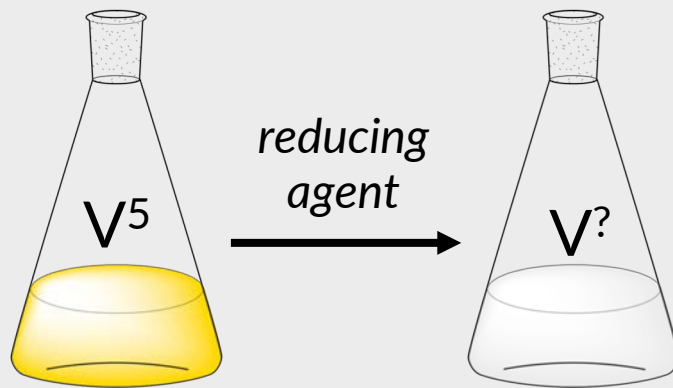


oxidation



# Overview

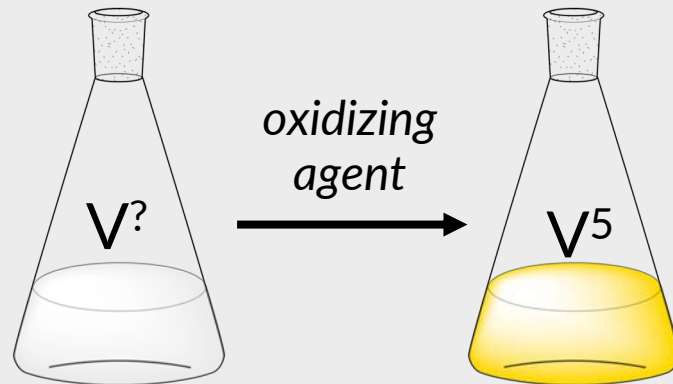
1



3

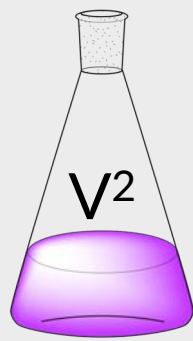
Compute mole ratios!

2

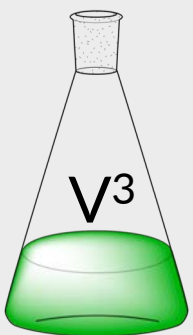


V?

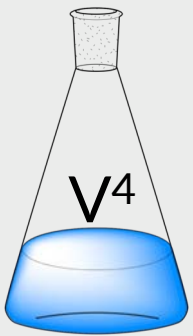
5:3



5:2

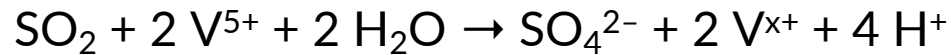
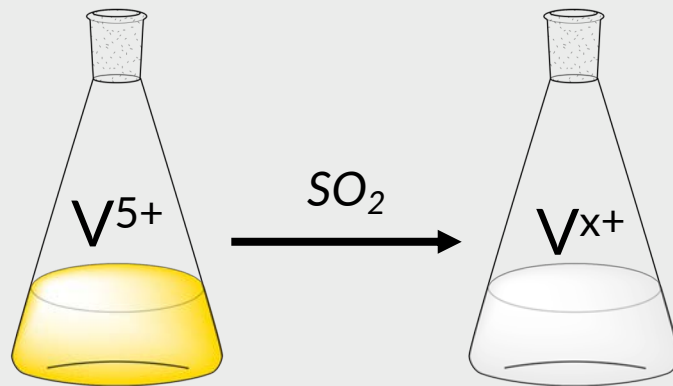


5:1



# Part B I

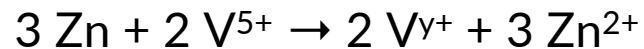
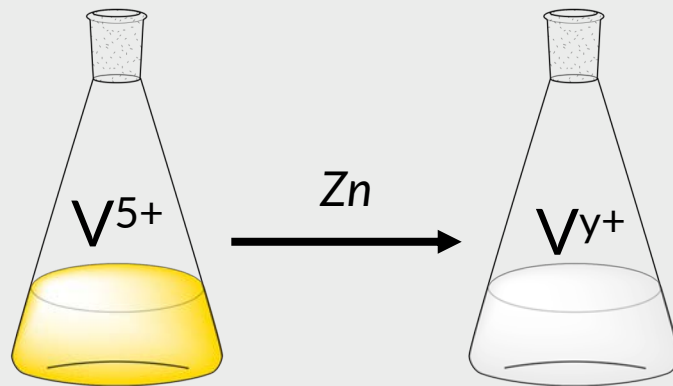
$V^{5+}$  reduces to  $V^{x+}$  using  $SO_2$



What can we do to find the value of x?

*Part B*  
*II-III*

$V^{5+}$  reduces to  $V^{y+}$  using Zn

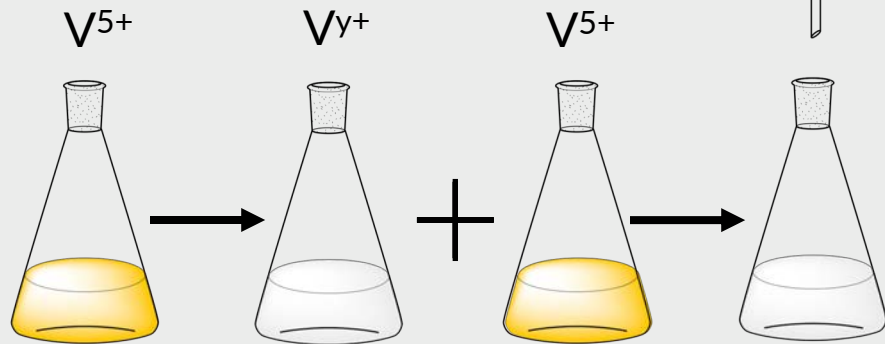
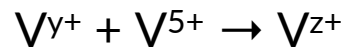


What can we do to find the value of y?

*Instead* of titrating right away...

*Let's* make use of comproportionation

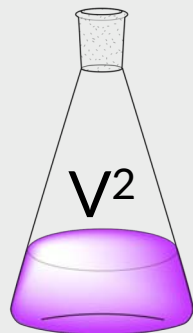
# Comproportionation



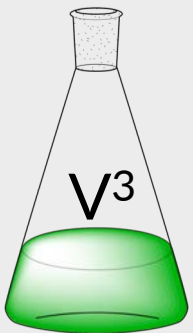
II) 1 mmol  $V^{5+}$  1 mmol  $V^{y+}$  2 mmol  $V^{5+}$  3 mmol  $V^{z+}$

III) 2 mmol  $V^{5+}$  2 mmol  $V^{y+}$  1 mmol  $V^{5+}$  3 mmol  $V^{z+}$

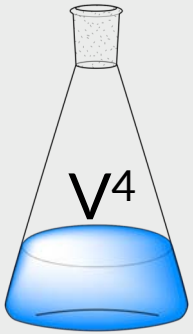
V:Mn = 5:3



V:Mn = 5:2



V:Mn = 5:1



# *Notes*

1. Do Part 1 in the fume hood because  $\text{SO}_2$  is toxic!
2. Be careful with the hot plates.
3. Be careful when inserting the rubber hose onto the filter flask – be gentle.
4. Parts 2 & 3: Loosen rubber stopper & swirl for 20 minutes.
5. Keep in the interference of  $\text{O}_2$  in the air.