Brookwood Invitational

Chemistry Lab

Answer Sheet

Key

team name

1. D
2. A
3. A
4. C
5. D
6. B
7. B
8. D
9. E
10. D
11. A
12. E
13. E
14. A
15. D
16. A
17. E
18. B
19. C
20. E
21. B
22. A
23. A
24. B
25. a) Li
    b) Na
    c) P
    d) S
26. a) C
    b) O
    c) Na
    d) F^-
27. Li B F Sc Fe^{+2}

II. Measuring an Equilibrium Constant

Data has been collected for you to determine the equilibrium constant, K_c, for the reaction:

$$Fe^{3+} + SCN^- <==> FeSCN^{2+}$$

Since $FeSCN^{2+}$ is highly colored, we can measure its concentration (in Molarity) spectrophotometrically. Before we can determine the concentration in an unknown solution, we must first produce a standard curve with a various concentrations of $FeSCN^{2+}$ in solution. I've done all that work for you. The table below provides the information you need for the standard curve.

	1	2	3	4	5
$[FeSCN^{2+}]$	0	4.0×10^{-5}	8.0×10^{-5}	1.2×10^{-4}	1.6×10^{-4}
Absorbance	0.015	0.138	0.279	0.414	0.556

$Abs = 3395 [FeSCN^{+2}] + .0088$

Construct a calibration (standard) curve for Absorbance vs $[FeSCN^{2+}]$ on the graph paper provided. Part of your score will be on the quality of this graph.

To make the $FeSCN^{2+}$ we mixed various volumes of 0.002 M NaSCN with 5.00 mL of 0.002 M $Fe(NO_3)_3$ and added enough water to make the total volume 10.0 mL. Complete the following table.

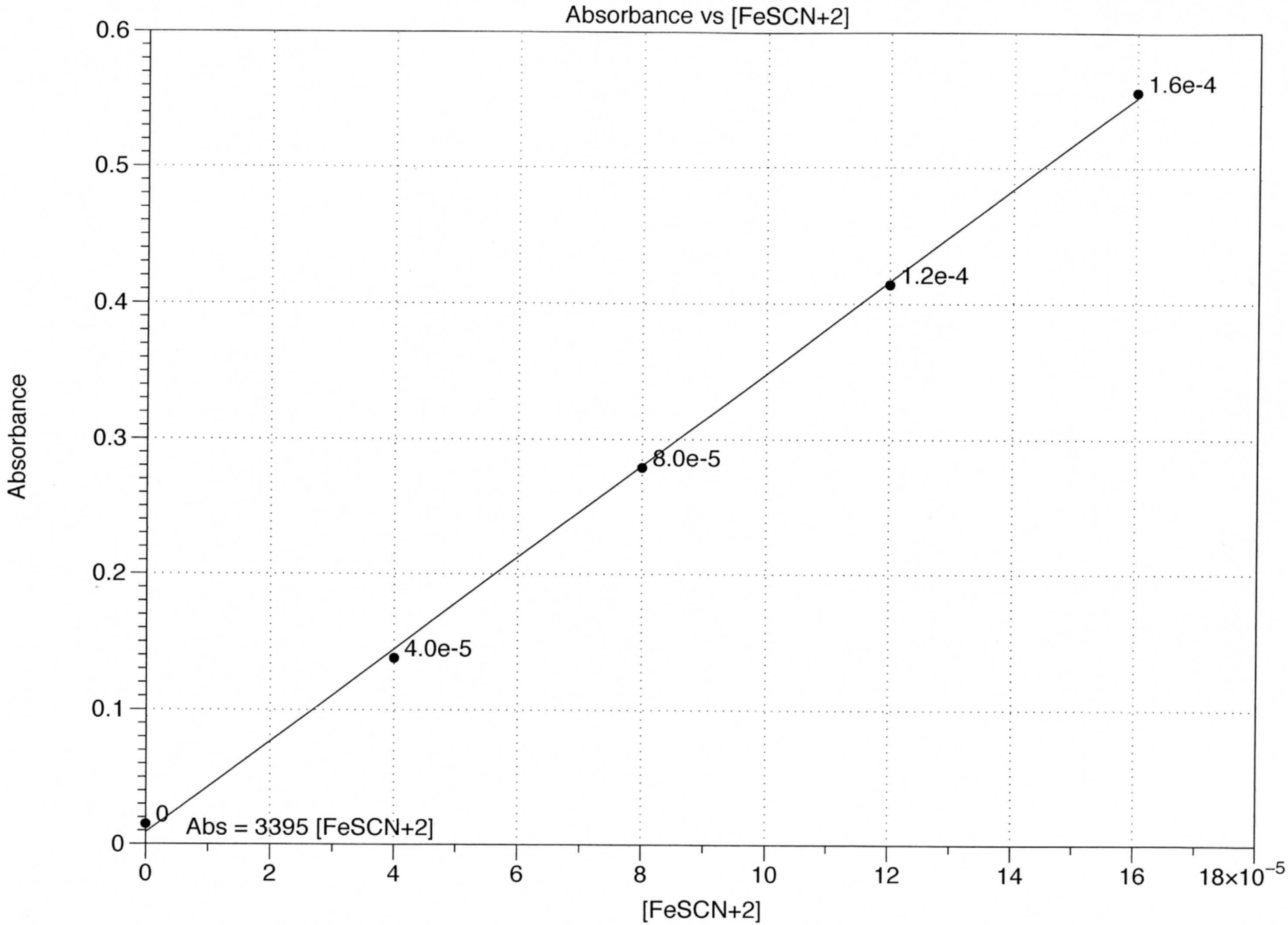
	1	2	3	4	5
Volume $Fe(NO_3)_3$ mL	5.00	5.00	5.00	5.00	5.00
Moles Fe^{3+} (initial)	1×10^{-5}	1×10^{-5}	1×10^{-5}	1×10^{-5}	1×10^{-5}
Volume NaSCN	1.00	2.00	3.00	4.00	5.00
Moles SCN (initial)	2×10^{-6}	4×10^{-6}	6×10^{-6}	8×10^{-6}	1×10^{-5}
Absorbance	0.123	0.259	0.396	0.508	0.654

Determination of K_c

To find K_c, you will need to complete the following table using your calibration curve and knowledge of stoichiometry.

	1	2	3	4	5
$[FeSCN^{+2}]$ from calibration curve	3.36×10^{-5}	7.37×10^{-5}	1.14×10^{-4}	1.47×10^{-4}	1.90×10^{-4}
Moles $[FeSCN^{+2}]$ at equilibrium	3.36×10^{-7}	7.37×10^{-7}	1.14×10^{-6}	1.47×10^{-6}	1.90×10^{-6}
Moles Fe^{3+} reacted	3.36×10^{-7}	7.37×10^{-7}	1.14×10^{-6}	1.47×10^{-6}	1.90×10^{-6}
Moles Fe3+ unreacted	9.66×10^{-6}	9.26×10^{-6}	8.86×10^{-6}	8.53×10^{-6}	8.10×10^{-6}
$[Fe^{3+}]$ at equilibrium unreacted	9.66×10^{-4}	9.26×10^{-4}	8.86×10^{-4}	8.53×10^{-4}	8.10×10^{-4}
Moles SCN^- reacted	3.36×10^{-7}	7.37×10^{-7}	1.14×10^{-6}	1.47×10^{-6}	1.90×10^{-6}
Moles SCN^- unreacted	1.66×10^{-6}	1.26×10^{-6}	4.86×10^{-6}	6.53×10^{-6}	8.10×10^{-6}
$[SCN^-]$ at equilibrium unreacted	1.66×10^{-4}	3.26×10^{-4}	4.86×10^{-4}	6.53×10^{-4}	8.10×10^{-4}
K_c	209	244	265	264	290

Average K_c 254


Absorbance vs [FeSCN+2]
Absorbance
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
16
18×10−5
[FeSCN+2]
1.6e-4
1.2e-4
8.0e-5
4.0e-5
0
Abs = 3395 [FeSCN+2]