## Merck State Science Day 2015

## Chemistry

Answer Section

## MULTIPLE CHOICE

1. E
2. A
3. D
4. D
a) did not K and inverted $\left(2.05^{*} 27\right) /(6.50 * 37)=\mathrm{X}$
b) used $\left(2.05 \mathrm{~atm}^{*} 300 \mathrm{~K}\right) /(6.50 \mathrm{~mL} * 310 \mathrm{~K})=\mathrm{X}$
c) math error: $(2.05 * 310 * 1) /(6.50 * 300)=X$
d) correct $\left(6.50 \mathrm{~mL}^{*} 310 \mathrm{~K} * 1 \mathrm{~atm}\right) /(2.05 \mathrm{~atm} * 300 \mathrm{~K})=X$
e) did not use Kelvin $\left(6.50 * 37^{* 1}\right) /(2.05 * 27)=X$
5. $B$
$50 \mathrm{~g} / 415.1=0.120 \mathrm{~mol} 5 \mathrm{~g} / 17 \mathrm{~g}=0.29 \mathrm{~mol}$ only $0.240 \mathrm{~mol} \mathrm{NH}_{3}$ needed for KTCP to react completely
a) used KTCP and found mass of $\mathrm{NH}_{3}$ used
b) correct: KTCP is the limiter: 0.120 mol KTCP yields 0.120 mol cis-platin* $330.1 \mathrm{~g} / \mathrm{mol}=36.1 \mathrm{~g}$
c) used $\mathrm{NH}_{3}$ as the limiter
d) used $\mathrm{NH}_{3}$ and found mass of KTCP needed
e) used $\mathrm{NH}_{3}$ but then forgot to divide by 2 .
6. C
7. D
8. D Eliminated
9. E
10. B
11. D

$$
P V=n R T, n=(0.0821)(25+273) /\left((550 / 760)^{*} 0.25\right)=0.0074 \mathrm{~mol} ; 0.118 \mathrm{~g} / 0.0074 \mathrm{~mol}=15.96 \mathrm{~g} / \mathrm{mol}
$$

12. A
13. D

100 g water yields 22.2 g of methane, 75 g aluminum carbide could yield 40 g of methane
A)
14. A
15. C
16. C
17. C
18. E
19. D
20. D
21. C
22. A
23. B
24. A
$36000 \mathrm{sec} \times 0.5 \mathrm{amp}=18000$ coul; 18000 coul/96500/6 e- $\times 22.4 \mathrm{~L}$ mol $=$
25. B
26. C
27. D
$K_{s p}=6.7 \times 10^{-31}=\mathrm{X} \cdot(3 \mathrm{x})^{3}$
28. C
29. B
$\Delta \mathrm{H}=$ bond energy of products - bond energy of reactants $=\left(2^{*} 800^{*} 2+2^{*} 460\right)-\left(835+2^{*} 410+2.5^{*} 494\right)=1230$
30. C
31. A
32. A
33. C
34. $B$
35. B
delta $\mathrm{G}=-\mathrm{nFE} E^{\circ}$
36. C
c) correct: the mass ratio of nitrogen to oxygen in each is:
$\begin{array}{lll}\mathrm{N}_{2} \mathrm{O}, 28: 16 & \mathrm{NO}, 14: 16 & \mathrm{NO}_{2}, 14: 32\end{array} \mathrm{~N}_{2} \mathrm{O}_{5}, 28: 80$
37. C

C is correct: amount of $\mathrm{CO}_{2}$ is determined by amount of C and amount of $\mathrm{H}_{2} \mathrm{O}$ is determined by the amount of H
38. A

The weakest acid has the strongest conjugate base $\left(\mathrm{K}_{\mathrm{w}}=\mathrm{K}_{\mathrm{a}} \times \mathrm{K}_{\mathrm{b}}\right)$. At the equivalence point all that is left is the weak base.
39. E
e is correct: there are $8 \mathrm{C}-\mathrm{H}$ and $6 \mathrm{C}-\mathrm{C}$ sigma bonds, and $4 \mathrm{C}-\mathrm{C}$ multiple pi bonds
40. A
ans: $Q=[C]^{2} /[A]^{2}[B]$
a) correct $(1)^{2} /(2)^{2}(2)=0.13 K_{c}>Q$ therefore reaction proceeds to right
b) $(1)^{2} /(0.2)^{2}(0.2)=125 \mathrm{~K}_{\mathrm{c}}<\mathrm{Q}$
c) $(5)^{2} /(2)^{2}(0.2)=31 \mathrm{~K}_{\mathrm{c}}<\mathrm{Q}$
d) $(0.1)^{2} /(0 .)^{2}(0.1)=10 K_{c}=Q$
e) $(10)^{2} /(2.0)^{2}(.10)=25,000 \mathrm{~K}_{\mathrm{c}}<\mathrm{Q}$
41. C reordered answers \& moved correct 1.3 to C
ans: a correct; $\mathrm{K}_{\mathrm{p}}=1 / P_{\mathrm{CO}} 1 / 0.75=0.13$
b) $0.75 / 2=0.38$
c) $\mathrm{K}_{\mathrm{p}}=\mathrm{P}_{\mathrm{CO} 2}$
d) at equilibrium so $\mathrm{P}_{\mathrm{coz}}$ must equal 1
e) thinks you need solid amounts
42. $B$
43. $B$
44. C
45. E
ans: $\mathbf{E}$ the anions of weak acids are basic and will increase in solubility in acids
46. B
a) the $\mathrm{CO} 2(\mathrm{~g})$ produced dissolves in the water in the beaker, thus the total volume of gas in the beaker is reduced, so the water takes its place
ans: $\mathbf{b} \mathrm{C}_{25} \mathrm{H}_{52}(\mathrm{~s})+38 \mathrm{O}_{2}(\mathrm{~g}) \rightarrow 25 \mathrm{CO}_{2}(\mathrm{~g})+26 \mathrm{H}_{2} \mathrm{O}(\mathrm{g})$
as shown by the equation for every $38 \mathrm{O}_{2}(\mathrm{~g})$ reacted a total of 51 moles of gas is produced so the pressure is increased until the $\mathrm{CO}_{2}(\mathrm{~g})$ dissolves in the water and the $\mathrm{H}_{2} \mathrm{O}(\mathrm{g})$ condenses
47. D
ans: $\mathbf{d ~} \mathrm{BrF}_{3}$ is T -shaped so $90^{\circ}, \mathrm{NF}_{3}$ is trigonal pyramidal so $107^{\circ}, \mathrm{CF}_{4}$ is tetrahedral so $109.5^{0}$
48. B
49. A
50. A
51. C
52. A
53. E

## MATCHING

54. E
55. C
56. B
57. A
58. E
59. D
60. B
61. A
62. B
