Chemistry 3202

Pre-Public Examination

May 2012

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_

Section A: Multiple Choice

This section contains 40 multiple choice covering concepts from the entire course. Please answer all multiple choice items on the answer sheet provided. You have one (1) hour to complete this section. If required, an additional 10 minutes will be provided.

A Periodic table as well as a relevant data table has been provided.

Good Luck. Relax, a test is a celebration of your knowledge ☺

Selected Response

1. Which of the following is an example of a closed system?

A. Burning Match

B. Unopened can of soda

C. Human Body

D. Sink full of water

2. What is the temperature change for a 46 g piece of iron that absorbs 26.5 J of heat?

(cFe = 0.444 J/gOC)

A. 0.25 OC

B. 0.78 OC

C. 1.3 OC

D. 4.0 OC

3. What is defined as the heat required to increase the temperature of one gram of a substance by one degree Celsius?

A. heat capacity

B. molar enthalpy

C. potential energy

D. specific heat capacity

4. Which metal will undergo an endothermic change when added to 750 mL of water at 25°C?

A. 75 g of copper at 50°C

B. 100 g of gold at 35°C

C. 125 g of iron at 25°C

D. 150 g of silver at 0°C

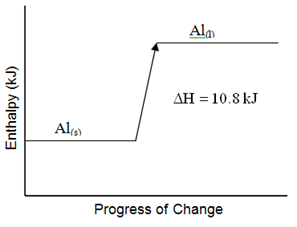
5. A disinfecting solution has a specific heat capacity 3.96 J/g°C. A 35.0 g sample of the solution undergoes a +1.4°C temperature change when a silver wristband is added to it. What is the heat change of the wristband?

A. **–**190 J

B. **–**6.3 J

C. +6.3 J

D. +190 J

6. Which interpretation of the enthalpy diagram to the right is correct?

|  |  |  |
| --- | --- | --- |
|  | **Type of Change** | **Classification** |
| A. | chemical | endothermic |
| B. | chemical | exothermic |
| C. | physical | endothermic |
| D. | physical | exothermic |

7. What is the heat change when 0.585 mol of benzene solidifies? 

A. **–**17.0 kJ

B. **–**5.80 kJ

C. +5.80 kJ

D. +17.0 kJ

8. Combustion of a 32 g chocolate bar caused a temperature increase of 36°C in a calorimeter with a heat capacity of 13.4 kJ/°C. What is the fuel value of the chocolate bar?

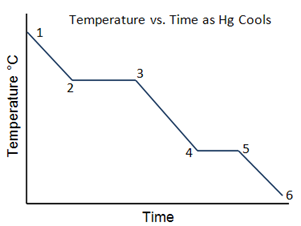
A. 1.1 kJ/g

B. 2.4 kJ/g

C. 15 kJ/g

D. 480 kJ/g

***Use the diagram to the right to complete the next two items.***



9. Between which points on the graph is liquid mercury cooling down?

A. 1 and 2

B. 2 and 3

C. 3 and 4

D. 4 and 5

10. Between which points on the graph does mercury vapor condense?

A. 1 and 2

B. 2 and 3

C. 3 and 4

D. 4 and 5

11. Which represents the highest energy position on an energy level diagram for any chemical reaction?

* 1. activated complex
  2. intermediate
  3. products
  4. reactants

12. Which is true for an exothermic reaction?

* 1. Ea(forward) + Ea(reverse) = 0
  2. Ea(forward) = Ea(reverse)
  3. Ea(forward) < Ea(reverse)
  4. Ea(forward) > Ea(reverse)

13. Consider the following reaction involving 1.0 g of powdered zinc and the data to the right.

|  |  |  |
| --- | --- | --- |
| Trial | Temperature (oC) | [HCl] (mol/L) |
| 1 | 30 | 3.0 |
| 2 | 20 | 1.0 |
| 3 | 30 | 1.0 |



What are the rates of reaction from slowest to fastest?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Slowest fastest | | |
| A. | 1 | 2 | 3 |
| B. | 1 | 3 | 2 |
| C. | 2 | 3 | 1 |
| D. | 3 | 2 | 1 |

14. Which unlabelled energy profile represents the faster exothermic reaction?

|  |  |  |  |
| --- | --- | --- | --- |
| A. |  | B. |  |
| C. |  | D. |  |

15. What is a reaction mechanism?

* 1. the kinetic energy gain required by reactants in order to become products
  2. the minimum intensity with which reacting particles must collide
  3. the series of steps by which reactants become products in a chemical change
  4. the way reacting particles adopt the correct orientation for collision

16. What is **not** a condition for the establishment and maintenance of a chemical equilibrium?

* 1. the chemical change must be reversible
  2. the concentrations of the reactants must be equal to the concentrations of the products
  3. the system must be closed - matter cannot enter or leave the reaction vessel
  4. the temperature and pressure of the system must be kept constant

17. Consider this system at equilibrium:



Which change will cause a shift of the equilibrium position to the right and an increase in the equilibrium constant?

* 1. adding hydrazine (N2H4) to the system
  2. decreasing pressure by increasing volume
  3. decreasing the temperature of the system
  4. removing nitrogen (N2) from the system

18. Which chemical system produces this equilibrium constant expression?



A. 2NO(g) + Br2(g) ⇌2NOBr(g)

B. 2NO(g) + Br2(l) ⇌2NOBr(g)

C. 2NOBr(g) ⇌2NO(g) + Br2(g)

D. 2NOBr(g) ⇌2NO(g) + Br2(l)

19. The system below is in a 1.0 L flask. The equilibrium amounts were found to be 2.4 mol of C, 1.6 mol of H2O, 0.80 mol of CO, and 1.2 mol of H2. What is the value of Keq?

C(s) + H2O(g) ⇌ CO(g) + H2(g)

* 1. 0.25
  2. 0.60
  3. 1.7
  4. 4.0

20. Which is true for this system at this temperature?

N2(g) + O2(g) ⇌ 2NO(g) K = 4.2 x 10-8

* 1. [NO] = 0
  2. [NO] = [N2] = [O2]
  3. [NO] is greater than [N2] and [O2]
  4. [NO] is less than [N2] and [O2]

21. Which substance will cause red litmus to change to blue?

* 1. H2SO4(aq)
  2. H3O+(aq)
  3. NH3(aq)
  4. NH4+(aq)

22. Which species behave as Brønsted bases in this system?

HCO3-(aq) + HSO4-(aq) ⇌ SO42-(aq) + H2CO3(aq)

* + 1.  and 
    2.  and 
    3.  and 
    4.  and 

23. Which species is **not** amphoteric?

* 1. 
  2. 
  3. 
  4. 

24. Which acid is weakest?

A. HBr(aq)

B. HF(aq)

C. H2SO3 (aq)

D. H2SO4(aq)

25. Which expression represents the base ionization constant for an aqueous solution of sodium acetate, NaCH3COO?

|  |  |  |  |
| --- | --- | --- | --- |
| A. |  | C. |  |
| B. |  | D. |  |

26. Which molecular acid has the lowest conductivity?

|  |  |  |
| --- | --- | --- |
|  | [Acid] | Ka |
| A. | 0.5 mol/L | 1.0 × 10 3 |
| B. | 1.0 mol/L | 1.0 × 10 5 |
| C. | 1.5 mol/L | 1.0 × 10 -4 |
| D. | 2.0 mol/L | 1.0 ×10 -7 |

27. What is the hydroxide ion concentration in a mol/L HCl solution?

A. mol/L

B. mol/L

C. mol/L

D. mol/L

28. Which pH represents a solution that is 10,000 times more acidic than M HNO3?

A. 1.00

B. 5.00

C. 9.00

D. 10.00

29. A solution was tested with three indicators to give the results shown. What is the

approximate pH of the solution?

Indicator Final Colour

bromocresol green blue

indigo carmine blue

thymolphthalein blue

A. 5.00

B. 9.00

C. 10.8

D. 11.6

30. Which term represents the point in a titration where neither the sample nor the titrant is in excess?

* 1. buffering capacity
  2. endpoint
  3. equilibrium
  4. equivalence point

31. Which titration would result in the highest pH at the equivalence point?

* 1. CH3COOH titrated with NaOH
  2. HCl titrated with KOH
  3. NH3 titrated with HCl
  4. NaOH titrated with HCl

32. Titration data is collected using 10.00 mL samples of an unknown acid with a 0.1040 mol/L standard solution of NaOH(aq). What volume of titrant would be used in the calculation of the concentration of the unknown acid?

|  |  |  |  |
| --- | --- | --- | --- |
| Burette | Trial 1 | Trial 2 | Trial 3 |
| Final (mL) | 16.90 | 32.02 | 47.18 |
| Initial (mL) | 1.35 | 16.90 | 32.02 |
| Volume of NaOH | 15.55 | 15.12 | 15.16 |

* 1. 10.00 mL
  2. 15.14 mL
  3. 15.16 mL
  4. 15.28 mL

33. Which defines reduction?

* 1. gain of protons
  2. gain of electrons
  3. loss of protons
  4. loss of electrons

34. Which *correctly* shows the oxidation of Cu+ ?

1. 
2. 
3. 
4. 

35. What is reduced and what is the reducing agent in this redox reaction?



|  |  |
| --- | --- |
| **Species Reduced** | **Reducing Agent** |
| A. Ag+ | Fe |
| B. Ag+ | Ag |
| C. Fe | Ag+ |
| D. Fe | Fe3+ |

36. What is the oxidation number of phosphorus, P, in Na3PO4?

* 1. –3
  2. –1
  3. +4
  4. +5

37. What coefficients balance this net ionic equation?



1. 1, 1, 1, 1
2. 2, 3, 2, 3
3. 3, 1, 1, 2
4. 3, 2, 3, 2

38. Which will spontaneously reduce?

1. 
2. 
3. 
4. 

39. What would be the minimum voltage that would have to be applied to recharge this cell?

Sn(s) / Sn2+(aq) //Fe2+(aq) / Fe(s)

1. > 0.31 V
2. > 0.59 V
3. > 0.63 V
4. > 0.91 V

40. How many moles of copper can be plated on a bracelet if 1500.0 C is passed through an electroplating cell containing Cu(NO3)2(aq)?

1. 0.0051813 mol
2. 0.0077720 mol
3. 0.015544 mol
4. 0.031088 mol

Response Sheet

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |

Part B: Constructed Response. Show all workings and use appropriate significant digits to receive full credit. 40 marks.

41. 1.88 g of benzoic acid, C6H5COOH(s) (∆Hcomb = -3225 kJ/mol), is burned in a bomb calorimeter. The temperature of the calorimeter and its contents increases from 20.77 oC to 25.14 oC. Calculate the heat capacity of the calorimeter. (4 marks)

42. a. Draw a heating curve for a 10.0g sample of Mercury as it is heated from -50 oC to 130 oC. (3 marks)

|  |  |
| --- | --- |
| Melting point of Hg | -39 oC |
| Boiling Point of Hg | 357 oC |
| ∆Hfusion Hg | 8.9 KJ/mol |

43. Calculate the enthalpy of reaction for this reaction: (3 marks)



given these thermochemical equations:



44. Ethanol decolourizes an acidified sodium dichromate solution.



a. Briefly describe **two (2) ways** to monitor the rate of this reaction. (2 marks)

b. Your lab partner suggests that the rate of the reaction can be increased by adding carbon dioxide to the reaction vessel. Is your partner's suggestion a valid one? Justify your response. (1 points)

45. A chemist proposes that these two reactions make up a reaction mechanism:



However, the order in which the two reactions occur is not certain. (That is, it is not sure if A is the first or the second step). A test reveals that  is a reaction intermediate.

a. What is a reaction intermediate? (1 mark)

b. Based on the information that is a reaction intermediate, which reaction will be step 1? Explain your choice. (1 mark)

c. Write the overall reaction equation.(1 mark)

46. A 5.0 L reaction vessel is filled with 4.0 mol of CO and 3.0 mol of H2. At equilibrium the concentration of H2 is 0.480 mol/L.

CO(g) + 2H2(g) ⇌ CH3OH(g)

a. Calculate the value of the equilibrium constant. (3 marks)

b. Are the products or reactants favored in this reaction? Explain Briefly (1 mark)

47. a. Determine the net ionic equation for the most likely acid-base reaction between potassium hydrogen sulfate, NaHSO4(aq) and sodium carbonate, Na2CO3(aq). Indicate the Acid, Base, Conjugate Acid and Conjugate Base. (2 marks)

b. This reaction is at equilibrium. Does the equilibrium favour the reactants or the products? Explain. (1 mark)

48. A solution of sodium phosphate, Na3PO4, was prepared by dissolving 8.20 g in enough water to produce 500.0 mL of solution. The pOH of the solution was 1.42. Calculate the *Kb* of phosphate ion, . (4 marks)

PO3-(aq) + H2O(aq) ⇌ HPO42-(aq) + OH-(aq)

49. A 10.00ml sample of Acetic Acid (CH3COOH) is titrated with 0.650Mol/L Sodium Hydroxide Solution. The results are shown below:

CH3COOH(aq) + NaOH(aq) 🡪 H2O(l) + NaCH3COO(aq)

|  |  |
| --- | --- |
| Trial 1 | 25.50ml |
| Trial 2 | 24.86ml |
| Trial 3 | 24.89 ml |
| Trial 4 | 24.83 ml |

a. Calculate the concentration of the Acetic Acid. (3 marks)

b. Would Methyl Red be a suitable indicator for this titration? Explain. (2 marks)

50. Balance the following reaction under basic conditions. (4 marks)

Cr(OH)3 + IO3- 🡪 CrO4- + I-

51. Calculate the time (in minutes) to plate 1.27 g of copper(II) ions onto a metal spoon by applying a current of 1.50 A. (4 marks) /3

