CHEM1109 Example Multiple Choice Questions

The following multiple choice questions are provided to *illustrate* the type of questions used in this section of the paper and to provide you with extra practice.

It is *not* a sample quiz. The questions in the paper will be in the style of these questions but may well cover different topics.

In the exam, the answer should be indicated by clearly circling the letter next to the choice you make **and** by filling in the corresponding box on the computer-marked sheet provided. The marks for each correct answer are given beside each question.

<u>Instructions for use of the computer sheet</u>. Draw a **thick** line through the **centre** and crossing both edges of each box selected, as in this example.

Use a **dark** lead pencil so that you can use an eraser if you make an error. Errors made in ink cannot be corrected – you will need to ask the examination supervisor for another sheet. Boxes with faint or incomplete lines or not completed in the prescribed manner may not be read. Be sure to complete the SID and name sections of the sheet.

Your answer as recorded on the sheet will be used in the event of any ambiguity.

There is only one correct choice for each question.

Negative marks will not be awarded for any question.

		Marks
1.	Which statement correctly describes Hess's Law? **A** The enthalpy of all reactants in their standard states is defined as zero. **B** Enthalpy changes may only be calculated if one or more of the reactants is an element. **C** The enthalpy change of a reaction is independent of the route taken. **D** The enthalpy change of a reaction may only be calculated at 1 atm pressure and 25 °C. **E** Exothermic reactions occur quickly, endothermic reactions occur slowly.	**1**
2.	Which one of the following statements best describes the standard enthalpy of formation of any element? **A** The value of $\Delta H°_f$(element) depends on temperature. **B** The value of $\Delta H°_f$(element) is zero only for elements in the solid state. **C** The value of $\Delta H°_f$(element) is zero for any element in the standard state. **D** The value of $\Delta H°_f$(element) is zero only at absolute zero temperature. **E** The value of $\Delta H°_f$(element) depends on $S°$ for that element.	**1**
3.	Under which circumstances would a reaction be non-spontaneous at all temperatures? **A** $\Delta H°$ negative and $\Delta S°$ positive **B** $\Delta H°$ negative and $\Delta S°$ negative **C** $\Delta H°$ positive and $\Delta S°$ negative **D** $\Delta H°$ positive and $\Delta S°$ positive **E** It is impossible to tell without calculating $\Delta G°$.	**1**
4.	In which direction will the following equilibrium shift if a solution of CH_3CO_2Na is added? $CH_3COOH(aq) \rightleftharpoons CH_3CO_2^-(aq) + H^+(aq)$ **A** shift to the right (more products) **B** shift to the left (more reactant) **C** no change **D** cannot be predicted	**1**
5.	In which of the following acid / base titrations, can we NOT determine the equivalence point in an accurate manner? **A** strong acid / strong base **B** strong acid / weak base **C** weak acid / strong base **D** weak acid / weak base	**1**

	Marks
6. What is the expression for K_a for the following reaction? $CH_3COOH(aq) \rightleftharpoons CH_3CO_2^-(aq) + H^+(aq)$ **A** $K_a = [CH_3CO_2^-(aq)][H^+(aq)]/[CH_3COOH(aq)]$ **B** $K_a = 2[H^+(aq)]/[CH_3COOH(aq)]$ **C** $K_a = [H^+(aq)]^2/[CH_3COOH(aq)]$ **D** $K_a = [CH_3COOH(aq)]/[H^+(aq)]^2$	**1**
7. Rank the following 1 M water solutions in order of decreasing freezing point. NaCl glucose $CaCl_2$ CH_3COOH Na_3PO_4 highest freezing point lowest freezing point **A** NaCl > glucose > $CaCl_2$ > CH_3COOH > Na_3PO_4 **B** glucose > NaCl > $CaCl_2$ > CH_3COOH > Na_3PO_4 **C** glucose > NaCl > CH_3COOH > $CaCl_2$ > Na_3PO_4 **D** glucose > NaCl > CH_3COOH > Na_3PO_4 > $CaCl_2$ **E** glucose > CH_3COOH > NaCl > $CaCl_2$ > Na_3PO_4	**1**
8. Arrange the following species from left to right in order of increasing radius. Na, Mg, F^-, Na^+, Mg^{2+} **A** $F^- < Mg^{2+} < Na^+ < Mg < Na$ **B** $Na^+ < Mg^{2+} < F^- < Mg < Na$ **C** $Na^+ < Mg^{2+} < F^- < Na < Mg$ **D** $Mg^{2+} < Na^+ < F^- < Mg < Na$ **E** $Mg^{2+} < Mg < Na^+ < Na < F^-$	**1**
9. What is the $[OH^-]$ of a solution with a pH of 9.0? **A** 1×10^{-5} M **B** 1×10^{-9} M **C** 1×10^{-4} M **D** 1×10^{-7} M **E** none of the above	**1**
10. Which of the following statements regarding the solubility of $Mg(OH)_2$ is correct? **A** pH has no effect on the solubility of $Mg(OH)_2$. **B** $Mg(OH)_2$ is less soluble at pH 4 than pH 7. **C** $Mg(OH)_2$ is less soluble in 0.1 M $MgCl_2$ solution than in water. **D** all of the above **E** none of the above	**1**

Marks

11. When cells are placed into an isotonic solution (*i.e.* the solution and cell fluid have the same osmotic pressure): **1**

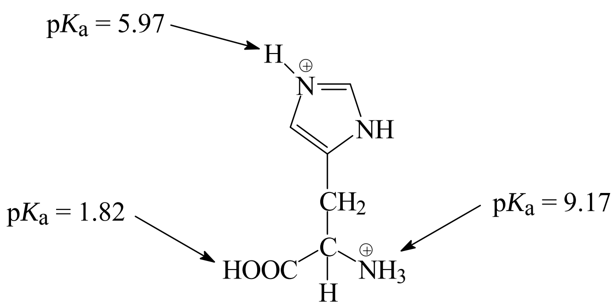
- **A** no exchange of water across the cell membrane occurs.
- **B** water enters the cell faster than it leaves the cell.
- **C** water leaves the cell faster than it enters the cell.
- **D** water enters the cell at the same rate that it leaves the cell.
- **E** ready exchange of solutes, but not water, occurs across the cell membrane.

12. What is the relationship between K_c and K_p for the following reaction? **1**

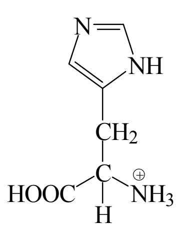
$$A(g) + B(g) \rightleftharpoons 2C(g)$$

- **A** $K_p = K_c(RT)^2$
- **B** $K_c = K_p(RT)^2$
- **C** $K_c = K_p$
- **D** $K_c = \sqrt{K_p}$
- **E** $K_c = K_pRT$

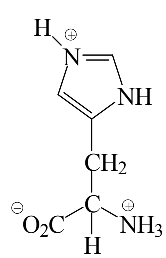
13. Histidine is an amino acid. The fully protonated form has the pK_a values indicated below. **2**



Which one of the following is the predominant structure at pH 7.6?



A



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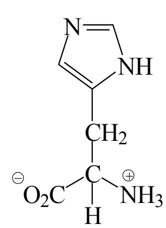

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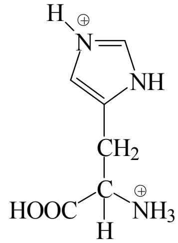

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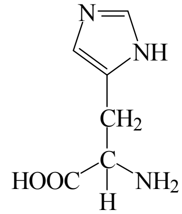


E

Marks

1

14. Arrange the following 1 M solutions in order of increasing pH.

HCl KOH $CaCl_2$ CH_3COOH Na_3PO_4

A $KOH < CaCl_2 < Na_3PO_4 < CH_3COOH < HCl$

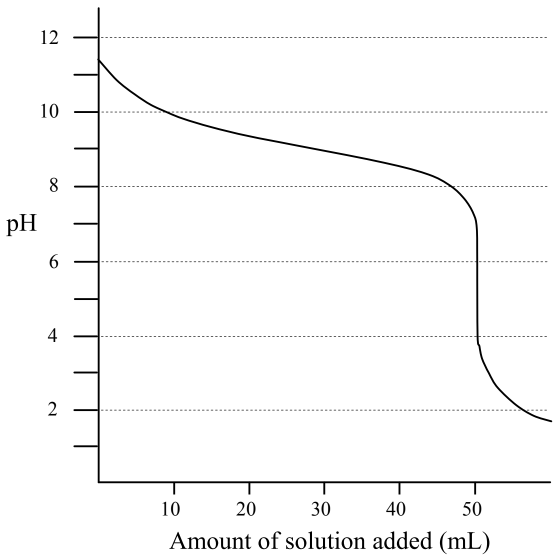
B $HCl < CaCl_2 < CH_3COOH < KOH < Na_3PO_4$

C $CH_3COOH < HCl < CaCl_2 < KOH < Na_3PO_4$

D $HCl < CH_3COOH < Na_3PO_4 < CaCl_2 < KOH$

E $HCl < CH_3COOH < CaCl_2 < Na_3PO_4 < KOH$

In answering questions 15-19, consider the following titration curve.



1

15. Which one of the following combinations does the titration curve represent?

A Addition of a strong base to a weak acid

B Addition of a weak base to a strong acid

C Addition of a strong acid to a weak base

D Addition of a weak acid to a strong base

E Addition of a strong acid to a strong base

1

16. What is the value of the pK_a that can be obtained from this titration curve?

A 11.3 **B** 10.0 **C** 9.3 **D** 5.3 **E** 1.8

1

17. What is the pH of the solution at the point of maximum buffering?

A 11.3 **B** 10.0 **C** 9.3 **D** 5.3 **E** 1.8

1

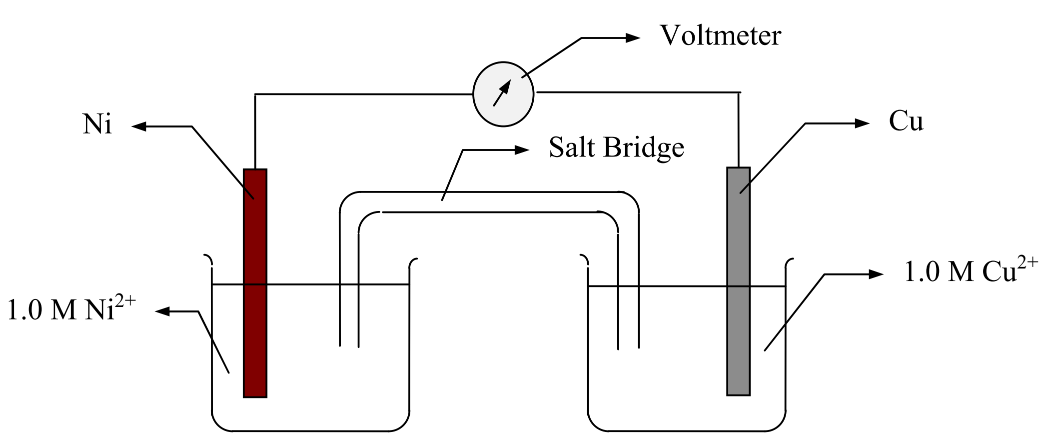
18. What is the pH of the solution at the equivalence point?

A 11.3 **B** 10.0 **C** 9.3 **D** 5.3 **E** 1.8

		Marks
19.	Which one of the following indicators would be most suitable for this titration? **A** any acid/base indicator is suitable **B** phenolphthalein (pK_a = 9.6) **C** cresol red (pK_a = 8.3) **D** methyl red (pK_a = 5.1) **E** methyl yellow (pK_a = 3.1)	**1**
20.	How many stereoisomers are possible for the complex $[NiCl_2(en)_2]$? en = ethylenediamine = $NH_2CH_2CH_2NH_2$ **A** 1 **B** 2 **C** 3 **D** 4 **E** 6	**1**
21.	How many stereoisomers are possible for the complex $[Ni(en)_3]^{2+}$? en = ethylenediamine = $NH_2CH_2CH_2NH_2$ **A** 1 **B** 2 **C** 3 **D** 4 **E** 6	**1**
22.	What is the solubility constant expression for $Zn_3(PO_4)_2$? **A** $K_{sp} = [Zn^{2+}][PO_4^{3-}]$ **B** $K_{sp} = [Zn^{2+}][2PO_4^{3-}]$ **C** $K_{sp} = [Zn^{2+}]^3[PO_4^{3-}]^2$ **D** $K_{sp} = [3Zn^{2+}]^3[2PO_4^{3-}]^2$ **E** $K_{sp} = [Zn^{3+}]^2[PO_4^{2-}]^3$	**1**
23.	What is the solubility product constant expression for Ag_3PO_4? **A** $K_{sp} = [Ag^+][PO_4^{3-}]$ **B** $K_{sp} = [Ag^+][PO_4^{3-}]^3$ **C** $K_{sp} = [Ag^+]^3[PO_4^{3-}]$ **D** $K_{sp} = [3Ag^+]^3[PO_4^{3-}]$ **E** $K_{sp} = 3[Ag^+][PO_4^{3-}]$	**1**

	Marks
24. How would the concentration of Pb^{2+}(aq) ions in equilibrium with PbI_2(s) be affected if the concentration of I^-(aq) ions were doubled? **A** no change **B** increased by a factor of 2 **C** decreased by a factor of 2 **D** decreased by a factor of 4 **E** decreased by a factor of 16	**1**
25. Which one of the following is a coordination isomer of the complex salt, *trans*-$[CrCl_2(OH_2)_4]Br$? **A** *cis*-$[CrCl_2(OH_2)_4]Br$ **B** *trans*-$[CrBrCl(OH_2)_4]Cl$ **C** *trans*-$[Cr\ Br_2\ (OH_2)_4]Cl$ **D** *trans*-$[CrBr_2(OH_2)_4]Cl$ **E** *trans*-$[Cr(OH_2)_4Cl_2]Br$	**1**
26. Which one of the following equations describes the enthalpy of combustion of glucose. **A** $C_6H_{12}O_6(s) \rightarrow 6C(s) + 6H_2O(l)$ **B** $C_6H_{12}O_6(s) \rightarrow 2C_2H_5OH(l) + 2CO_2(g)$ **C** $C_6H_{12}O_6(s) \rightarrow 6C(s) + 3O_2(g) + 6H_2(g)$ **D** $C_6H_{12}O_6(s) + 3O_2(g) \rightarrow 6CO_2(g) + 6H_2(g)$ **E** $C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g)$	**1**

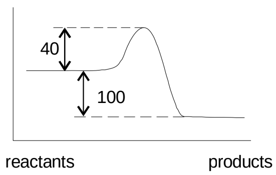
Questions 27 - 30 refer to the voltaic cell shown below.

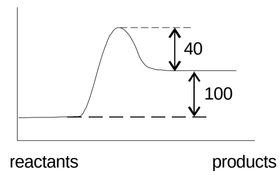


	Marks
27. What is the overall reaction occurring in this cell? **A** There will be no spontaneous reaction. **B** $Ni^{2+}(aq) + Cu(s) \rightarrow Ni(s) + Cu^{2+}(aq)$ **C** $Cu^{2+}(aq) + Ni(s) \rightarrow Cu(s) + Ni^{2+}(aq)$ **D** $Cu^{2+}(aq) + Ni^{2+}(aq) + 4e^{-} \rightarrow Cu(s) + Ni(s)$ **E** $Cu(s) + Ni(s) \rightarrow Cu^{2+}(aq) + Ni^{2+}(aq) + 4e^{-}$	**1**
28. What would be the value of E_{cell} at equilibrium? **A** 0.58 V **B** 0.34 V **C** 0.24 V **D** 0.10 V **E** 0.00 V	**1**
29. What is the reading on the voltmeter when the half cells are first connected? **A** 0.58 V **B** 0.34 V **C** 0.24 V **D** 0.10 V **E** 0.00 V	**1**
30. Which electrode is the anode and to which electrode do the electrons flow? **A** The Ni electrode is the anode; electrons flow to the cathode. **B** The Cu electrode is the anode; electrons flow to the cathode. **C** The Ni electrode is the anode; electrons flow to the anode. **D** The Cu electrode is the anode; electrons flow to the anode	**1**
31. Rank the following series of atoms in order of INCREASING electronegativity. N O F P As **A** N < O < F < P < As **B** F < O < N < P < As **C** As < P < N < O < F **D** As < P < N < F < O **E** F < N < O < As < P	**1**

Marks

32. A reaction has an activation energy of 40 kJ mol^{-1} and an overall energy change of –100 kJ mol^{-1}. In each of the potential energy diagrams shown below, the horizontal axis is the reaction coordinate and the vertical axis is potential energy in kJ mol^{-1}. Which potential energy diagram best describes this reaction? **1**

A


B


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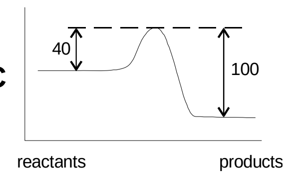

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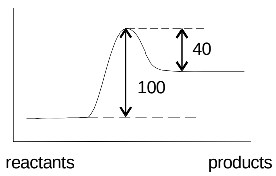
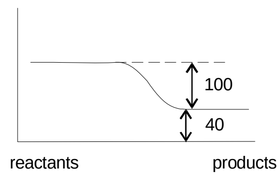


E


33. What is the missing particle for the following nuclear decay process? **1**

$$^{137}_{55}\text{Cs} \rightarrow \ ^{137}_{56}\text{Ba} + ?$$

A $^{1}_{0}n$

B $^{0}_{1}\alpha$

C $^{0}_{-1}\alpha$

D $^{0}_{-1}\beta$

E $^{0}_{1}\beta$

34. What isotope is produced by the α-decay of $^{222}_{86}\text{Rn}$? **1**

A $^{222}_{85}\text{At}$

B $^{218}_{84}\text{Po}$

C $^{218}_{88}\text{Rn}$

D $^{222}_{87}\text{Fr}$

E $^{221}_{85}\text{At}$

35. Which one of the following statements about reaction rate is false? **1**

A Reaction rate is the speed at which the reaction proceeds.

B Reaction rate is governed by the energy barrier between reactants and products.

C Enzymes can accelerate the rate of a reaction.

D Reaction rates are not sensitive to temperature.

		Marks
36.	What isotope is produced by the α-decay of ${}^{99}_{43}Tc$? **A** None - ${}^{99}_{43}Tc$ undergoes β^- decay **B** ${}^{99}_{42}Mo$ **C** ${}^{95}_{41}Nb$ **D** ${}^{99}_{44}Ru$ **E** ${}^{103}_{45}Rh$	1
37.	What is the oxidation state of Rh in the complex $K_3[Rh(CN)_6]$? **A** +I **B** +III **C** +VI **D** 0 **E** –III	1
38.	What is the oxidation state of Tc in $K_2[TcO(ox)_2]$? ox is the oxalate anion, $C_2O_4^{2-}$. **A** +II **B** +III **C** +IV **D** +V **E** +VI	1
39.	A solid pharmaceutical dispersed in a carrier gas is an example of which one of the following? **A** a gel **B** a foam **C** an emulsion **D** an aerosol	1
40.	How many isomers are possible for the square planar complex $[PtI_2(NH_3)_2]$? **A** 1 **B** 2 **C** 3 **D** 4 **E** 5	1

Answers

Question	1	2	3	4	5	6	7	8	9	10
Answer	C	C	C	B	D	A	E	D	A	C

Question	11	12	13	14	15	16	17	18	19	20
Answer	D	C	C	E	C	C	C	D	D	C

Question	21	22	23	24	25	26	27	28	29	30
Answer	B	C	C	D	B	E	C	E	A	A

Question	31	32	33	34	35	36	37	38	39	40
Answer	C	A	D	B	D	A	B	C	D	B