

CHEM1405 - CHEMISTRY (VETERINARY SCIENCE)FIRST SEMESTER EXAMINATION**CONFIDENTIAL****JUNE 2003****TIME ALLOWED: THREE HOURS**

GIVE THE FOLLOWING INFORMATION IN BLOCK LETTERS

FAMILY NAME		SID NUMBER	
OTHER NAMES		TABLE NUMBER	

INSTRUCTIONS TO CANDIDATES

- All questions are to be attempted. There are 19 pages of examinable material.
- Complete the examination paper in **INK**.
- Read each question carefully. Report the appropriate answer and show all relevant working in the space provided.
- The total score for this paper is 100. The possible score per page is shown in the adjacent tables.
- Each new short answer question begins with a •.
- Electronic calculators, including programmable calculators, may be used. Students are warned, however, that credit may not be given, even for a correct answer, where there is insufficient evidence of the working required to obtain the solution. Logarithms may also be used.
- Numerical values required for any question as well as a Periodic Table are printed on a separate data sheet.
- Pages 10, 19, 21 & 24 are for rough work only.

OFFICIAL USE ONLY**Multiple choice section**

	Marks	
Pages	Max	Gained
2-15	49	

Short answer section

Page	Marks		Marker
	Max	Gained	
16	10		
17	6		
18	8		
20	10		
22	10		
23	7		
Total	51		
Check Total			

Marks
1

- Write a balanced equation for the dissolution of $\text{Ca}(\text{CH}_3\text{CO}_2)_2$ in water.

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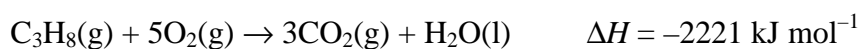
2

- Complete the following table.

Formula	Systematic Name
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$	
	ammonium chloride
Li_2SO_4	
	calcium hydrogencarbonate

3

- What quantity of heat is released when 15.2 g of propane (C_3H_8) is burnt according to the following equation?



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Answer:

2

- Illustrate by means of a diagram what is meant by the term "micelle".

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2

- Draw the Lewis structure for sulfur dichloride, SCl_2 .

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- The table below gives the concentrations of C_2H_4O as a function of time at 690 K for the following reaction:



$[C_2H_4O]$ (M)	time (mins)
0.0860	0
0.0465	50
0.0355	72
0.0274	93
0.0174	130

The reaction is first order with respect to C_2H_4O .

Use the above data to determine the rate constant and the half-life of the reaction.

Marks
4

$k =$	$t_{1/2} =$
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How long does it take for 75% of the C_2H_4O to react?

Answer:

- Calculate the osmotic pressure of a 0.25 M aqueous solution of sucrose, $C_{12}H_{22}O_{11}$, at 37 °C

2

Answer:

Marks
3

- Calcium oxalate is only slightly soluble in water (5.73 mg L^{-1} at $25 \text{ }^\circ\text{C}$) and can be deposited as “kidney stones”. Calculate the solubility product constant, K_{so} , of calcium oxalate at $25 \text{ }^\circ\text{C}$. The formula of the oxalate ion is $\text{C}_2\text{O}_4^{2-}$.

Answer:

3

- Ascorbic acid (Vitamin C) is a monoprotic acid of formula $\text{C}_6\text{H}_8\text{O}_6$. Calculate the pH of a 0.10 M solution of ascorbic acid, given the K_{a} of ascorbic acid is $8.0 \times 10^{-5} \text{ M}$.

Answer:

2

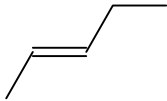
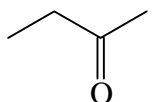
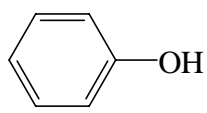
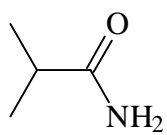
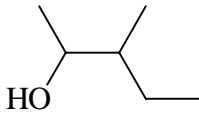
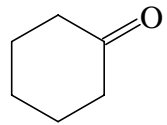
- Write equations to show what happens to a buffer solution containing equimolar amounts of $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{COOK}$ when:
(a) H_3O^+ is added, (b) OH^- is added.

(a)

(b)

Marks
10

- Complete the following table.

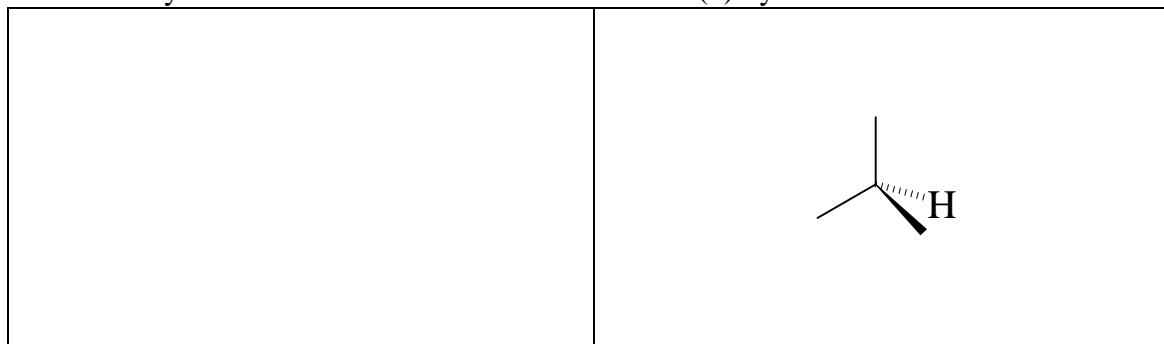
STARTING MATERIAL	REAGENT/CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
 Name:	excess Br ₂ CCl ₄ solvent	
 Name:	1. LiAlH ₄ 2. dilute HCl	
 Name:	dilute NaOH	
 Name:	6 M NaOH heat	
 Name:	Na ₂ Cr ₂ O ₇ in dilute sulfuric acid	
 Name:	excess CH ₃ CH ₂ OH conc. H ₂ SO ₄ catalyst heat	

**Marks
10**

- The amino acid cysteine (Cys, sidechain R= -CH₂SH) is one of the twenty common amino acids found in proteins.

Draw a Fischer projection of L-cysteine as the zwitterion.

Complete the structure of (S)-cysteine as the zwitterion.



Give the constitutional formulas of the products formed when a solution of L-cysteine is treated with each of the following reagents.

Cold dilute HCl solution	Cold dilute NaOH solution	A solution of iodine

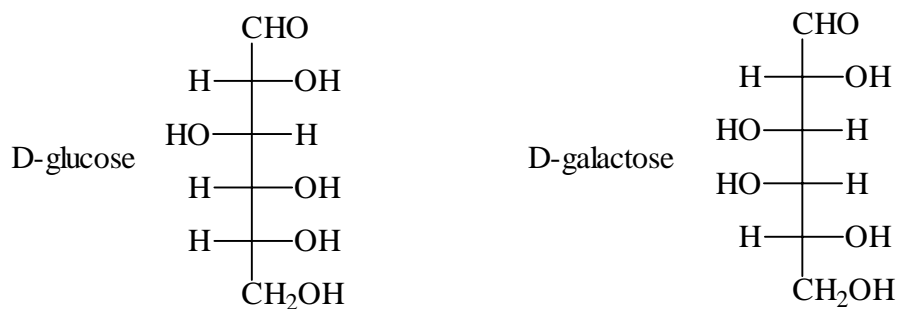
The pK_a values of cysteine are 1.96, 8.18 and 10.28. Draw Fischer projections of the major species present in a water solution of cysteine at pH 8.2 and 13.0.

pH 8.2	pH 13.0

Give the constitutional formula of the dipeptide Cys-Cys.

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- The open chain forms of D-glucose and D-galactose are shown below .



Marks
5

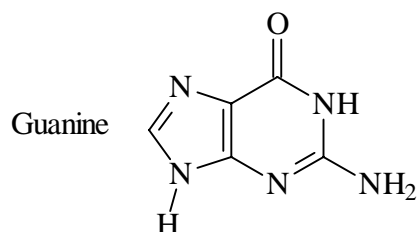
D-glucose is in equilibrium with two cyclic pyranose forms **P** and **Q**. Give the structures of **P** and **Q**.

P	Q
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Give the product(s) formed when a solution of D-galactose is treated with $[\text{Ag}(\text{NH}_3)_2]^+$ / dilute NaOH.

Give an example of a non-reducing disaccharide formed from glucose and galactose.

- Guanine is one of the four nucleic bases present in DNA. Give the structure of a tautomer of guanine.



2

The University of Sydney

CHEM1405 - CHEMISTRY (VETERINARY SCIENCE)

FIRST SEMESTER EXAMINATION

JUNE 2003

Numerical Data

Physical constants

$$\text{Planck constant} = h = 6.626 \times 10^{-34} \text{ J s}$$

$$\text{Speed of light in vacuum} = c_0 = 2.998 \times 10^8 \text{ m s}^{-1}$$

$$\text{Avogadro constant} = N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$\text{Faraday constant} = F = 96485 \text{ C mol}^{-1}$$

$$\begin{aligned} \text{Ideal gas constant} = R &= 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \\ &= 0.08206 \text{ L atm K}^{-1} \text{ mol}^{-1} \end{aligned}$$

$$\text{Volume of 1 mol of ideal gas at 1 atm, } 0^\circ\text{C} = 22.4 \text{ L}$$

$$\text{Volume of 1 mol of ideal gas at 1 atm, } 25^\circ\text{C} = 24.5 \text{ L}$$

Conversion factors

$$0^\circ\text{C} = 273 \text{ K}$$

$$1 \text{ atm} = 101.3 \text{ kPa} = 760.0 \text{ mmHg}$$

$$1 \text{ nm} = 10^{-9} \text{ m}$$

$$1 \text{ MHz} = 10^6 \text{ Hz} = 10^6 \text{ s}^{-1}$$

$$1 \text{ L} = 10^{-3} \text{ m}^3$$

Useful equations

$$\pi = iMRT$$

$$\text{pH} = -\log[\text{H}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pH} + \text{pOH} = 14.00$$

$$\text{Henderson-Hasselbalch equation: } \text{pH} = \text{p}K_a + \log\left(\frac{[\text{conj base}]}{[\text{conj acid}]}\right)$$

$$\text{For first order integrated rate law: } \ln[\text{A}]_0 - \ln[\text{A}]_t = kt$$

$$t_{1/2} = \ln 2 / k$$

**A periodic table is printed on the other side of this data sheet.
Atomic weights are included in the periodic table.**

PERIODIC TABLE OF THE ELEMENTS

June 2003

CHEM1405

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
	1 HYDROGEN H 1.008																	2 HELIUM He 4.003	
	3 LITHIUM Li 6.941	4 BERYLLIUM Be 9.012											5 BORON B 10.81	6 CARBON C 12.01	7 NITROGEN N 14.01	8 OXYGEN O 16.00	9 FLUORINE F 19.00	10 NEON Ne 20.18	
	11 SODIUM Na 22.99	12 MAGNESIUM Mg 24.31											13 ALUMINIUM Al 26.98	14 SILICON Si 28.09	15 PHOSPHORUS P 30.97	16 SULFUR S 32.07	17 CHLORINE Cl 35.45	18 ARGON Ar 39.95	
	19 POTASSIUM K 39.10	20 CALCIUM Ca 40.08	21 SCANDIUM Sc 44.96	22 TITANIUM Ti 47.88	23 VANADIUM V 50.94	24 CHROMIUM Cr 52.00	25 MANGANESE Mn 54.94	26 IRON Fe 55.85	27 COBALT Co 58.93	28 NICKEL Ni 58.69	29 COPPER Cu 63.55	30 ZINC Zn 65.39	31 GALLIUM Ga 69.72	32 GERMANIUM Ge 72.59	33 ARSENIC As 74.92	34 SELENIUM Se 78.96	35 BROMINE Br 79.90	36 KRYPTON Kr 83.80	
	37 RUBIDIUM Rb 85.47	38 STRONTIUM Sr 87.62	39 YTRIUM Y 88.91	40 ZIRCONIUM Zr 91.22	41 NIObIUM Nb 92.91	42 MOLYBDENUM Mo 95.94	43 TECHNETIUM Tc [98.91]	44 RUTHENIUM Ru 101.07	45 RHODIUM Rh 102.91	46 PALLADIUM Pd 106.4	47 SILVER Ag 107.87	48 CADMIUM Cd 112.40	49 INDIUM In 114.82	50 TIN Sn 118.69	51 ANTIMONY Sb 121.75	52 TELLURIUM Te 127.60	53 IODINE I 126.90	54 XENON Xe 131.30	
	55 CAESIUM Cs 132.91	56 BARIUM Ba 137.34	57-71	72 HAFNIUM Hf 178.49	73 TANTALUM Ta 180.95	74 TUNGSTEN W 183.85	75 RHENIUM Re 186.2	76 OSMIUM Os 190.2	77 IRIDIUM Ir 192.22	78 PLATINUM Pt 195.09	79 GOLD Au 196.97	80 MERCURY Hg 200.59	81 THALLIUM Tl 204.37	82 LEAD Pb 207.2	83 BISMUTH Bi 208.98	84 POLONIUM Po [210.0]	85 ASTATINE At [210.0]	86 RADON Rn [222.0]	
	87 FRANCIUM Fr [223.0]	88 RADIUM Ra [226.0]	89-103	104 RUTHERFORDIUM Rf [261]	105 DUBNIUM Db [262]	106 SEABORGIUM Sg [266]	107 BOHRIUM Bh [262]	108 HASSIUM Hs [265]	109 MEITNERIUM Mt [266]										

LANTHANIDES

	57 LANTHANUM La 138.91	58 CERIUM Ce 140.12	59 PRASEODYMIUM Pr 140.91	60 NEODYMIUM Nd 144.24	61 PROMETHIUM Pm [144.9]	62 SAMARIUM Sm 150.4	63 EUROPIUM Eu 151.96	64 GADOLINIUM Gd 157.25	65 TERBIUM Tb 158.93	66 DYSPROSIUM Dy 162.50	67 HOLMIUM Ho 164.93	68 ERBIUM Er 167.26	69 THULIUM Tm 168.93	70 YTTERBIUM Yb 173.04	71 LUTETIUM Lu 174.97
	89 ACTINIUM Ac [227.0]	90 THORIUM Th 232.04	91 PROTACTINIUM Pa [231.0]	92 URANIUM U 238.03	93 NEPTUNIUM Np [237.0]	94 PLUTONIUM Pu [239.1]	95 AMERICIUM Am [243.1]	96 CURIUM Cm [247.1]	97 BERKELIUM Bk [247.1]	98 CALIFORNIUM Cf [252.1]	99 EINSTEINIUM Es [252.1]	100 FERMIUM Fm [257.1]	101 MENDELEVIUM Md [256.1]	102 NOBELIUM No [259.1]	103 LAWRENCIUM Lr [260.1]

ACTINIDES

99/21(b)