99/21(a) # The University of Sydney

CHEM1405 **FIRST SEMESTER EXAMINATION**

FACULTY: VETERINARY SCIENCE

CONFIDENTIAL

JUNE 2002 **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 17 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 3, 7, 10, 19, 21 & 24 are for rough work only.

OFFICIAL USE ONLY

Multiple choice section

	Marks	
Pages	Max	Gained
2-15	51	

Short answer section

Page	Marks Max	Marks Gained		Marker
16	10			
17	6			
18	8			
20	7			
22	10			
23	8			
Total	49			
Check Total				

- Write a balanced equation for the dissolution of $Bi_2(SO_4)_3$ in water.

Marks **1**

- Complete the following table.

2

Formula	Systematic Name
$CuCl_2 \cdot 6H_2O$	
	ammonium bromide
$KMnO_4$	
	titanium(IV) oxide

- Iron is obtained from iron ore by reduction with carbon monoxide. The overall reaction is $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$. Calculate the standard enthalpy change for this reaction at 298 K.

3

Data: $\Delta H_f^\circ{}_{298}\ Fe_2O_3(s) = -825.5$ kJ mol^{-1} $\Delta H_f^\circ{}_{298}\ CO(g) = -110.5$ kJ mol^{-1}

$\Delta H_f^\circ{}_{298}\ CO_2(g) = -393.5$ kJ mol^{-1}

$\Delta H^\circ{}_{298} =$

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

2

- Draw the Lewis structure for antimony trichloride, $SbCl_3$.

2

Marks 6

- The hydrolysis of sucrose can be represented by the following overall reaction.

$$\underset{\text{(sucrose)}}{C_{12}H_{22}O_{11}(aq)} + H_2O(l) \rightarrow \underset{\text{(glucose)}}{C_6H_{12}O_6(aq)} + \underset{\text{(fructose)}}{C_6H_{12}O_6(aq)}$$

A nutritional biochemist studied the kinetics of the process and obtained the following data.

sucrose (M)	time (hours)
0.501	0
0.451	0.50
0.404	1.00
0.363	1.50
0.267	3.00

The reaction is first order with respect to sucrose.

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

k =	$t_{½}$ =

How long does it take to hydrolyse 75% of the sucrose?

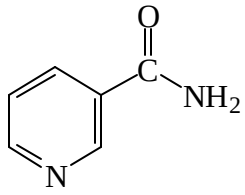
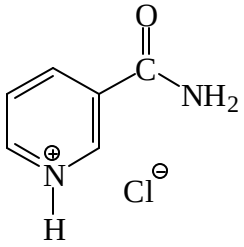
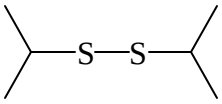
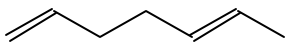
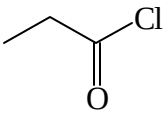
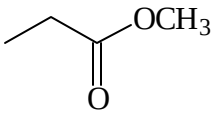
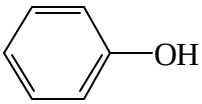
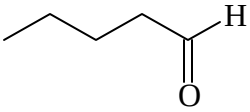
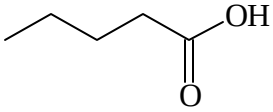
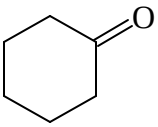
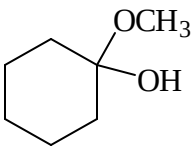
	Answer:

Other studies have shown that this reaction is actually second order, but appears to follow first order kinetics. (Such a reaction is termed a pseudo first order reaction.) Suggest a reason for this apparent first order behaviour.

	Marks
• Calcium oxalate is only slightly soluble in water (5.73 mg L^{-1} at 25 °C) and can be deposited as "kidney stones". Calculate the solubility product constant, K_{so}, of calcium oxalate at 25 °C. The formula of the oxalate ion is $C_2O_4^{2-}$.	3
Answer:	
• Phenylacetic acid ($C_6H_5CH_2COOH$) builds up in the blood of persons with phenyl-ketonuria, an inherited disorder that, if untreated, causes mental retardation or death. A study of the acid shows that a 0.12 M solution of phenylacetic acid has a pH of 2.6. What is the K_a of phenylacetic acid?	5
Answer:	
Write equations to show what happens to a buffer solution containing equimolar amounts of $C_6H_5CH_2COOH$ and $C_6H_5CH_2COOK$ when: (a) H_3O^+ is added, (b) OH^- is added.	
(a)	
(b)	

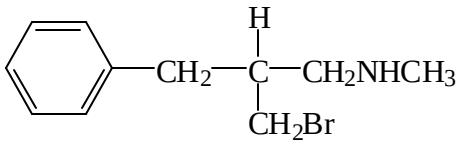
- Complete the following table.

Marks 7

STARTING MATERIAL	REAGENT/CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
		
	NADH	
	excess Br_2 CCl_4 solvent	
		
	dilute NaOH	
		
		

Marks

- Consider the molecule **P**. **3**

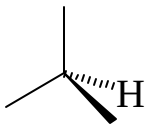


P

List the four groups at the stereogenic carbon centre in order of priority (highest to lowest).

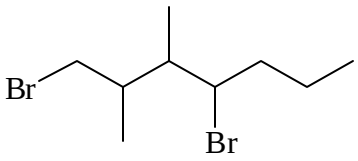
Highest priority			Lowest priority

Draw the (*R*)-enantiomer.



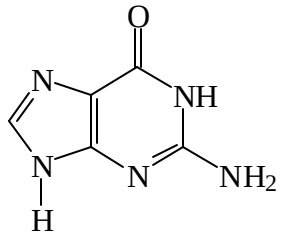
- Give the constitutional formula of (*E*)-4-bromo-2-pentene. **1½**

- Name the following compound. **1½**



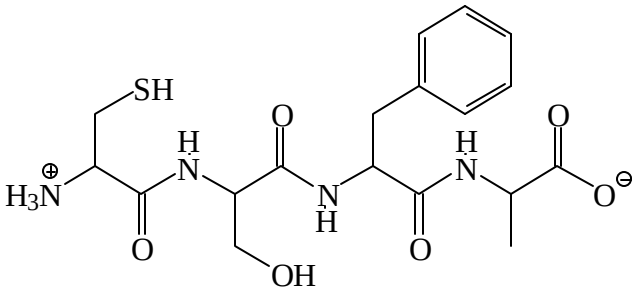
Name:

- The structure of the nucleic base guanine is shown below. Give the structures of two tautomers of guanine. **4**



Marks 8

- The constitutional formula of the tetrapeptide Cys-Ser-Phe-Ala is shown below as the zwitterion.



Give the product(s) obtained, in their correct ionic states, when Cys-Ser-Phe-Ala is heated in 5 M NaOH (ie., hydrolysis conditions).

Give the constitutional formula of the major product(s) present when cold dilute acid is added to a solution of Cys-Ser-Phe-Ala to give a pH of 0.5.

The pK_a values of the amino acid cysteine are 1.7 (α-COOH), 10.8 (α-NH_3^+) and 8.3 (sidechain). Give the Fischer projections of the two major forms of cysteine present at pH 8.3.

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CHEM1405 - Chemistry 1 (Veterinary Science)

FIRST SEMESTER EXAMINATION **JUNE 2002**

Numerical Data

Physical constants

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

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

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

Ideal gas constant = R = 8.314 J K^{-1} mol^{-1}

= 0.08206 L atm K^{-1} mol^{-1}

Conversion factors

1 nm = 10^{-9} m

1 kJ = 10^{3} J

1 mg = 10^{-3} g

1 atm = 101.3 kPa

1 L = 10^{-3} m^3

1 mL = 10^{-3} L

1 Hz = 1 s^{-1}

Useful equations

$\pi = iMRT$

$pH = -\log[H^+]$ $pOH = -\log[OH^-]$ $pH + pOH = 14$

Henderson-Hasselbalch equation: $pH = pK_a + \log([\text{conj base}]/[\text{acid}])$

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

$t_{½} = \ln 2 / k$

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

.../2

June 2002

CHEM1405

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PERIODIC TABLE OF THE ELEMENTS

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 YTTRIUM **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

ACTINIDES	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 BERKELLIUM **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]