89/07(a) # The University of Sydney

CHEM1612 - CHEMISTRY 1B (PHARMACY)

SECOND SEMESTER EXAMINATION

CONFIDENTIAL

NOVEMBER 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 13 pages of examinable material.
- Complete the written section of 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 table.
- Each new question of the short answer section 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.
- A Periodic Table and numerical values required for any question may be found on a separate data sheet.
- Pages 13 & 16 and part of the data sheet are for rough working only.

OFFICIAL USE ONLY

Multiple choice section

	Marks	
Page	Max	Gained
5-9	35	

Short answer section

Page	Marks Max	Marks Gained		Marker
2	8			
3	7			
4	6			
10	13			
11	4			
12	8			
14	10			
15	9			
Total	65			
Check Total				

- The visual range of the electromagnetic spectrum lies between about 450 and 700 nm. What frequency and energy range does the visual spectrum span? **Marks 3**

frequency range	
energy range	

- What is meant by the *electron density* at a particular point in space? **1**

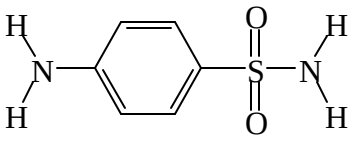
- Which of the following has the higher first ionisation energy? Give reasons for your answers. **2**

O or F	
O or S	

- Double and triple bonds are commonly observed between second row elements and are occasionally seen in compounds involving third row elements. They are not observed in bonds involving elements in the fourth or subsequent rows. Explain these observations. **2**

	Marks
• Carbon monoxide, CO, might be expected to be quite polar. Its measured dipole moment (0.12 Debye), however, is small. (CH_3OH, for example, has a dipole moment of 1.71 Debye.) Draw a Lewis structure for carbon monoxide and assign formal charges to the atoms.	**5**
Hence rationalise the small size of the dipole moment of carbon monoxide.	
• Predict which member of each pair of the following solutes is more soluble in water. Give reasons for your answer.	**2**
1-butanol ($CH_3CH_2CH_2CH_2OH$) or 1,4-butanediol ($HOCH_2CH_2CH_2CH_2OH$)	
chloroform ($CHCl_3$) or carbon tetrachloride (CCl_4)	

- Some of the earliest antibacterial agents belong to the family of benzenesulfonamide derivatives:



Marks

3

Complete the Lewis structure above by including all lone pair electrons.

What is the geometry about the S atom?	
What is the hybridisation of the two O atoms?	
Estimate the CCC bond angle in the ring.	
How many π electrons are there in this molecule?	

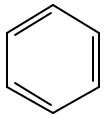
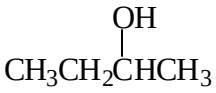
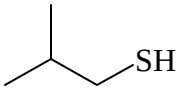
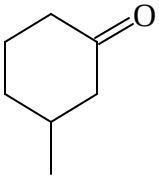
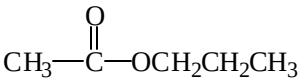
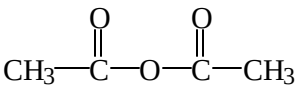
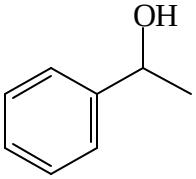
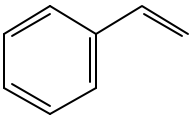
3

- The boiling points of H_2O, H_2S and H_2Te are 100 °C, –60 °C and –2 °C respectively. Nominate the dominant intermolecular force present between molecules in the liquid phase of each pure substance. Give reasons for your answer.

H_2O	
H_2S	
H_2Te	

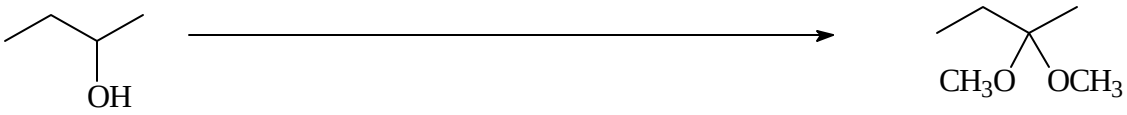
Marks 13

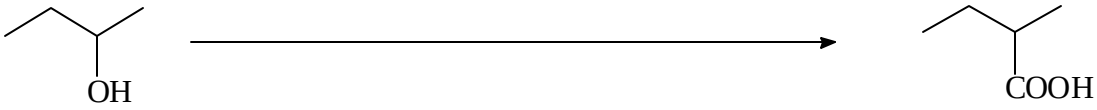
- Complete the following table. Make sure you also give the name of the product or starting material where requested.

STARTING MATERIAL	REAGENTS/CONDITIONS	CONSTITUTIONAL FORMULA(S) OF MAJOR ORGANIC PRODUCT(S)
	Cl_2 / $FeCl_3$	
CH_3CH_2CHO		 Name:
$CH_3CH=CHCH_3$	dilute H_2SO_4 / heat	
	1. NaOH 2. CH_3I	
 Name:	1. $LiAlH_4$ / dry ether 2. $H^{\oplus}$ / H_2O	
 Name:	$H^{\oplus}$ / H_2O / heat	
	excess $CH_3CH_2NH_2$	
		

- Show clearly the reagents you would use to carry out the following chemical conversions. Draw constitutional formulas for any intermediate compounds.
  NOTE: more than one step is necessary in each case.

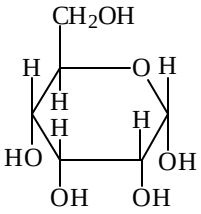
Marks
4



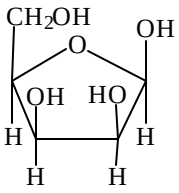


Marks 8

- Consider the following two monosaccharides **A** and **B**.



A: α-D-allopyranose



B: β-D-lyxofuranose

Draw Fischer projections of the open chain forms of **A** and **B**.

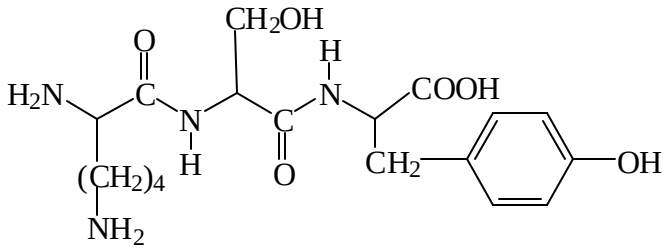
Give the products obtained when D-allose is treated with the following reagents.

$[Ag(NH_3)_2]^+$ / OH^- solution	$NaBH_4$ in methanol solvent

Draw the Haworth structure of a non-reducing disaccharide, which yields D-allose and D-lyxose on acid hydrolysis.

Marks 10

- Consider the tripeptide lysinylserinyltyrosine (Lys-Ser-Tyr), whose constitutional formula is shown below.



Draw the constitutional formula(s) of the product(s) obtained when the tripeptide is subjected to the following conditions.

cold 2 M NaOH

5 M HCl / heat

The pK_a values of lysine are pK_{a1} = 2.18 (α-COOH), pK_{a2} = 8.95 (α-$NH_3^{\oplus}$) and pK_{a3} = 10.53 (-$(CH_2)_4NH_3^{\oplus}$).

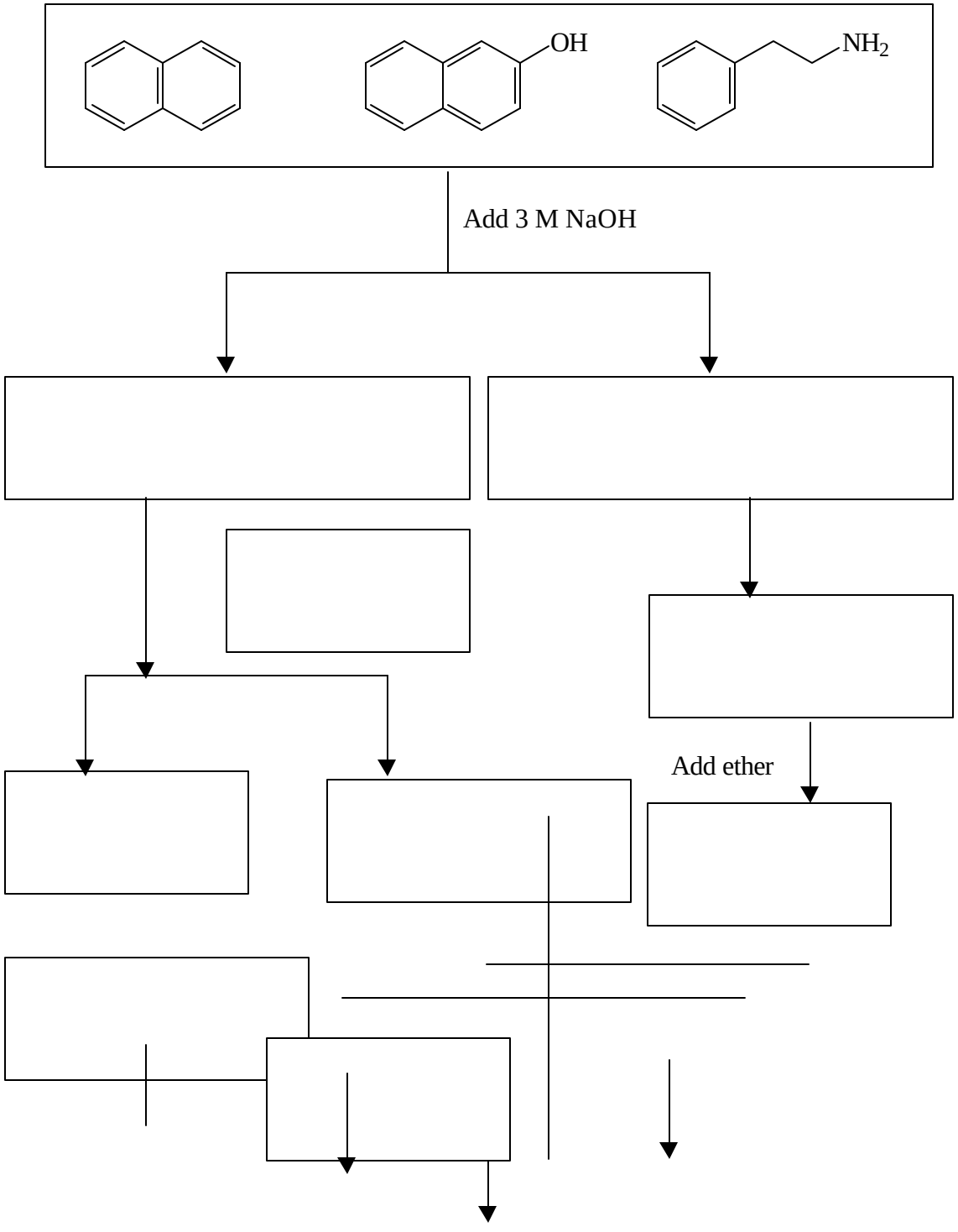
Draw the structure of the zwitterionic form of lysine.	At what pH will this be the predominant species in aqueous solution?

Give the constitutional formulas for these dipeptides in their zwitterionic states.

Tyr-Ser	Ser-Lys

Marks 9

- Organic compounds may be readily separated in the laboratory by extraction methods using acid-base chemistry. Complete the following flowsheet by showing the constitutional formulas of all species that will be present in the aqueous and organic phases and hence show how a mixture of naphthalene, 2-hydroxynaphthalene and 2-phenylethylamine could be separated.



NB To be fixed up!

89/07(b)

The University of Sydney

CHEM1612 - CHEMISTRY 1B (PHARMACY)

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Numerical Data

Physical constants

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

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

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

Conversion factors

1 kJ = 10^3 J

1 Hz = 1 s^{-1}

1 nm = 10^{-9} m

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

November 2002

CHEM1612 – CHEMISTRY 1B (Pharmacy)

89/07(b)

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]