22/10(a) # The University of Sydney

CHEM1902 - CHEMISTRY 1B (ADVANCED)

and

CHEM1904 - CHEMISTRY 1B (SPECIAL STUDIES PROGRAM)

SECOND SEMESTER EXAMINATION

CONFIDENTIAL

NOVEMBER 2001 **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 15 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 tables.
- 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. Logarithms may also be used.
- A Periodic Table and numerical values required for any question may be found on a separate data sheet.
- Pages 3, 12, 17 & 20 are for rough working only.

OFFICIAL USE ONLY

Multiple choice sections

	Marks	
Page	Max	Gained
2-10	50	

Short answer section

Page	Marks Max	Gained		Marker
11	8			
13	9			
14	3			
15	10			
16	10			
18	5			
19	5			
Total	50			

Check Total		

Marks

- Consider the compound with formula $[PtCl_4(NH_3)_2]\cdot 2H_2O$. **3**

Name the compound.

Write the formula of the complex ion.

Write the atomic symbols of the ligand donor atoms.

What is the 5d electron configuration of the metal ion in this complex?

- Write balanced equations for each of the following reactions. If there is no reaction then write "no reaction". **5**

Excess sodium hydroxide (2 M) is added to a solution containing $A\beta^{+}$.

Water is added to solid lithium hydride.

Excess hydrochloric acid (4 M) is added to solid nickel(II) sulfide.

50 mL of ammonia solution (1 M) is added to 1 L of cobalt(II) chloride solution (1 M).

Solid silver(I) sulfide is added to a solution of potassium cyanide (1.0 M).

Marks 9

- The difference between the solubilities of the Fe(III) and Zn(II) hydroxides can be used to effect a separation of the metal ions.
  K_{so} ($Fe(OH)_3$) = 1.0×10^{-38} M^4, K_{so} ($Zn(OH)_2$) = 1.0×10^{-15} M^3.
  Calculate the pH of a solution that is in equilibrium with excess $Fe(OH)_3(s)$.

ANSWER:

Would a solution buffered at pH 5.5 be suitable for separating Fe^{3+} from Zn^{2+}? Show all working used to arrive at your conclusion.

ANSWER:

If the metal was subsequently electroplated from the filtered solution buffered at pH 5.5, what is the maximum percentage le vel of iron impurity present in the zinc?

	ANSWER:

- A solution contains cobalt ions in an unknown oxidation state. When a current of 3.0 A was applied for 1.0 hr, 3.3 g of cobalt metal was deposited. What was the oxidation state of the cobalt ions? Show all working.

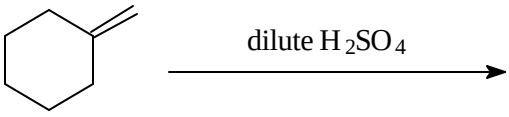
Marks 3

ANSWER:

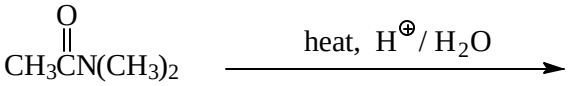
THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

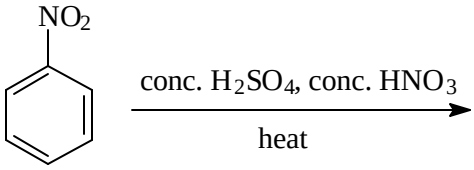
- Give the constitutional formulas and names, where required, of the major organic product(s) formed in the following reactions.

Marks 10



Name:





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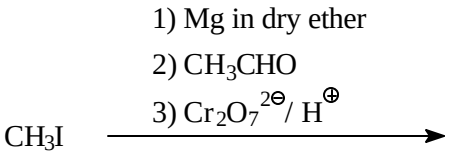
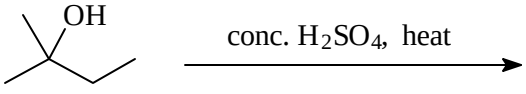
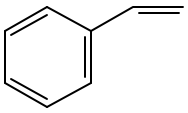




Name:

- Draw a scheme that represents the electrophilic addition reaction of HBr to styrene. Clearly show any intermediates in the reaction and include curly arrows to indicate electron movements.

Marks **4**



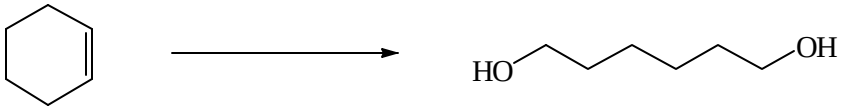
styrene

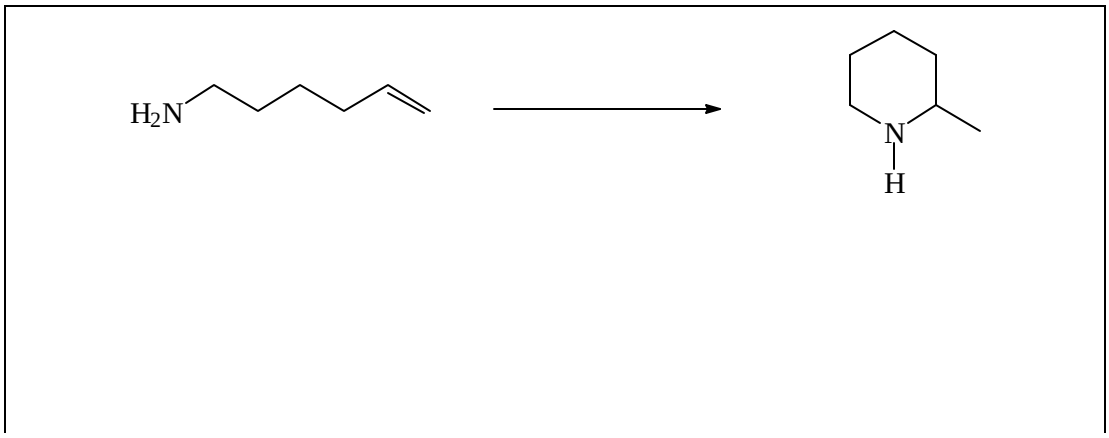
Comment on the stability of any intermediate(s).

Is the product of this reaction formed as an achiral compound, the (*R*)-enantiomer, the (*S*)-enantiomer or as a racemic mixture?

- With the aid of structure diagrams, show how you would effect the following conversions. Clearly indicate the reagents you would use and any intermediate compounds.

6

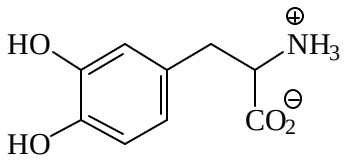



H2N
N
H

Marks 5

- DOPA (3,4-dihydroxyphenylalanine), (**G**), is the biological precursor to the neurotransmitter dopamine.

(**G**)

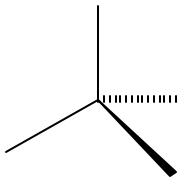


On the above diagram clearly mark the stereogenic centre in DOPA, (**G**).

List the substituents attached to the stereogenic centre in descending order of priority according to the appropriate rules.

highest priority			lowest priority

Only the (*S*)-enantiomer of (**G**) is converted to dopamine in the brain. Draw the (*S*)-enantiomer of DOPA by completing the diagram on the right.

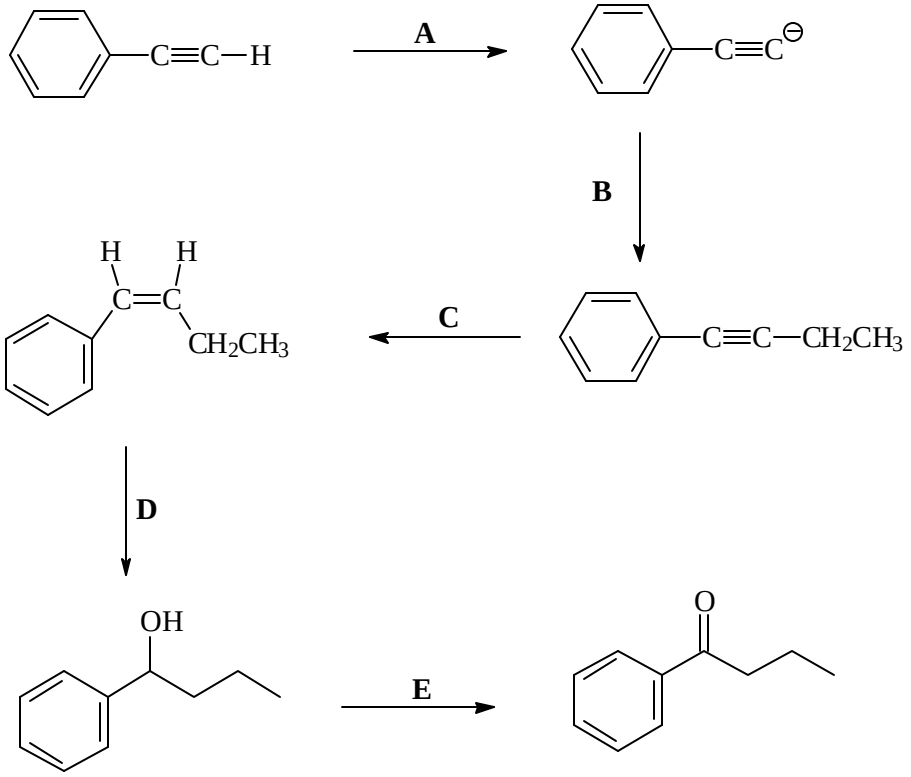


Draw the structure of the product that results from treatment of (**G**) with excess OH^-.

Draw the structure of the product that results from treatment of (**G**) with $LiAlH_4$ followed by H^+/H_2O.

Marks 5

- Consider the following synthetic sequence.



Write the reagents **A** - **E** required to effect each conversion.

A:
B:
C:
D:
E:

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Numerical Data

Physical constants Faraday constant = F = 96485 C mol^{-1}

Electrode potentials

$2H^+(aq)$	+	$2e^-$	$\rightleftharpoons$	$H_2(g)$	E° = 0.00 V
$Pb^{2+}(aq)$	+	$2e^-$	$\rightleftharpoons$	Pb(s)	E° = –0.13 V
$Zn^{2+}(aq)$	+	$2e^-$	$\rightleftharpoons$	Zn(s)	E° = –0.76 V

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

November 2001

CHEM1902/1904

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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]