Name: Student Code:

Problem 1

PART A

1-1. Determine the molecular formula and write a balanced equation with correct state of matters for the combustion of Q

Calculation

1-2. Calculate the heat capacity of the calorimeter (excluding the water).
Calculation with proper units:

The heat capacity of calorimeter is _____ $J\ K^{-1}$

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Problem 1

1-3. Calculate the standard enthalpy of formation (ΔH^o_f) of Q.
Calculation with proper units:

ΔH^o_f of Q is _____ kJ mol^{-1}

PART B

1-4. Show whether Q is monomer or dimer in benzene by calculation assume that Q is a monomer in water.
Calculation:

Q in benzene is ☐ monomer ☐ dimer.

1-5. Calculate the freezing point (T_f) of a solution containing 0.244 g of Q in 5.85 g of benzene at 1 atm.
Calculation

T_f of solution is ☐ °C

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Problem 2

PART **A**

2-1. On adding 1.00 mL of HCl, which species reacts first and what would be the product?

Species which reacts first is

The product is

2-2. What is the amount (mmol) of the product formed in (2-1)?

mmol of product =

2-3 Write down the main equilibrium of the product from (2-1) reacting with the solvent?

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Problem 2

2-4. What are the amounts (mmol) of Na_2A and NaHA initially present?

Calculation:

mmol of Na_2A =

mmol of NaHA =

2-5. Calculate the total volume of HCl required to reach the second equivalence point.

Calculation:

Total volume of HCl required = mL

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Problem 2

PART B

2-6. Calculate the absorbance at 400 nm of Solution III.
Calculation:

The absorbance at 400 nm of Solution III =

2-7. Apart from H^+, OH^- and H_2O, what are all the chemical species present in the solution resulting from mixing Solution II and Solution III at 1:1 volume ratio?

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Problem 2

2-8. What is the absorbance at 400 nm of the solution in (2-7) ?

Calculation:

The absorbance at 400 nm of the solution =

Name:	Student Code:

Problem 2

2-9. What is the transmittance at 400 nm of the solution in (2-7)?
Calculation:

Transmittance of the solution =

Name:	Student Code:

Problem 3

3-1. How many beta decays in this series? Show by calculation.

Calculation:

Number of beta decays =

3-2. How much energy in MeV is released in the complete chain?

Calculation:

Energy released = MeV

Name:	Student Code:

Problem 3

3-3. Calculate the rate of production of energy (power) in watts ($1W = Js^{-1}$) produced by 1.00 kilogram of ^{232}Th ($t_{1/2} = 1.40 \times 10^{10}$ years).

Calculation:

Rate of production of energy = _____ W

Name:	Student Code:

Problem 3

3-4. What volume in cm^3 of helium at 0 °C and 1 atm collected when 1.00 gram of ^{228}Th ($t_{1/2}$ = 1.91 years) is stored in a container for 20.0 years.

Calculation:

Volume of He at 0 °C and 1 atm = _____ cm^3

3-5. One member of thorium series, after isolation, is found to contain 1.50×10^{10} atoms of the nuclide and decays at the rate of 3440 disintegrations per minute. What is the half-life in years?

Calculation:

Half-life = _____ years

Name:	Student Code:

Problem 4

4-1. The molecular formula of **L** is

4-2. The structures of bipyridine and **L**

structure of bipyridine

structure of **L**

4-3. Does the ligand **L** have any charge, i.e., net charge ? Please tick.

- 2 charge	- 1 charge	no charge	+ 1 charge	+ 2 charge

4-4. Draw the structure when one molecule of **L** binds to metal ion (M)

Name: Student Code:

Problem 4

4-5. Determine the empirical formula of **A**.

Calculation:

The empirical formula of **A** is

What are the values of m and n in $FeL_m(ClO_4)_n.3H_2O$?

m =

n =

The complete formula of **A** is

The ratio of cation to anion is :

Name:	Student Code:

Problem 4

4-6. The oxidation number of Fe in complex **A** is ☐

The number of *d*-electrons in Fe ion in the complex = ☐

Write the high spin and the low spin configuration that may exist for this complex.

High spin configuration	Low spin configuration

Which configuration, high or low spin, is the correct one (please tick)?

☐ High spin

☐ Low spin

The best evidence to support your answer for this high/low spin selection (Please tick):

☐ Color

☐ Elemental analysis data

☐ Magnetic moment

☐ Molar conductance

4-7. λ_{max} of complex **A** is ☐ nm.

Name:	Student Code:

Problem 4

4-8. Calculate the 'spin-only' magnetic moment of complex B.
Calculation:

The 'spin-only' magnetic moment of complex **B** = _____ B.M.

4-9.

The empirical formula of **B** is _____

x = _____

y = _____

z = _____

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Problem 5

5-1. Write structures of **A - D** with appropriate stereochemistry in Haworth projection, except for **B**.

A	**B**
C	**D**

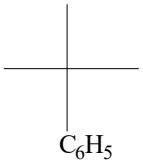
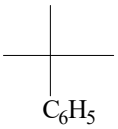
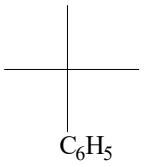
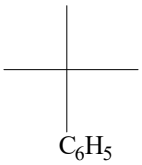
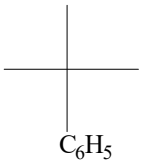
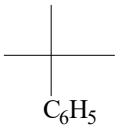
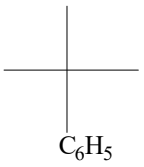
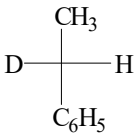
5-2. Write molecular formula for compounds **F** and **G,** and structural formula for compounds **H** and **I** and indicate stereochemistry of **H.**

Molecular formula of compound **F** = Molecular formula of compound **G** =	Compound **H**	Compound **I**

Name:	Student Code:

Problem 5

5-3. Deduce the absolute configuration of (-) **E** and the structure with configuration of each intermediate (**J-O**) in the sequence with the proper R,S-assignment.

 ☐ R or ☐ S (-) **E**	 (-) **J**	 (-) **K**	 Compound **L**
 (-) **M**	 (-) **N** ☐ R or ☐ S	 Compound **O**	 (-) **1-phenylethane-** ***1-d*** ☐ R or ☐ S

5-4. The mechanism involved in the conversion of compound **O** to (-) **1-phenylethane-*1-d*** is .

☐	S_N1
☐	S_N2
☐	S_Ni
☐	E1
☐	E2

Name:	Student Code:

Problem 6

6-1.

[ ] sulfonic acid groups are formed from oxidation of a disulfide bond.

6-2. Complete structure of DNP-Asp at its isoelectric point is

6-3.

The sequence of B8 is

6-4.

The sequence of B9 is

6-5. The *complete* structure of **A** is

6-6. Write the revised structure of **A** below and circle the site(s) to indicate all the possible source of ammonia.

6-7.

The isoelectric point of **A** is