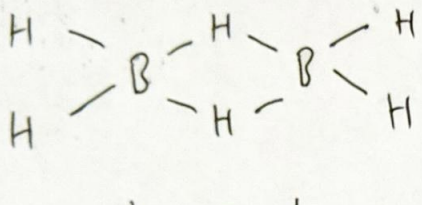
Name:
Student #:
Laboratory Demonstrator Gp.:

QUESTION 1

(a) **(4 marks)** Draw the molecular structures and compare and contrast the bonding in B_2H_6 and in Al_2Cl_6.

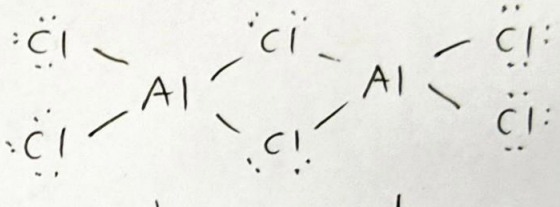
B_2H_6



bridge bond

* 3-center-2-electron bonding across B-H-B

Al_2Cl_6

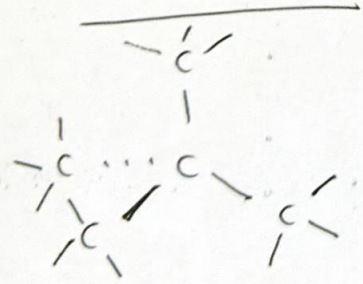


bridge bond

* coordinate / dative bonding from Al-Cl → Al (4 e^- total)

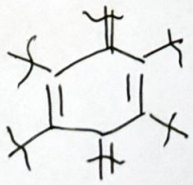
(b) **(6 marks)** List, describe and distinguish three allotropes of carbon.

Diamond



- tetrahedral around C (sp^3)
- single bonding (d C-C : 1.54 Å)
- insulator (large σ/σ^* gap)
- extremely hard (10 Mohs)
- colourless / transparent

Graphite



- planar
- 2 single bonds, 1 double at C (sp^2)
- conducting in layer but not between layers
- VDW interactions between layers
- no gap between π/π^*
- shiny, black

Fullerene

- Spherical
- C_{60}, C_{70}, etc.
- combination of pentagons / hexagons
- can enclose metals
- can make superconducting materials

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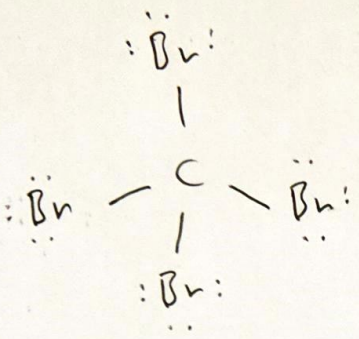
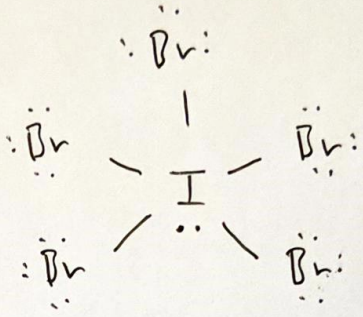
QUESTION 2

(a) **(2 marks)** Draw the Lewis dot diagram of CBr_4 and IBr_5 and include all lone pairs of electrons.



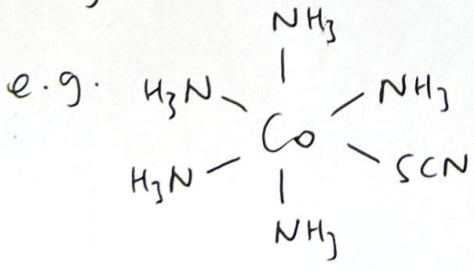
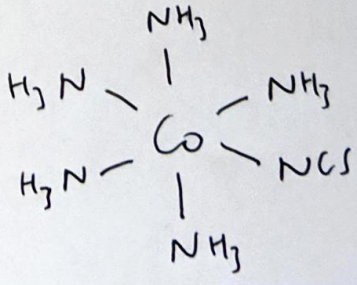


(b) **(2 marks)** Describe and distinguish between coordination compounds that exhibit coordination isomerism and linkage isomerism. Give an example of each.

Coordination isomerism - ion / ligand exchange

e.g. $[Co(NH_3)_5Br][SO_4]$ vs. $[Co(NH_3)_5SO_4]Br$

Linkage isomerism - different donor atom from same ligand

e.g.  vs. 

* Both are constitutional / structural isomers

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QUESTION 3

(6 marks) Distinguish between diamagnetic and paramagnetic compounds. Explain how one determines the magnetic nature of a material.

Diamagnetic – atom, ion, or molecule has no unpaired electrons

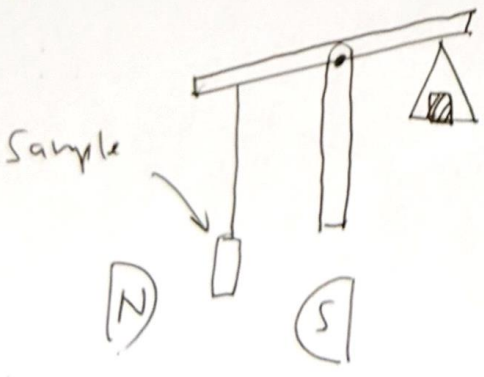
↳ weakly repelled by a magnetic field

Paramagnetic – atom, ion, ~~one~~ molecule has one or more unpaired e^-

↳ attracted to magnetic field

Determined by measurement of magnetic susceptibility (the degree of magnetization in an applied field)

– paramagnetic materials are attracted to the field, while diamagnetic materials are repelled



Electromagnet

– a sample is hung between an electromagnet, and the weight (or measured force) change is proportional to susceptibility