Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

(a)

This question is marked using Levels of Response. Refer to the Mark Scheme Instructions for Examiners for guidance.	
Level 3 5-6 marks	All stages are covered, and the explanation of each stage is correct and virtually complete Answer communicates the whole explanation coherently and shows a logical progression through all three stages.
Level 2 3-4 marks	All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies. OR two stages are covered, and the explanations are generally correct and virtually complete. Answer is coherent and shows some progression through all three stages. Some steps in each stage may be incomplete.
Level 1 1-2 marks	Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies. OR only one stage is covered but the explanation is generally correct and virtually complete. Answer shows some progression between two stages.
0 mark	Insufficient correct chemistry to gain a mark.

Indicative Chemistry content

<u>Stage 1 absorption of light</u>
(3/4 virtually complete, 1/4 for covered)

1a d orbitals have different energy/d orbital (energies) are split

1b Electrons move to higher (energy) (d) orbitals/electrons move to excited state

1c Absorb visible/white light

1d Colour seen is that from complementary colours/colours transmitted/reflected/not absorbed

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Stage 2 reasons for different colours
(3/4 virtually complete, 1/4 for covered)

2a The metal

2b The oxidation state (of the metal)/charge of metal (ion)

2c The ligand(s)

2d The co-ordination number/shape

Stage 3 Colorimetry
(2/3 virtually complete, 1/3 for covered)

3a Measure the absorbance for a range of (known) concentrations

3b Plot graph of absorbance v concentration/calibration curve (of absorbance v concentration)

3c Measure absorbance of the coloured complex **and** find concentration from graph

6

(b) **M1** Wavelength = 800 (nm) ± 5

Range 2.47 x 10^{-19} to 2.502 x 10^{-19} = 3/3

Range 2.47 x 10^{-28} to 2.502 x 10^{-28} = 2/3

800 nm on bottom of expression scores M1

M2 $\Delta E \left(= \frac{hc}{\lambda}\right) = \frac{6.63 \times 10^{-34} \times 3.00 \times 10^{8}}{M1 \times 10^{-9}}$

M3 2.49 × 10^{-19} (J) (allow ECF from M1 or M2)

At least 2sf

NOT ECF from M2 if equation re-arranged incorrectly

3

[9]

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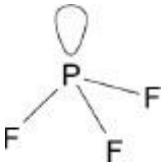
Q2.

(a) (Central) metal atom/ion surrounded by ligands

Allow complex in which number of coordinate bonds exceeds oxidation state of the metal

1

(b)



Allow diagram with 3 bonds <u>and</u> 1 lone pair

Pyramidal or tetrahedral

Allow triangular pyramid

2

(c) PF_3 is neutral **and** the complex is neutral

*Allow PF_3 has no charge **and** the complex has no charge*

Ignore electronegativity

1

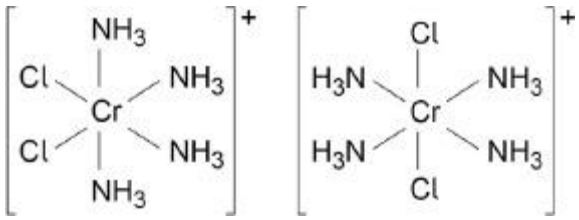
(d) (+)3

1

(e) Covalent (bond)

1

(f)



M1 for the two isomers

M2 for the charge on the complex ion.

Allow 1 mark for one correct isomer with + charge

Cis-trans/geometric/E-Z isomerism

Ignore stereoisomerism

3

(g) $[Cr(H_2O)_5Cl]Cl_2$

Allow $[Cr(H_2O)_5Cl]^{2+}$ + 2 Cl^-

1

[10]

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