			Mark
2.		**This question is about the industrial separation of precious metals**	**Mark**
(a)	(i)	Pd	☑
	(ii)	Pt	☑
	(iii)	Ir	☑
(b)	(i)	$Au + 3HNO_3 + 4HCl \rightarrow HAuCl_4 + 3NO_2 + 3H_2O$ *Must be fully correct for mark.*	☑
	(ii)	$Pt + 4HNO_3 + 6HCl \rightarrow H_2PtCl_6 + 4NO_2 + 4H_2O$ *Must be fully correct for mark.*	☑

(c)

$m/z = {}^{197}Au + 4\ {}^{35}Cl = 337$ $Prob = (0.75)^4 = 31.6\%$

$m/z = {}^{197}Au + 3\ {}^{35}Cl + 1\ {}^{37}Cl = 339$ $Prob = (0.75)^3 \times 0.25 \times 4 = 42.2\%$

$m/z = {}^{197}Au + 2\ {}^{35}Cl + 2\ {}^{37}Cl = 341$ $Prob = (0.75)^2 \times (0.25)^2 \times 6 = 21.1\%$

$m/z = {}^{197}Au + 1\ {}^{35}Cl + 3\ {}^{37}Cl = 343$ $Prob = 0.75 \times (0.25)^3 \times 4 = 4.7\%$

$m/z = {}^{197}Au + 4\ {}^{37}Cl = 345$ $Prob = (0.25)^4 = 0.4\%$

m/z	337	339	341	343	345
relative intensity	31.6%	42.2%	21.1%	4.7%	0.4%
(as fractions)	$^{81}/_{256}$	$^{108}/_{256}$	$^{54}/_{256}$	$^{12}/_{256}$	$^{1}/_{256}$

☑ ☑ ☑

First mark for all m/z correct. First mark not given if one or more m/z incorrect. Second and third mark for all relative intensities correct. Accept if relative intensities quoted as decimals or as fractions or as a whole number ratio. If one relative intensity wrong award second mark but not third. If two or more relative intensities wrong do not award second or third mark. If statistical factors are forgotten, but intensities are all correct otherwise, award second mark but not third. Table without statistical factors shown below.

m/z	337	339	341	343	345
relative intensity	66.9%	22.3%	7.4%	2.5%	0.8%
(as fractions)	$^{81}/_{120}$	$^{27}/_{120}$	$^{9}/_{120}$	$^{3}/_{120}$	$^{1}/_{120}$

(d)

$3FeCl_2 + HAuCl_4 \rightarrow Au + 3FeCl_3 + HCl$

(allow $3Fe^{2+} + Au^{3+} \rightarrow 3Fe^{3+} + Au$)

Must be fully correct for mark.

☑

(e)

$[PtCl_6][NH_4]_2$

Allow if written as ions with separate charges. Allow multiples of this formula.

☑

(f)	☑ ☑	
	One mark for each correct structure. If three structures drawn maximum mark is one if there is one correct. Four or more structures drawn is no marks.	
(g)	H_2PdCl_4 + $4NH_4OH$ → $Pd(NH_3)_2Cl_2$ + $4H_2O$ + $2NH_4Cl$ *or* H_2PdCl_4 + $2NH_4OH$ → $Pd(NH_3)_2Cl_2$ + $2H_2O$ + $2HCl$ *or suitable ionic form, eg* H_2PdCl_4 + $4NH_4OH$ → $Pd(NH_3)_2Cl_2$ + $4H_2O$ + $2NH_4^+$ $2Cl^-$ *Must be fully correct for mark.*	☑
(h)	(i) $(2N \times I) + 1 = (2 \times 2 \times 1) + 1$ = 5 lines	☑
	(ii) $(2N \times I) + 1 = (2 \times 4 \times 1) + 1$ = 9 lines	☑
	(iii) $(2N \times I) + 1 = (2 \times 4 \times \frac{1}{2}) + 1$ = 5 lines	☑
(i)	(i) 1:2:3:2:1	☑
	(ii) 1:4:10:16:19:16:10:4:1	☑

Total out of 18 **18**

4