Electronic Supplementary Information

Water solvation models on the S_NX mechanism: the case of the hydrolysis of isopropyl chloride

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1. Methods

We selected the Dunning double-*zeta* basis set aug-cc-pVDZ[1,2] for all evaluations. Since this is a small basis set, we also assessed the Basis Set Superposition Error (BSSE) using counterpoise correction. The evaluation was performed for the stationary points of a prototypic system (n = 9). The calculated errors using the explicit solvation model were 3.0, 3.7 and 4.3 kcal mol^{-1} for the initial complex, transition state, and final complex, respectively. Given that the values exhibited the same magnitude (3.7 $\pm$ 0.7 kcal mol^{-1}), we hypothesize that there is an error cancellation along the reaction coordinate. The BSSE effect becomes more significant when considering the isolated structures and, then, their interactions (reactive complex). In all explored cases, we initiated from well-defined complex (that is, solute and water cluster). Additionally, besides evaluating the BSSE effect, we also tested the possibility of refining the electronic energy using a triple-zeta basis set (aug-cc-pVTZ). The same representative system was chosen (n = 9) to refine the energy barrier ($\Delta H^{\ddagger}$) using the aug-cc-pVTZ basis set. The new value, with the respective electronic energy correction, was $\Delta H^{\ddagger}$ = 21.9 kcal mol^{-1}. Since the difference between DZ and TZ was $\Delta\Delta H^{\ddagger}$ = 0.9 kcal mol^{-1}, we maintained the double-zeta choice due to the substantial volume of calculations with high computational costs, such as the activation strain analyses (single point calculations of all IRC points).

2. Explicit solvation

2.1 Monte Carlo calculations

We employed DICE software[3] in the isothermal-isobaric (NPT) ensemble (298.15 K), with one solute molecule and 999 water molecules, along with 25000 simulations steps. The charge distribution was computed using the electrostatic potentials based on a grid method (CHELPG)[4] calculated at the M06-2X/aug-cc-pVDZ level. Lennard-Jones potential parameters (σ and ε) were obtained from the OPLS-AA (optimized potentials for liquid simulations-all atom)[5] force field. The last configuration was used to set up the solvation environment for the solvolysis reaction. To assess the influence of different numbers of water molecules on the energy profiles for the

solvolysis reactions, we evaluated three radial distribution functions (RDFs) – see Figure S1. The first RDF is calculated between the center of masses of the solute (^{i}PrCl) and the solvent (H_2O), while the second one is calculated between all solute atoms and the nearest solvent molecule. These RDFs are DICE software's default. The third RDF accounts for the distance between the electrophilic carbon from the substrate (C^{α}) and the nucleophilic oxygen atoms from the solvent molecules. These clusters were then fully optimized at the DFT level M06-2X/aug-cc-pVDZ as our initial complexes (IC).

1. Dunning, T. H., Peterson, K. A. & Wilson, A. K. *J Chem Phys* 114, 9244–9253 (**2001**); 2. Kendall, R. A., Dunning, T. H. & Harrison, R. J. *J Chem Phys* 96, 6796–6806 (**1992**); 3. Cezar, H. M., Canuto, S. & Coutinho, K. *J Chem Inf Model* 60, 3472–3488 (**2020**); 4. Breneman, C. M. & Wiberg, K. B. *J Comput Chem* 11, 361–373 (**1990**); 5. Jorgensen, W. L., Maxwell, D. S. & Tirado-Rives, J. *J Am Chem Soc* 118, 11225–11236 (**1996**).

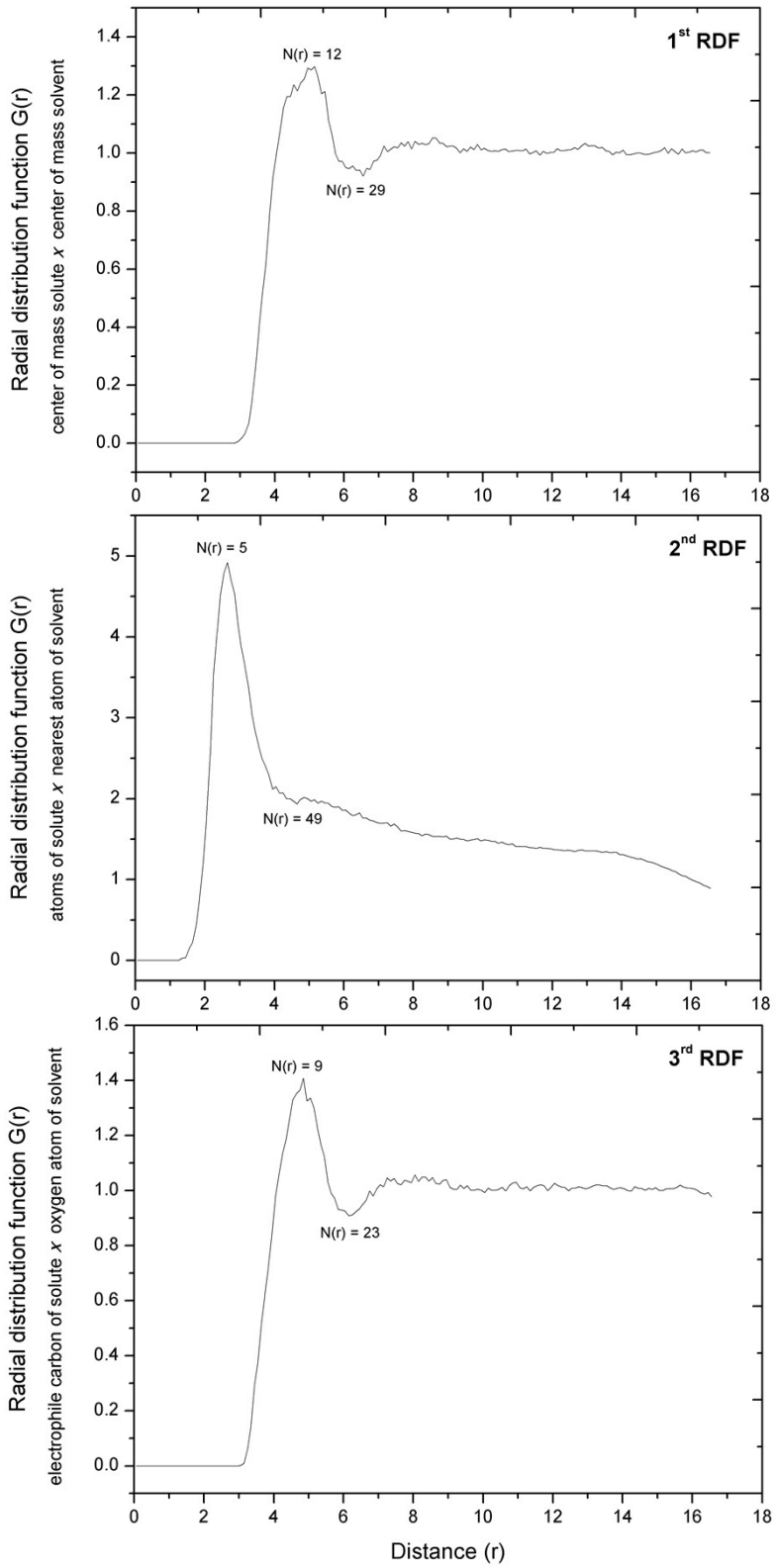


Figure S1: Radial distribution function (G_r) calculated between center of mass of solute and all solvent molecules (1st RDF), all solute atoms and the nearest solvent molecule (2nd RDF), electrophilic carbon and solvent oxygen atom (3rd RDF).

2.2 Explicit microsolvation

For n = 5, the $(1,2)_{n=5}$ configuration is 9.8 kcal mol^{-1} less stable than the $(2,2)_{n=5}$ configuration. However, for n = 7, despite successive attempts, we could not identify any stable $(3,3)_{n=7}$ configuration, possibly due to the formation of stable cyclic water trimers. Instead, the most stable configuration observed is $(3,2)_{n=7}$, with a ΔH = 5.7 kcal mol^{-1} relative to the $(1,3)_{n=7}$. The higher stability of the $(2,2)_{n=5}$ and $(3,2)_{n=7}$ arrangements is associated with a higher number of hydrogen bonds. Interestingly, the $(2,2)_{n=5}$ MS configuration lacks the cyclic water pentamer found in the MC configuration, resulting in a stability difference of 4.9 kcal mol^{-1}. This discrepancy suggests user bias, which may underestimate relevant solvent-solvent interactions.

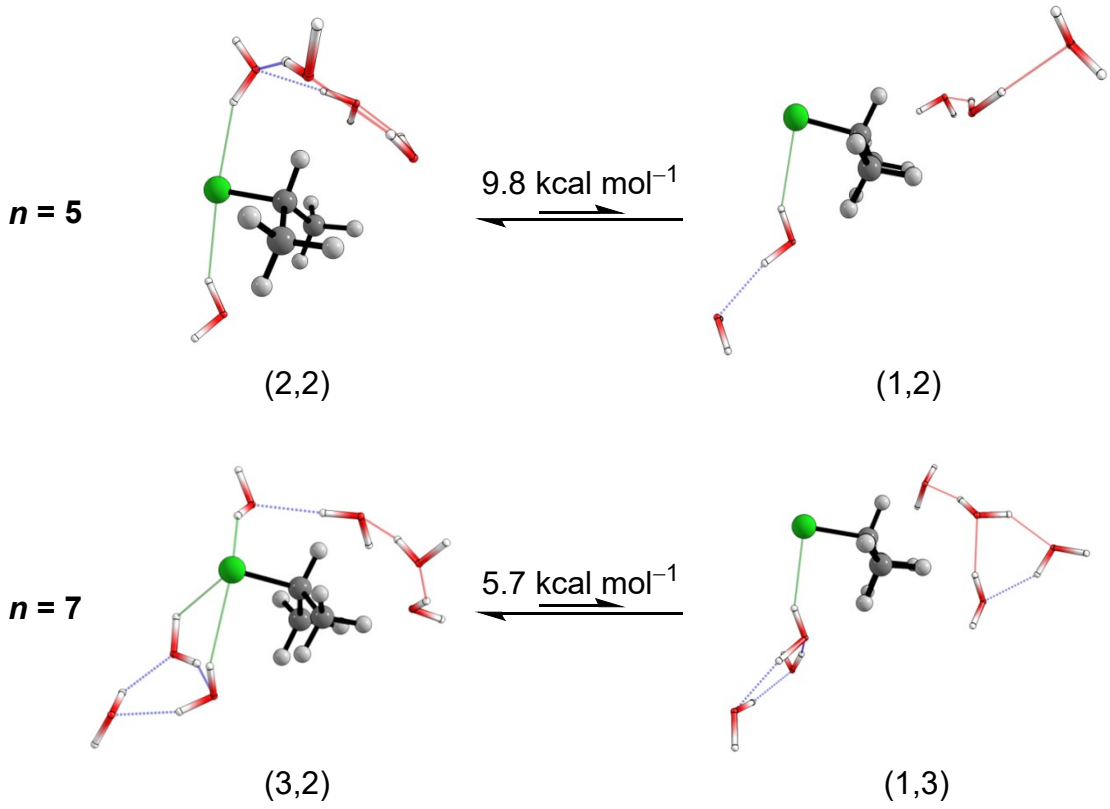


Figure S2: Optimized structures (M06-2X/aug-cc-pVDZ) obtained from explicit MS for n = 5 and 7. MS configurations described by (l,m), where l denotes the number of solvent molecules directly interacting with the leaving group (highlighted in green) and m (highlighted in red).

3. Reaction mechanism

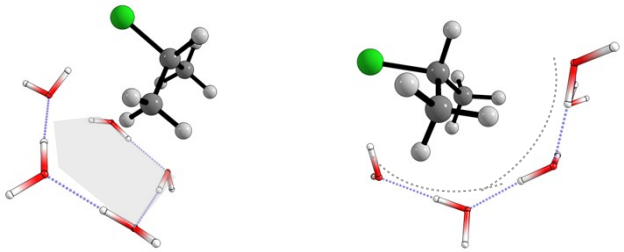
The reaction mechanism was explored for all system starting with the initial configurations obtained from MC and MS explicit solvation models. All relative energies in terms of electronic energy and Gibbs free energy are organized on table 1. All energies were calculated with respect to the initial complex (IC) using the transition state structure (TS) and final complex (FC) obtained from IRC calculations.

$$\Delta E = E\,(\mathrm{IC}) - E\,(\mathrm{FC}) \qquad \Delta G = G\,(\mathrm{IC}) - G\,(\mathrm{FC})$$
$$\Delta E^{\ddagger} = E\,(\mathrm{IC}) - E\,(\mathrm{TS}^{\ddagger}) \qquad \Delta G^{\ddagger} = G\,(\mathrm{IC}) - G\,(\mathrm{TS}^{\ddagger})$$

Table S1: Energies relative to reactants (initial complexes) of the stationary points of the nucleophilic substitution reaction *iso*-PrCl • *n*(H_2O) ⇌ *iso*-PrOH • [H_3O • (*n*–2) H_2O]$^+Cl^-$.

	Electronic energy/ Gibbs Free Energy* [kcal mol^{-1}]	
n	Explicit solvation	Explicit + implicit solvation
1	[*a*]	$\Delta E^{\ddagger}$ = 29.2, ΔE = 17.1 $\Delta G^{\ddagger}$ = 29.9, ΔG = 19.2
	Monte Carlo configuration	
5	$\Delta E^{\ddagger}$ = 33.9, ΔE = –13.0 $\Delta G^{\ddagger}$ = 35.6, ΔG = –11.8	$\Delta E^{\ddagger}$ = 27.9, ΔE = –12.3 $\Delta G^{\ddagger}$ = 26.5, ΔG = –12.2
9	$\Delta E^{\ddagger}$ = 27.9, ΔE = –7.9 $\Delta G^{\ddagger}$ = 26.8, ΔG = –2.6	$\Delta E^{\ddagger}$ = 21.3, ΔE = –9.7 $\Delta G^{\ddagger}$ = 25.4, ΔG = –3.5
12	$\Delta E^{\ddagger}$ = 21.6, ΔE = –6.3 $\Delta G^{\ddagger}$ = 24.7, ΔG = –2.1	$\Delta E^{\ddagger}$ = 21.2, ΔE = –11.5 $\Delta G^{\ddagger}$ = 23.8, ΔG = –6.7
	Microsolvation configuration	
3	$\Delta E^{\ddagger}$ = 31.2, ΔE = –1.6 $\Delta G^{\ddagger}$ = 32.3, ΔG = –1.3	$\Delta E^{\ddagger}$ = 25.9, ΔE = –5.9 $\Delta G^{\ddagger}$ = 27.8, ΔG = –2.1
5	$\Delta E^{\ddagger}$ = 21.5, ΔE = –10.8 $\Delta G^{\ddagger}$ = 23.1, ΔG = –7.3	$\Delta E^{\ddagger}$ = 21.7, ΔE = –11.2 $\Delta G^{\ddagger}$ = 22.5, ΔG = –7.8
7	$\Delta E^{\ddagger}$ = 28.4, ΔE = 0.05 $\Delta G^{\ddagger}$ = 28.8, ΔG = 1.6	$\Delta E^{\ddagger}$ = 23.0, ΔE = –6.3 $\Delta G^{\ddagger}$ = 23.8, ΔG = –4.7

[*a*] Not found



Initial Complex (IC) | Pre-reactive Complex (PRC)

Figure S3: Optimized structures (M06-2X/aug-cc-pVDZ) of initial complex for n = 5 calculated from MC (solvent-solvent interaction prevails) and the pre-reactive complex (solvent-substrate interaction prevails).

4. Reactivity analysis

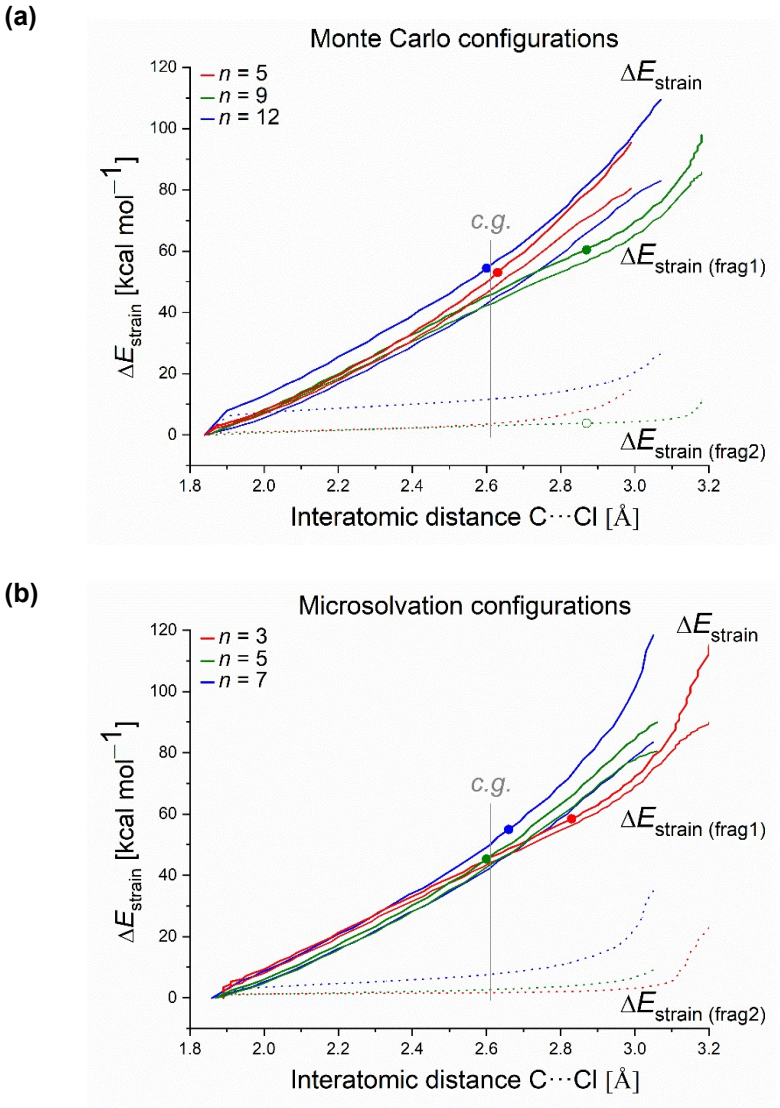


Figure S4: Strain energy decomposition (ΔE_{strain}) into contribution of fragment 1 (substrate) and fragment 2 (water molecules) for all Monte Carlo (a) and Microsolvation (b) configurations using the explicit solvation model. The bold lines represent the total strain energy (ΔE_{strain}), the light lines represent the strain contribution of fragment 1 ΔE_{strain}(frag1), and the dashed lines accounts for the strain contribution of

fragment 2 ΔE_{strain}(frag 2). The transition states are indicated by a dot on each energy curve. Consistent geometry at $d_{C\cdots Cl}$ = 2.6 Å (vertical line).

5. Intrinsic Reaction Coordinate (IRC) calculations

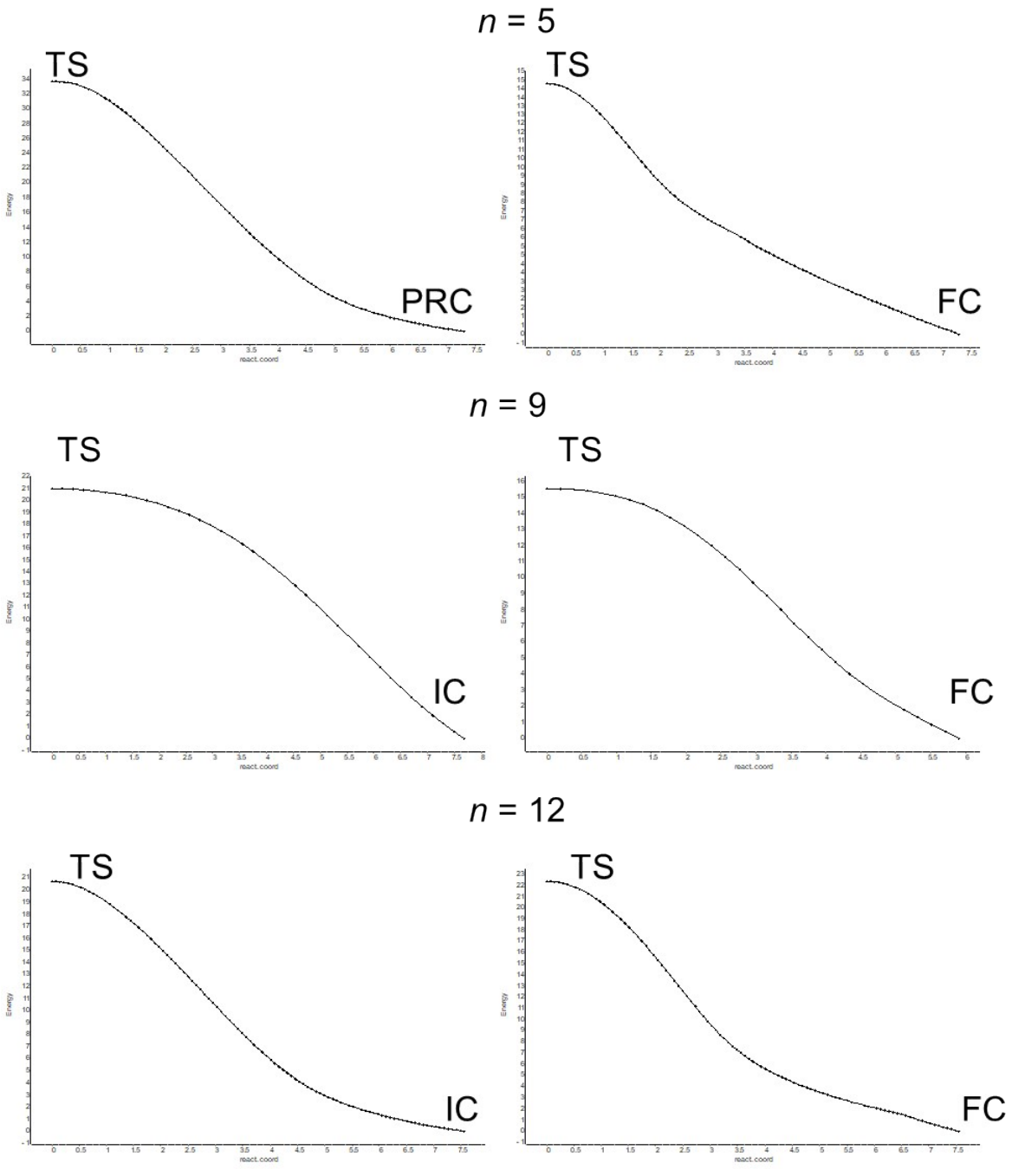


Figure S5: Intrinsic reaction coordinate (IRC) calculated from TS structure of MC configurations (M06-2X/aug-cc-pVDZ level) using explicit solvation model.

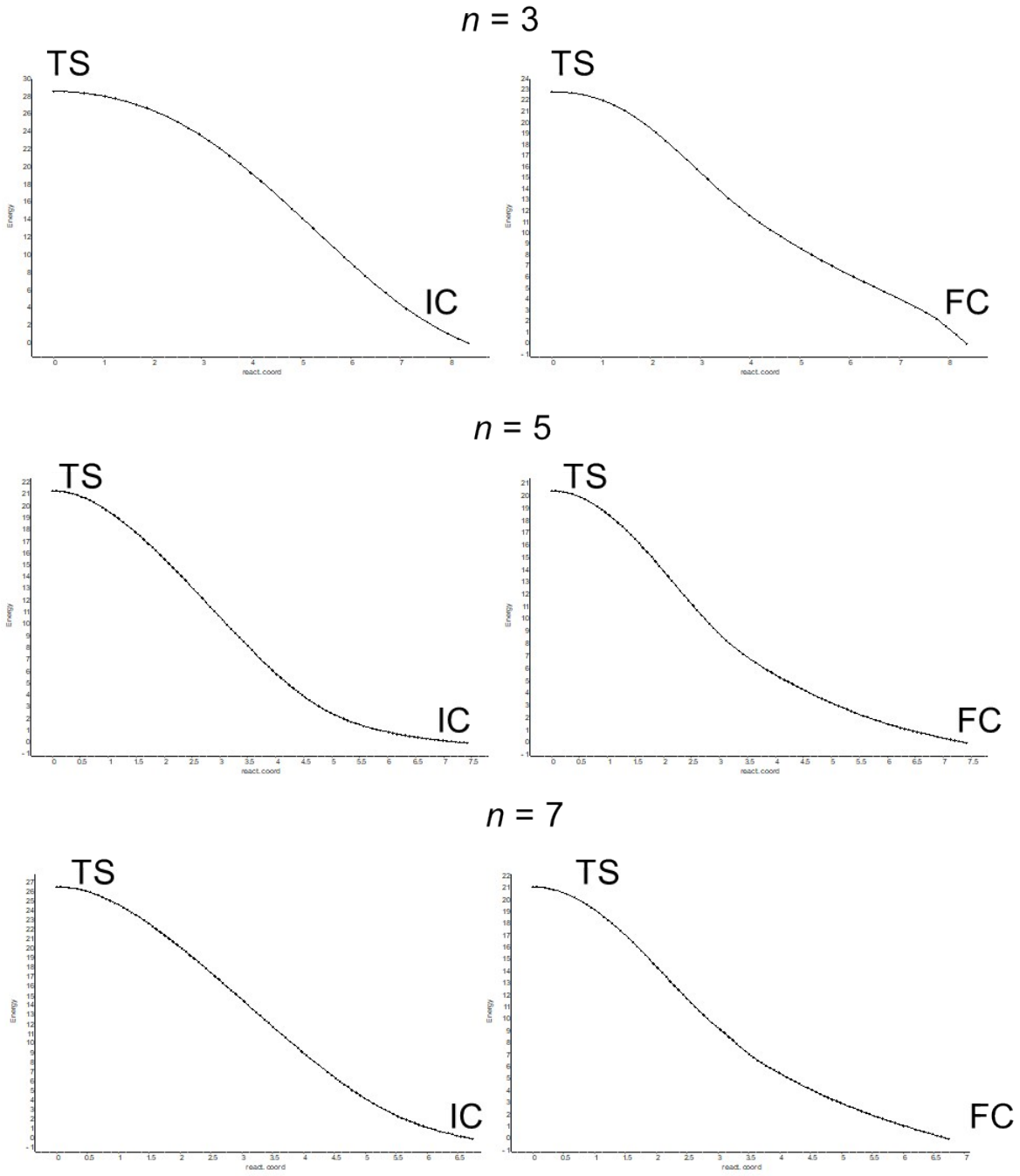


Figure S6: Intrinsic reaction coordinate (IRC) calculated from TS structure of MS configurations (M06-2X/aug-cc-pVDZ level) using explicit solvation model.

6. Matrices of optimized structures

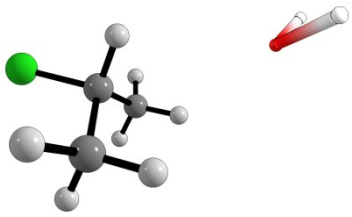
The following structures were calculated at the M06-2X/aug-cc-pVDZ level. Here, we present the structure obtained in the explicit solvation model, considering only explicit solvation. However, it is worth noting that for n = 1, the transition state (TS) was not identified in the gas

phase. The optimized structures in the explicit + implicit solvation model exhibited remarkable similarity to those obtained in the explicit solvation model.

6.1 Monohydrated (*n* = 1)

Initial Complex *n* = 1 (IEFPCM, solvent=water)

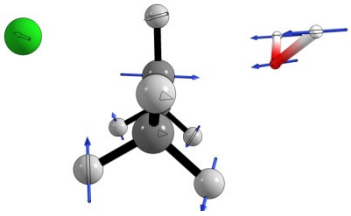
6	-0.157754000	0.000016000	0.005895000
1	0.393666000	-0.000023000	-0.936564000
6	0.123654000	-1.265295000	0.788511000
1	-0.470014000	-1.286414000	1.710759000
1	-0.102231000	-2.157905000	0.195927000
1	1.189242000	-1.272965000	1.049180000
6	0.123508000	1.265463000	0.788348000
1	1.189057000	1.273264000	1.049173000
1	-0.102378000	2.157973000	0.195615000
1	-0.470259000	1.286679000	1.710531000
17	-1.924649000	-0.000094000	-0.505986000
8	2.958325000	-0.000162000	-0.519351000
1	3.445560000	-0.760066000	-0.857386000
1	3.443334000	0.761252000	-0.857188000



E = – 655.0976437 a. u.
H = – 654.969544 a. u.
G = – 655.014421 a. u.

Transition state *n* = 1 (IEFPCM, solvent=water)

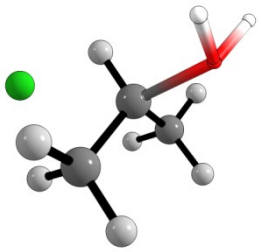
6	0.443486000	-0.001457000	-0.036218000
1	0.211588000	-0.000551000	-1.091622000
6	0.527849000	-1.283946000	0.705754000
1	-0.312026000	-1.321161000	1.407892000
1	0.484679000	-2.148880000	0.040148000
1	1.453005000	-1.293555000	1.293947000
6	0.528886000	1.280291000	0.707113000
1	1.456613000	1.290832000	1.291460000
1	0.481223000	2.146038000	0.042840000
1	-0.307463000	1.315455000	1.413505000
17	-2.202021000	0.001430000	-0.309102000
8	2.458906000	-0.002009000	-0.628799000
1	2.640366000	-0.750072000	-1.215075000
1	2.653798000	0.784326000	-1.157861000



E = – 655.0510345 a. u.
H = – 654.924101 a. u.
G = – 654.966839 a. u.
f = 424.5662*i*

Final complex *n* = 1 (IEFPCM, solvent=water)

6	0.864032000	0.000578000	-0.093735000
1	0.160475000	0.000293000	-0.928361000
6	0.804087000	-1.273012000	0.702828000
1	-0.201667000	-1.323062000	1.134450000
1	0.942232000	-2.153596000	0.064639000
1	1.550960000	-1.270116000	1.504423000
6	0.802327000	1.272929000	0.704685000
1	1.545518000	1.267102000	1.509620000
1	0.946097000	2.153923000	0.068423000
1	-0.205472000	1.324354000	1.131354000
17	-2.498291000	-0.000482000	-0.220881000
8	2.261743000	0.002571000	-0.750553000
1	2.416758000	-0.796992000	-1.287611000
1	2.399434000	0.782761000	-1.320213000

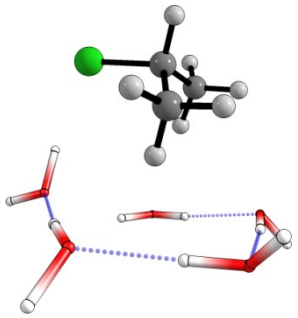


E = – 655.0703788 a. u.
H = – 654.940193 a. u.
G = – 654.983764 a. u.

6.2 Monte Carlo configurations

Initial Complex *n* = 5 (explicit solvation model)

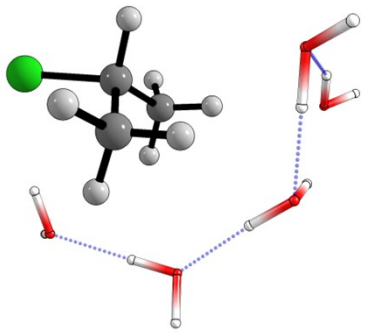
6	1.562063000	0.706500000	-1.025343000
1	2.015606000	0.891890000	-2.003910000
6	1.688703000	1.908895000	-0.113842000
1	1.320519000	1.661766000	0.888852000
1	2.727712000	2.248919000	-0.053247000
1	1.067170000	2.717980000	-0.519767000
6	0.138146000	0.212050000	-1.178232000
1	-0.454837000	1.001518000	-1.656802000
1	0.085420000	-0.697386000	-1.786479000
1	-0.307583000	0.023638000	-0.195542000
17	2.597576000	-0.660707000	-0.350531000
8	-0.259931000	0.643853000	2.428004000
1	-0.807373000	1.148175000	1.803286000
1	-0.341084000	-0.277089000	2.153626000
8	0.139738000	-2.080097000	1.215248000
1	0.945122000	-1.717101000	0.808855000
1	0.439738000	-2.764494000	1.821407000
8	-2.042536000	-2.164736000	-0.543577000
1	-1.282084000	-2.201753000	0.065035000
1	-2.643181000	-2.856359000	-0.251623000
8	-3.163316000	0.310781000	-1.001200000
1	-2.780378000	-0.574430000	-0.834645000
1	-3.199373000	0.395490000	-1.958139000
8	-1.749711000	2.161945000	0.490157000
1	-2.382570000	2.737688000	0.929186000
1	-2.289055000	1.554915000	-0.055620000



E = – 960.7825351 a. u.
H = – 960.541263 a. u.
G = – 960.609013 a. u.

Pre-reactive Complex *n* = 5 (explicit solvation model)

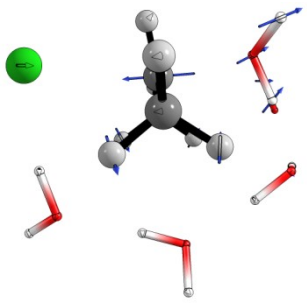
6	0.790530000	-1.188430000	0.153165000
1	0.416769000	-2.207760000	0.282339000
6	0.116509000	-0.520271000	-1.026954000
1	-0.962767000	-0.486031000	-0.843538000
1	0.482664000	0.504531000	-1.157298000
1	0.294244000	-1.084473000	-1.947796000
6	0.697849000	-0.414468000	1.452390000
1	1.206757000	-0.947131000	2.261898000
1	1.140573000	0.582315000	1.346705000
1	-0.359469000	-0.294296000	1.712722000
17	2.576274000	-1.429746000	-0.244988000
8	-3.472990000	-0.235227000	-1.449212000
1	-3.341910000	-0.926139000	-0.776323000
1	-4.316553000	-0.423905000	-1.868168000
8	2.636551000	1.855413000	-0.347709000
1	2.795708000	0.899534000	-0.302159000
1	3.057245000	2.140853000	-1.164646000
8	0.019802000	2.731099000	0.171371000
1	0.932343000	2.440403000	-0.008663000
1	0.101604000	3.548903000	0.669743000
8	-2.299822000	1.217713000	0.689677000
1	-1.468595000	1.697171000	0.522423000
1	-2.747240000	1.161278000	-0.168439000
8	-2.533709000	-1.476454000	0.873099000
1	-3.052299000	-1.788353000	1.619863000
1	-2.403718000	-0.512544000	1.016725000



E = – 960.7844678 a. u.
H = – 960.543524 a. u.
G = – 960.612278 a. u.

Transition State *n* = 5 (explicit solvation model)

6	0.287165000	-0.999886000	0.326713000
1	0.560418000	-2.045158000	0.383419000
6	-0.048687000	-0.440053000	-1.021806000
1	-0.960941000	0.161465000	-0.980810000
1	0.765590000	0.205079000	-1.355759000
1	-0.168895000	-1.249009000	-1.747152000
6	0.562937000	-0.130404000	1.520311000
1	0.872155000	-0.741816000	2.373186000
1	1.374911000	0.561616000	1.291051000

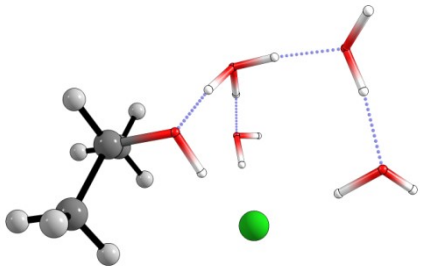


1	-0.315356000	0.467534000	1.782320000
17	2.849005000	-1.166460000	-0.244542000
8	-3.534755000	-0.675998000	-1.222003000
1	-2.973734000	-1.402362000	-0.921336000
1	-3.989108000	-0.994625000	-2.006816000
8	2.270794000	1.821396000	-0.457465000
1	2.598041000	0.886789000	-0.411168000
1	2.862477000	2.268458000	-1.068975000
8	-0.380570000	2.536446000	-0.029242000
1	0.540175000	2.255583000	-0.220431000
1	-0.300525000	3.426082000	0.326488000
8	-2.491152000	0.950950000	0.785410000
1	-1.782632000	1.568691000	0.500015000
1	-3.103129000	0.873831000	0.038264000
8	-1.570012000	-1.456415000	0.764084000
1	-1.605349000	-1.875293000	1.632788000
1	-1.970109000	-0.526021000	0.864553000

E = – 960.7285133 a. u.
H = – 960.488893 a. u.
G = – 960.552360 a. u.
f = 444.0331*i*

Final Complex *n* = 5 (explicit solvation model)

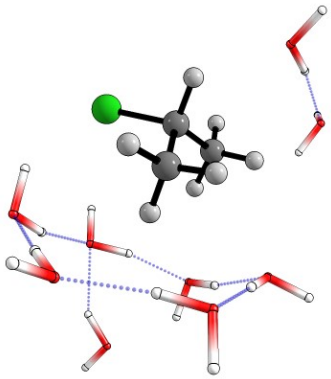
6	-2.351586000	-0.483647000	-0.706066000
1	-2.690623000	-1.343463000	-1.297502000
6	-2.506778000	-0.778303000	0.778795000
1	-2.131504000	0.066218000	1.371008000
1	-3.565048000	-0.935140000	1.019841000
1	-1.953699000	-1.681395000	1.063998000
6	-3.095858000	0.769142000	-1.133980000
1	-2.945873000	0.959215000	-2.202400000
1	-4.169087000	0.654444000	-0.940844000
1	-2.727483000	1.633063000	-0.564301000
17	0.274571000	1.813064000	0.671672000
8	0.556990000	-0.726737000	2.299012000
1	0.468008000	0.192798000	1.940734000
1	1.287591000	-0.701276000	2.924536000
8	2.895715000	1.279906000	-0.838313000
1	2.053759000	1.536751000	-0.395160000
1	3.575884000	1.810805000	-0.413940000
8	2.905388000	-1.341917000	-0.965185000
1	2.992009000	-0.350499000	-0.936289000
1	3.108399000	-1.609678000	-1.866451000
8	0.628683000	-1.884323000	0.023844000
1	1.541943000	-1.721635000	-0.405818000
1	0.670811000	-1.527415000	0.975799000
8	-0.954798000	-0.336879000	-1.047256000
1	-0.622569000	0.497250000	-0.622820000



1	-0.090716000	-1.265682000	-0.478145000

E = – 960.8032542 a. u.
H = – 960.564388 a. u.
G = – 960.627805 a. u.

Initial Complex *n* = 9 (explicit solvation model)

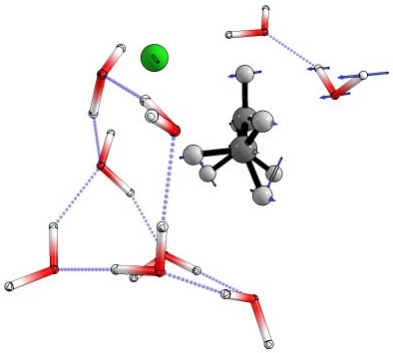


6	-1.264723000	-1.125633000	-0.249468000
1	-2.087778000	-1.783781000	0.036797000
6	-1.793701000	0.261572000	-0.543129000
1	-1.003856000	0.912703000	-0.933850000
1	-2.624664000	0.210725000	-1.254861000
1	-2.148231000	0.682156000	0.407567000
6	-0.158489000	-1.136196000	0.782330000
1	-0.576442000	-0.794190000	1.737006000
1	0.255686000	-2.139574000	0.923865000
1	0.650789000	-0.453205000	0.495162000
17	-0.644815000	-1.865494000	-1.821927000
8	0.768767000	2.444992000	-0.432972000
1	0.524307000	2.313218000	0.504643000
1	1.589322000	2.956961000	-0.461099000
8	1.778066000	0.484959000	-1.932069000
1	1.303725000	1.112793000	-1.332261000
1	1.093179000	0.109155000	-2.497635000
8	2.599065000	-1.952601000	-0.843218000
1	1.777372000	-2.405678000	-1.070305000
1	2.443616000	-1.049889000	-1.185343000
8	2.936349000	-1.780300000	1.840341000
1	2.836471000	-1.867879000	0.864611000
1	3.196104000	-2.647465000	2.161193000
8	1.521638000	0.011472000	3.304225000
1	2.235983000	0.391169000	3.823786000
1	1.961488000	-0.669738000	2.749260000
8	-0.113159000	1.824060000	2.085445000
1	-0.359171000	2.462626000	2.759791000
1	0.469365000	1.171429000	2.533521000
8	-4.688819000	1.803910000	-0.046825000
1	-3.803522000	2.107185000	-0.277755000
1	-5.252771000	2.099126000	-0.768685000
8	-4.331568000	-0.992884000	0.614734000
1	-5.084348000	-1.324132000	1.111789000
1	-4.544986000	-0.067761000	0.415825000
8	3.310077000	2.815762000	-1.554897000
1	4.107422000	3.125401000	-1.990860000
1	3.060936000	1.988628000	-1.995920000

E = – 1266.4693935 a. u.
H = – 1266.116730 a. u.

G = – 1266.214722 a. u.

Transition State *n* = 9 (explicit solvation model)

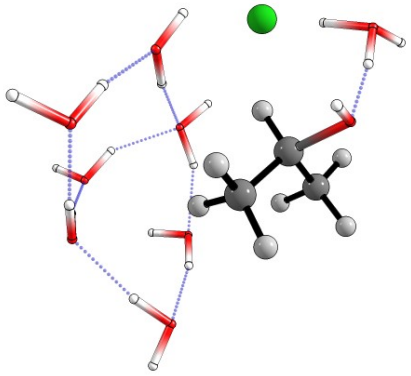


6	-1.469237000	0.742915000	0.116139000
1	-2.241341000	0.162071000	0.593774000
6	-1.600530000	1.162097000	-1.285342000
1	-0.732593000	0.779827000	-1.843203000
1	-2.534150000	0.825720000	-1.736091000
1	-1.514674000	2.257689000	-1.304956000
6	-0.230862000	0.971016000	0.846362000
1	0.303375000	1.866773000	0.513450000
1	-0.340430000	0.907370000	1.930762000
1	0.391521000	0.103816000	0.542337000
17	-2.042445000	-1.985588000	-0.545791000
8	1.701387000	0.897795000	-2.136526000
1	1.814680000	1.689808000	-1.575635000
1	2.589088000	0.515590000	-2.185430000
8	0.977218000	-1.582484000	-1.248954000
1	1.029194000	-0.655976000	-1.559627000
1	0.047393000	-1.859310000	-1.348670000
8	0.456659000	-2.334385000	1.443628000
1	-0.485396000	-2.413825000	1.220361000
1	0.850093000	-2.156041000	0.572630000
8	1.588143000	-0.451213000	2.983865000
1	1.115027000	-1.190275000	2.536047000
1	2.035343000	-0.843841000	3.738649000
8	3.134762000	0.690808000	0.972502000
1	3.353029000	-0.006427000	0.333750000
1	2.652258000	0.269683000	1.710295000
8	2.163833000	2.856155000	-0.229524000
1	2.805422000	3.567883000	-0.298510000
1	2.591402000	2.140157000	0.301897000
8	-4.415171000	0.050489000	-0.110358000
1	-5.316953000	-0.252333000	-0.245888000
1	-3.841185000	-0.717513000	-0.315909000
8	-3.025203000	2.319152000	0.802575000
1	-3.156400000	2.484983000	1.741996000
1	-3.729806000	1.694115000	0.543360000
8	3.623778000	-1.111226000	-1.223806000
1	4.374251000	-1.691006000	-1.378882000
1	2.822950000	-1.660851000	-1.298226000

E = – 1266.4345465 a. u.
H = – 1266.083359 a. u.
G = – 1266.172044 a. u.
f = 172.1586*i*

Final Complex *n* = 9 (explicit solvation model)

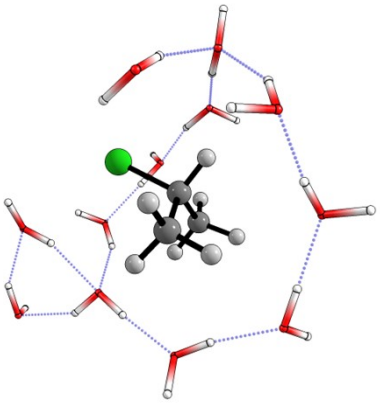
6	-0.992120000	1.363498000	0.107896000
1	-1.245184000	0.299064000	0.070155000
6	-1.049430000	1.960757000	-1.281816000
1	-0.277797000	1.499886000	-1.909743000
1	-2.024544000	1.781653000	-1.752961000
1	-0.866055000	3.040795000	-1.237724000
6	0.342231000	1.542477000	0.792055000
1	0.670393000	2.588136000	0.763374000
1	0.309069000	1.190112000	1.830972000
1	1.090802000	0.935073000	0.272483000
17	-2.975397000	-1.714491000	-0.607545000
8	1.904449000	0.377959000	-2.251221000
1	2.319833000	1.111084000	-1.753461000
1	2.561929000	-0.330908000	-2.216489000
8	0.203957000	-1.415345000	-1.162235000
1	0.594370000	-0.625766000	-1.595063000
1	-0.722058000	-1.502376000	-1.435837000
8	-0.444919000	-1.601852000	1.550951000
1	-1.363891000	-1.872503000	1.430272000
1	-0.113752000	-1.522566000	0.636942000
8	1.574319000	-0.602636000	3.064586000
1	0.781541000	-1.013264000	2.664472000
1	1.873936000	-1.219919000	3.737722000
8	3.337564000	-0.160847000	0.909813000
1	3.201618000	-0.920537000	0.321549000
1	2.765162000	-0.310642000	1.685507000
8	3.204140000	2.116161000	-0.531584000
1	4.087349000	2.442745000	-0.723261000
1	3.324442000	1.359759000	0.088537000
8	-4.047802000	0.703983000	0.199757000
1	-4.495440000	1.114537000	-0.551051000
1	-3.627742000	-0.307371000	-0.135070000
8	-2.051780000	2.013794000	0.888303000
1	-1.842461000	1.907127000	1.824929000
1	-3.256982000	1.316173000	0.515696000
8	2.818223000	-2.147582000	-1.115308000
1	3.198045000	-3.026481000	-1.197315000
1	1.849867000	-2.256930000	-1.139675000



E = – 1266. 4819544 a. u.
H = – 1266.131375 a. u.
G = – 1266.218880 a. u.

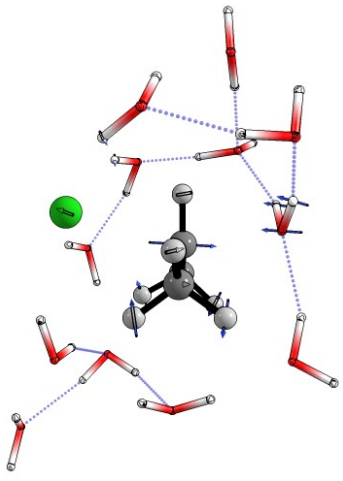
Initial Complex *n* = 12 (explicit solvation model)

6	-0.727105000	0.153555000	0.094974000
1	-1.769630000	-0.159327000	-0.005784000
6	-0.152571000	0.545753000	-1.249578000
1	0.886884000	0.871437000	-1.144373000
1	-0.198504000	-0.283409000	-1.960105000



1	-0.749526000	1.380892000	-1.635524000
6	-0.576199000	1.226142000	1.154606000
1	-1.080633000	2.137960000	0.811466000
1	-1.030170000	0.915100000	2.100687000
1	0.483433000	1.454967000	1.312324000
17	0.113805000	-1.372051000	0.691403000
8	2.903046000	0.969935000	0.133002000
1	2.493890000	1.851475000	0.027840000
1	3.854305000	1.092239000	0.293786000
8	3.292651000	-1.314418000	1.590052000
1	2.787118000	-0.532617000	1.296493000
1	2.751290000	-1.735933000	2.263440000
8	-2.481744000	-1.172767000	2.732184000
1	-1.522220000	-1.262709000	2.718510000
1	-2.765355000	-1.691705000	1.959327000
8	-3.929688000	0.620658000	1.072198000
1	-3.410615000	0.386898000	1.859582000
1	-4.048487000	-0.246778000	0.650861000
8	-3.097916000	2.334424000	-0.826539000
1	-3.927149000	2.757527000	-1.067377000
1	-3.335947000	1.734187000	-0.080111000
8	1.653725000	3.387614000	-0.221092000
1	1.825666000	4.121279000	0.375556000
1	0.723070000	3.502896000	-0.502255000
8	-1.935665000	-2.369216000	-1.853175000
1	-2.197088000	-1.900266000	-2.650863000
1	-0.962187000	-2.472522000	-1.932021000
8	-3.533691000	-2.081376000	0.267160000
1	-4.138181000	-2.827426000	0.220415000
1	-2.899213000	-2.207751000	-0.477762000
8	5.496354000	0.286600000	0.884539000
1	6.004451000	-0.132408000	0.183034000
1	4.998062000	-0.435384000	1.302067000
8	2.901242000	-1.461760000	-1.307248000
1	2.828037000	-0.515729000	-1.089509000
1	3.022786000	-1.854248000	-0.430410000
8	0.689404000	-2.491642000	-2.512002000
1	1.041334000	-3.255812000	-2.975775000
1	1.456786000	-2.096234000	-2.037397000
8	-0.914757000	3.972458000	-1.001655000
1	-0.959563000	4.331315000	-1.892407000
1	-1.705758000	3.400164000	-0.906975000

E = – 1495.7587379 a. u.
H = – 1495.320186 a. u.
G = – 1495.428509 a. u.



Transition State *n* = 12 (explicit solvation model)

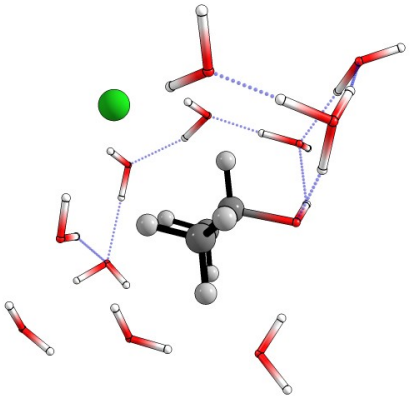
6	0.576929000	0.473911000	-0.176148000
1	1.486934000	-0.111666000	-0.189432000
6	-0.357268000	0.376725000	0.969330000
1	-1.295432000	-0.046299000	0.607386000
1	0.035207000	-0.250215000	1.768620000
1	-0.584898000	1.380162000	1.340117000
6	0.251927000	1.329708000	-1.346103000
1	0.201111000	2.374816000	-1.018317000
1	0.985370000	1.212976000	-2.146458000
1	-0.742029000	1.052673000	-1.713971000
17	-0.081308000	-1.751107000	-1.349316000
8	-3.558372000	-0.311916000	1.238440000
1	-3.375450000	0.645228000	1.201679000
1	-4.469281000	-0.400867000	0.911366000
8	-2.888228000	-0.149390000	-1.495780000
1	-2.990857000	-0.418938000	-0.564320000
1	-2.181833000	-0.723986000	-1.830372000
8	2.803007000	-0.683130000	-2.302026000
1	1.936871000	-1.122328000	-2.283858000
1	3.334046000	-1.133983000	-1.628197000
8	3.679929000	1.620789000	-1.067584000
1	3.267038000	0.978297000	-1.679887000
1	4.398085000	1.092709000	-0.690392000
8	1.876372000	1.895585000	0.834959000
1	2.182960000	1.267009000	1.512687000
1	2.603587000	1.912574000	0.152348000
8	-2.855941000	2.239257000	0.229999000
1	-2.723303000	1.792578000	-0.618573000
1	-2.065411000	2.779724000	0.380156000
8	2.683262000	-0.501845000	2.140128000
1	2.989688000	-0.613708000	3.045393000
1	2.051726000	-1.262444000	1.970536000
8	4.468729000	-0.912109000	0.035997000
1	5.156844000	-1.552636000	0.238728000
1	3.932271000	-0.828622000	0.848609000
8	-5.577021000	-0.472150000	-0.711512000
1	-6.346676000	0.002027000	-1.036940000
1	-4.881071000	-0.349759000	-1.376220000
8	-1.665928000	-2.545121000	1.457663000
1	-2.341793000	-1.865273000	1.607429000
1	-1.519205000	-2.530964000	0.499645000
8	1.119329000	-2.504242000	1.523897000
1	1.035809000	-2.534539000	0.555345000
1	0.180765000	-2.527664000	1.798648000
8	-0.335160000	3.656687000	0.911746000
1	-0.247862000	4.566022000	1.210172000
1	0.539670000	3.244523000	1.016550000

E = – 1495.7242661 a. u.

H = – 1495.286695 a. u.

G = – 1495.389131 a. u.
f = 403.823*i*

Final Complex *n* = 12 (explicit solvation model)



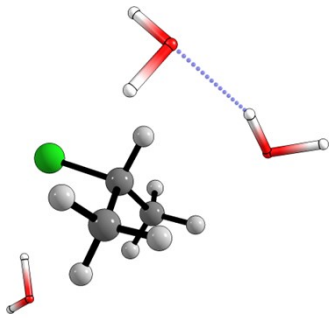
6	0.661213000	0.867410000	-0.033777000
1	1.243138000	-0.056032000	-0.152955000
6	-0.370522000	0.632464000	1.048090000
1	-0.996674000	-0.210354000	0.743119000
1	0.114715000	0.360539000	1.991175000
1	-0.991436000	1.517593000	1.211230000
6	0.083099000	1.276782000	-1.374474000
1	-0.503973000	2.196582000	-1.282402000
1	0.873141000	1.447171000	-2.115109000
1	-0.557212000	0.472035000	-1.745967000
17	0.165280000	-2.346249000	-1.272800000
8	-3.451054000	-0.568404000	1.465460000
1	-3.200419000	0.351171000	1.276925000
1	-4.345408000	-0.615097000	1.084802000
8	-2.672600000	-0.787275000	-1.286963000
1	-2.832989000	-0.995008000	-0.351605000
1	-1.891840000	-1.317055000	-1.523809000
8	2.271313000	-0.689446000	-2.556043000
1	1.526371000	-1.217123000	-2.134898000
1	2.811227000	-1.332735000	-3.026964000
8	3.406200000	1.076883000	-1.263541000
1	2.922261000	0.302800000	-1.818586000
1	4.066690000	0.647560000	-0.617295000
8	1.591888000	1.920469000	0.370559000
1	1.967897000	1.614217000	1.216250000
1	2.726631000	1.551656000	-0.675996000
8	-3.104884000	1.809776000	-0.190663000
1	-2.689314000	1.153227000	-0.775906000
1	-2.469958000	2.533544000	-0.087993000
8	2.736552000	0.059349000	2.198304000
1	2.854350000	0.070764000	3.153441000
1	2.162946000	-0.759721000	2.006035000
8	4.797352000	-0.071831000	0.513995000
1	5.660012000	0.184183000	0.851671000
1	4.161287000	-0.084866000	1.271006000
8	-5.363880000	0.019289000	-0.535843000
1	-5.001734000	0.915764000	-0.488110000
1	-4.817666000	-0.399727000	-1.215697000
8	-1.354899000	-2.547085000	1.726592000
1	-2.113030000	-1.942367000	1.779102000
1	-1.239862000	-2.737114000	0.783055000
8	1.347590000	-2.026067000	1.658882000
1	1.257177000	-2.231325000	0.708911000
1	0.419446000	-2.114378000	1.959718000
8	-0.878919000	3.775426000	0.503086000

1	-0.788648000	4.730182000	0.431659000
1	0.023088000	3.421537000	0.513148000

E = – 1495.7688404 a. u.
H = – 1495.332023 a. u.
G = – 1495.431856 a. u.

6.3 Microsolvation configurations

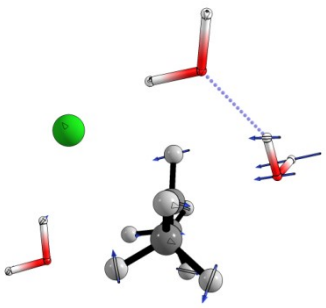
Initial Complex *n* = 3 (explicit solvation model)



6	-0.039022000	0.102269000	0.319680000
1	0.908600000	-0.225940000	0.753359000
6	-0.482216000	1.407106000	0.945253000
1	-1.450129000	1.717723000	0.534062000
1	-0.558441000	1.314175000	2.033361000
1	0.278071000	2.161608000	0.708130000
6	0.042759000	0.164370000	-1.193360000
1	0.855504000	0.852108000	-1.461538000
1	0.233034000	-0.826535000	-1.625638000
1	-0.898720000	0.538632000	-1.612167000
17	-1.212076000	-1.235170000	0.796226000
8	-3.268864000	0.621946000	-1.011923000
1	-2.945961000	-0.084564000	-0.436591000
1	-4.223380000	0.624069000	-0.895620000
8	2.761844000	1.412109000	0.231370000
1	3.584389000	1.902962000	0.309660000
1	3.021166000	0.504534000	0.006430000
8	2.967565000	-1.310541000	-0.595406000
1	2.697985000	-2.009830000	0.009630000
1	2.289696000	-1.301641000	-1.280678000

E = – 807.9271387 a. u.
H = – 807.742844 a. u.
G = – 807.801865 a. u.

Transition State *n* = 3 (explicit solvation model)

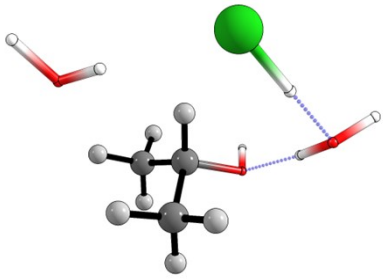


6	0.326720000	-0.792042000	-0.154617000
1	0.670692000	0.060190000	-0.716838000
6	-0.247472000	-1.910463000	-0.902856000
1	-0.208597000	-2.849590000	-0.342460000
1	-1.316858000	-1.626566000	-0.977873000
1	0.162322000	-2.002076000	-1.911203000
6	0.223658000	-0.750466000	1.310588000
1	0.673814000	-1.663402000	1.720755000
1	0.669450000	0.150351000	1.733034000
1	-0.853715000	-0.781190000	1.539863000

17	-1.062331000	1.663218000	-0.370548000
8	-2.885618000	-0.740772000	0.360269000
1	-2.503628000	0.134999000	0.145405000
1	-3.830622000	-0.590415000	0.447036000
8	2.559238000	-1.082339000	-0.086806000
1	3.012004000	-1.261022000	-0.918177000
1	2.647556000	-0.117445000	0.054845000
8	2.022807000	1.651372000	0.188336000
1	2.477844000	2.495519000	0.247206000
1	1.070512000	1.867673000	0.064630000

E = – 807.8774505 a. u.
H = – 807.695744 a. u.
G = – 807.750413 a. u.
f = 227.8827*i*

Final Complex *n* = 3 (explicit solvation model)



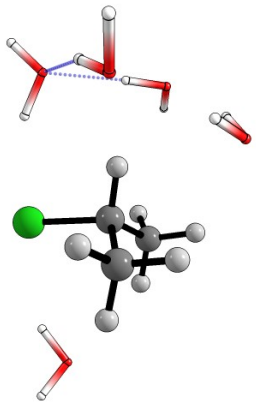
6	1.316111000	0.177221000	-0.092476000
1	0.487235000	-0.235922000	-0.684467000
6	2.604323000	-0.520057000	-0.482710000
1	3.445169000	-0.121514000	0.099584000
1	2.498305000	-1.593275000	-0.290248000
1	2.817360000	-0.387439000	-1.552614000
6	1.006324000	0.052364000	1.385938000
1	1.825188000	0.487560000	1.972847000
1	0.075863000	0.572189000	1.642346000
1	0.896660000	-1.006410000	1.642938000
17	-2.420000000	-0.391860000	-0.150279000
8	0.055037000	-2.675390000	-0.080233000
1	-0.693496000	-2.062556000	-0.038203000
1	-0.341269000	-3.530029000	-0.273017000
8	1.401016000	1.598776000	-0.376848000
1	1.761119000	1.710052000	-1.263668000
1	-0.197408000	2.110006000	-0.131081000
8	-1.159766000	2.174919000	0.092806000
1	-1.552954000	2.827116000	-0.496205000
1	-1.812622000	0.848232000	-0.023786000

E = – 807.9297468 a. u.
H = – 807.748341 a. u.
G = – 807.804004 a. u.

Initial Complex *n* = 5 (explicit solvation model)

6	-0.528861000	-0.312901000	0.024598000
1	0.542281000	-0.104149000	0.017896000
6	-0.947837000	-1.015721000	-1.245914000
1	-2.026979000	-1.206962000	-1.245889000

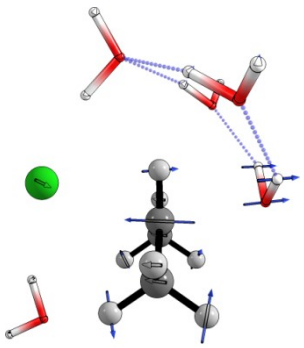
1	-0.682630000	-0.428480000	-2.131548000
1	-0.405964000	-1.969772000	-1.273435000
6	-0.931354000	-1.030882000	1.291015000
1	-0.422241000	-2.003154000	1.280348000
1	-0.608606000	-0.475631000	2.176507000
1	-2.015721000	-1.189040000	1.312799000
17	-1.282599000	1.396129000	0.039612000
8	-4.081824000	-0.405611000	-0.125040000
1	-3.540248000	0.388594000	-0.036725000
1	-4.948861000	-0.157922000	0.209216000
8	1.892898000	-2.284188000	0.039332000
1	2.172354000	-1.739346000	-0.710667000
1	2.046885000	-1.700347000	0.795485000
8	2.171465000	0.001542000	1.889499000
1	2.906980000	0.057020000	2.506320000
1	2.238465000	0.788672000	1.327503000
8	2.422465000	-0.106357000	-1.863799000
1	1.939337000	-0.039257000	-2.692468000
1	2.245275000	0.720429000	-1.389999000
8	1.817350000	2.084367000	-0.076514000
1	2.180417000	2.974085000	-0.124940000
1	0.852929000	2.190063000	-0.019814000



E = – 960.7742631 a. u.
H = – 960.533504 a. u.
G = – 960.603972 a. u.

Transition State *n* = 5 (explicit solvation model)

6	-0.272496000	-0.755656000	0.011616000
1	0.515782000	-0.024433000	0.022935000
6	-0.830109000	-1.227103000	-1.278363000
1	-1.906204000	-1.017073000	-1.290102000
1	-0.331473000	-0.752972000	-2.125797000
1	-0.708037000	-2.317093000	-1.320087000
6	-0.855285000	-1.231842000	1.289005000
1	-0.727961000	-2.321063000	1.332838000
1	-0.378140000	-0.755247000	2.147623000
1	-1.932291000	-1.026787000	1.280033000
17	-1.328888000	1.623630000	0.012965000
8	-3.782385000	-0.360676000	-0.018683000
1	-3.216722000	0.431088000	-0.011280000
1	-4.682934000	-0.026551000	-0.048981000
8	1.452828000	-2.043310000	0.028511000
1	1.904563000	-1.634334000	-0.732294000
1	1.900129000	-1.628423000	0.787802000
8	2.328182000	-0.035803000	1.760733000
1	2.671950000	0.195399000	2.627293000
1	2.180871000	0.803350000	1.288753000
8	2.278129000	-0.095152000	-1.782790000

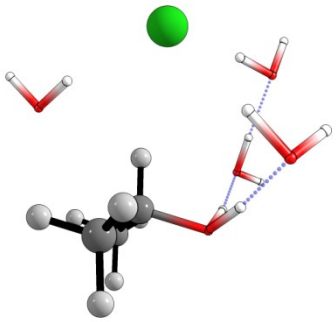


1	2.873626000	0.080639000	-2.515660000
1	2.157561000	0.752007000	-1.316624000
8	1.649329000	2.024951000	-0.035789000
1	1.951751000	2.937399000	-0.067965000
1	0.657293000	2.069912000	-0.028297000

E = – 960.7400112 a. u.
H = – 960.500725 a. u.
G = – 960.567092 a. u.
f = 406.216*i*

Final Complex *n* = 5 (explicit solvation model)

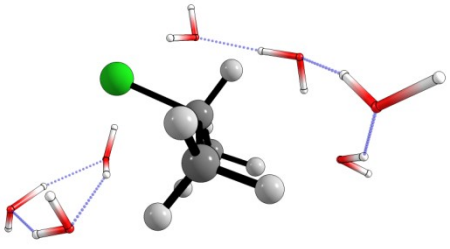
6	-1.353421000	-0.569998000	0.201358000
1	-0.739199000	0.057578000	-0.451087000
6	-2.386279000	-1.323221000	-0.602184000
1	-3.021600000	-0.584771000	-1.103239000
1	-1.909160000	-1.944556000	-1.369285000
1	-3.002402000	-1.954893000	0.049285000
6	-1.923463000	0.242822000	1.339422000
1	-2.467495000	-0.407014000	2.036153000
1	-1.135436000	0.781982000	1.877380000
1	-2.606814000	0.985421000	0.915636000
17	1.062595000	2.075699000	0.043396000
8	-1.875226000	2.006016000	-1.287277000
1	-0.992275000	2.163663000	-0.906419000
1	-2.030879000	2.763468000	-1.857974000
8	-0.425990000	-1.569655000	0.797473000
1	0.062542000	-2.021059000	0.030278000
1	0.345976000	-1.035930000	1.318715000
8	1.379971000	-0.260890000	1.849619000
1	1.242836000	0.639647000	1.433343000
1	2.224699000	-0.537136000	1.465027000
8	0.938869000	-2.328813000	-1.208139000
1	1.374899000	-3.178057000	-1.322644000
1	1.643105000	-1.632435000	-1.205928000
8	2.652796000	-0.334093000	-0.808648000
1	3.412010000	-0.095248000	-1.349208000
1	2.150693000	0.514313000	-0.673567000



E = – 960.7915617 a. u.
H = – 960.551687 a. u.
G = – 960.615634 a. u.

Initial Complex *n* = 7 (explicit solvation model)

6	-0.458415000	-0.541133000	-0.803132000
1	-1.349432000	-0.084635000	-1.241822000
6	-0.404977000	-0.315941000	0.691543000

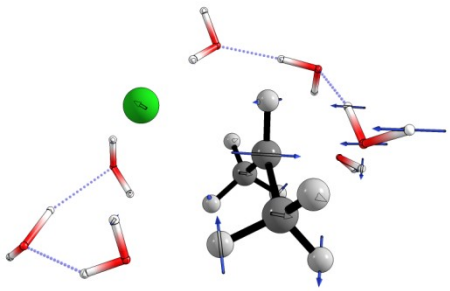


1	0.486483000	-0.791510000	1.115633000
1	-0.409806000	0.749013000	0.945345000
1	-1.293355000	-0.778468000	1.139279000
6	-0.337802000	-1.996594000	-1.195813000
1	-1.210363000	-2.518087000	-0.783797000
1	-0.334458000	-2.118231000	-2.283710000
1	0.575197000	-2.430964000	-0.771029000
17	0.923749000	0.401374000	-1.612561000
8	2.850413000	-1.534512000	0.227558000
1	2.726266000	-1.326020000	-0.705675000
1	3.787038000	-1.332687000	0.402521000
8	-3.244083000	1.293343000	0.125445000
1	-2.453007000	1.834501000	-0.034609000
1	-3.232199000	1.050799000	1.064654000
8	-3.463385000	-0.541343000	2.270687000
1	-3.655184000	-1.101853000	1.498387000
1	-4.112976000	-0.771238000	2.940082000
8	-0.923015000	2.801798000	-0.510771000
1	-0.280148000	2.300958000	-1.033642000
1	-1.066290000	3.624413000	-0.988506000
8	5.162896000	-0.064197000	0.842036000
1	4.487008000	0.591114000	1.095106000
1	5.783168000	-0.101024000	1.575182000
8	-3.539192000	-1.341583000	-0.399507000
1	-3.469060000	-0.362098000	-0.431664000
1	-4.294114000	-1.571678000	-0.948246000
8	2.681527000	1.079031000	1.314289000
1	2.448299000	0.199939000	0.964069000
1	2.169090000	1.696110000	0.782503000

E = – 1113.6248453 a. u.
H = – 1113.327778 a. u.
G = – 1113.410861 a. u.

Transition State *n* = 7 (explicit solvation model)

6	0.821183000	-0.646480000	0.803569000
1	1.167776000	0.237241000	1.320697000
6	0.558544000	-0.606496000	-0.657224000
1	-0.452554000	-0.996174000	-0.825933000
1	0.658578000	0.399063000	-1.070156000
1	1.257902000	-1.285337000	-1.159895000
6	0.402928000	-1.840551000	1.579573000
1	0.847978000	-2.732644000	1.122352000
1	0.672863000	-1.765698000	2.635883000
1	-0.684940000	-1.940102000	1.482657000
17	-1.209730000	0.950762000	1.440532000
8	-2.558635000	-1.547900000	-0.003621000
1	-2.437060000	-0.814100000	0.622446000
1	-3.502134000	-1.512003000	-0.229784000

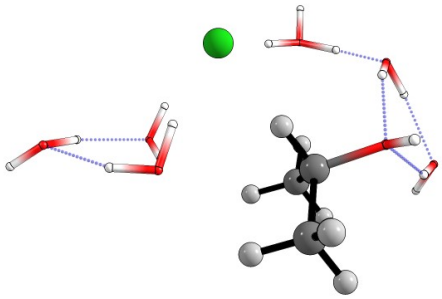


8	3.334979000	1.227240000	-0.218415000
1	2.532682000	1.791164000	-0.142718000
1	3.440559000	0.994828000	-1.152335000
8	3.639297000	-0.865131000	-2.078746000
1	3.648656000	-1.430223000	-1.294770000
1	4.198528000	-1.298920000	-2.729425000
8	1.030797000	2.607756000	0.112107000
1	0.242769000	2.177204000	0.511626000
1	1.011498000	3.517020000	0.423948000
8	-4.988404000	-0.385561000	-0.906670000
1	-4.369102000	0.304019000	-1.209888000
1	-5.701960000	-0.406220000	-1.549078000
8	2.862660000	-1.111084000	0.674891000
1	3.140077000	-0.170347000	0.402099000
1	3.238492000	-1.275307000	1.547713000
8	-2.620220000	0.968912000	-1.514173000
1	-2.353658000	0.049540000	-1.362152000
1	-2.291265000	1.401342000	-0.710837000

E = – 1113.5795674 a. u.
H = – 1113.284705 a. u.
G = – 1113.364929 a. u.
f = 424.0753*i*

Final Complex *n* = 7 (explicit solvation model)

6	-0.863771000	-1.505545000	-0.406375000
1	-0.210327000	-0.953008000	-1.092117000
6	-0.699395000	-0.952496000	0.994140000
1	0.343324000	-1.072818000	1.302565000
1	-0.948473000	0.114383000	1.032021000
1	-1.338167000	-1.504386000	1.698074000
6	-0.575101000	-2.990831000	-0.488481000
1	-1.224612000	-3.547991000	0.199809000
1	-0.732858000	-3.368054000	-1.508317000
1	0.474488000	-3.160272000	-0.225832000
17	1.017801000	1.608592000	-0.986295000
8	2.271739000	-1.367651000	-0.286874000
1	1.968232000	-0.572101000	-0.751009000
1	3.240250000	-1.327172000	-0.360149000
8	-2.950927000	1.417706000	-0.424185000
1	-1.958460000	2.287104000	-0.050791000
1	-3.476994000	1.035432000	0.309700000
8	-4.071460000	-0.428365000	1.216380000
1	-3.504507000	-1.024510000	0.698575000
1	-3.870286000	-0.608951000	2.139709000
8	-1.121993000	2.908843000	0.219089000
1	-0.237415000	2.413241000	-0.206844000
1	-1.199303000	3.769066000	-0.213590000
8	4.928873000	-0.432664000	0.042339000



1	4.467574000	0.161121000	0.664520000
1	5.748178000	-0.687998000	0.473709000
8	-2.240501000	-1.235475000	-0.799950000
1	-2.573953000	0.613248000	-0.834085000
1	-2.427193000	-1.720679000	-1.611435000
8	2.930848000	0.779846000	1.563420000
1	2.522194000	-0.054827000	1.284006000
1	2.492664000	1.418412000	0.981044000

E = – 1113.6247619 a. u.

H = – 1113.329623 a. u.

G = – 1113.408348 a. u.