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APPENDIX

APPENDIX A

SPECTRUM OF DINITRATE COMPOUNDS

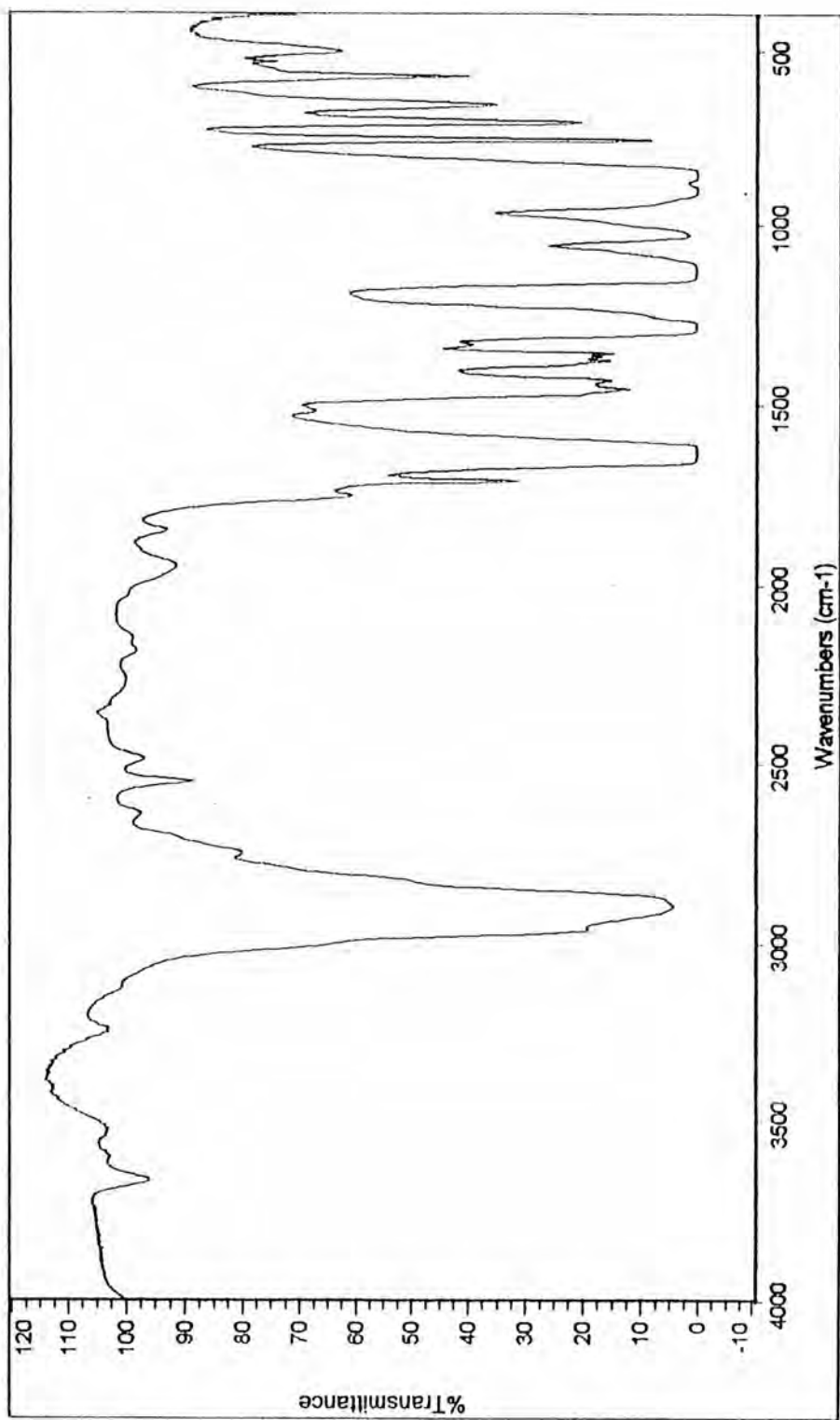


Figure A1 FTIR spectrum of triethylene glycol dinitrate

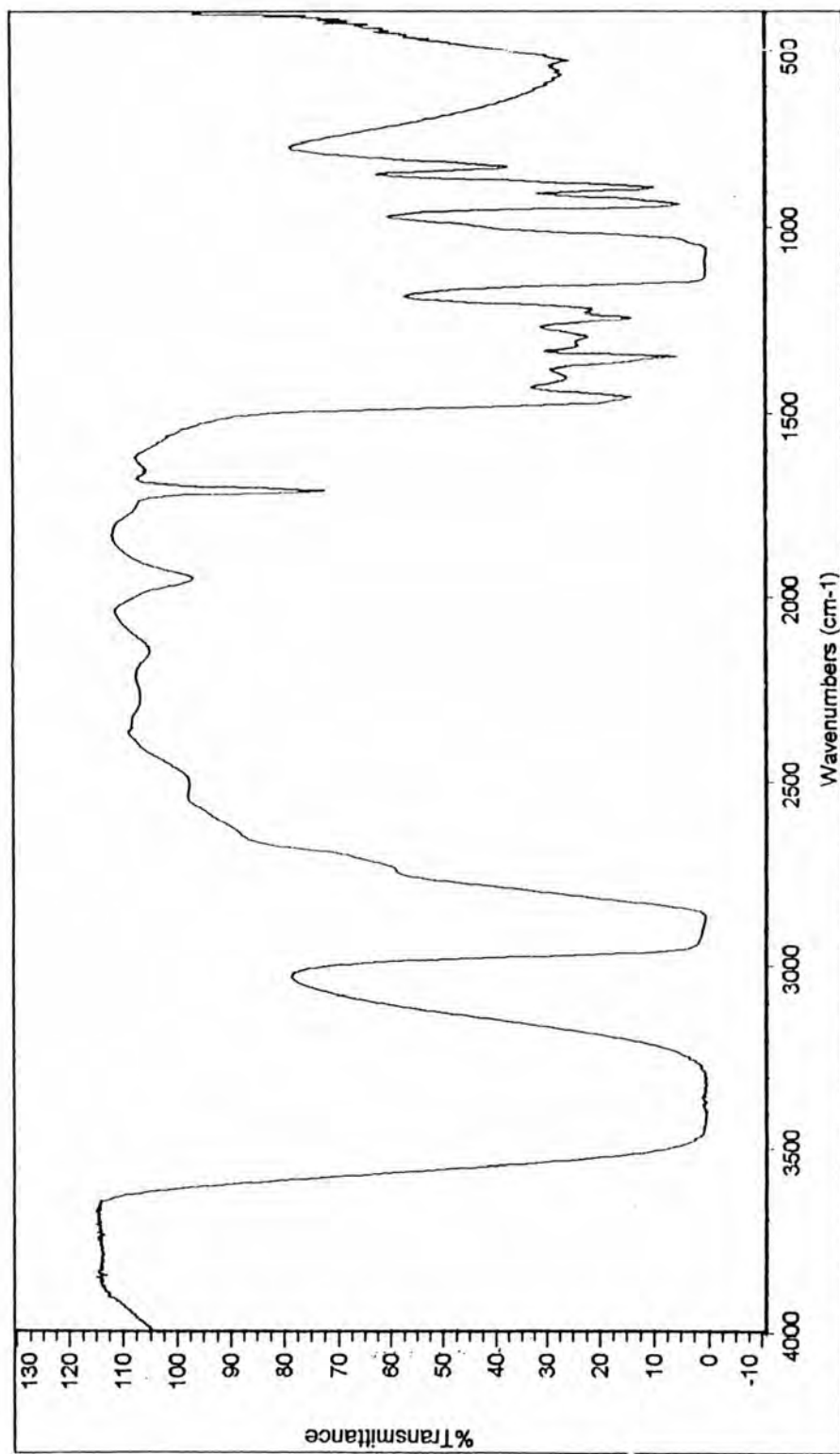


Figure A2 FTIR spectrum of triethylene glycol

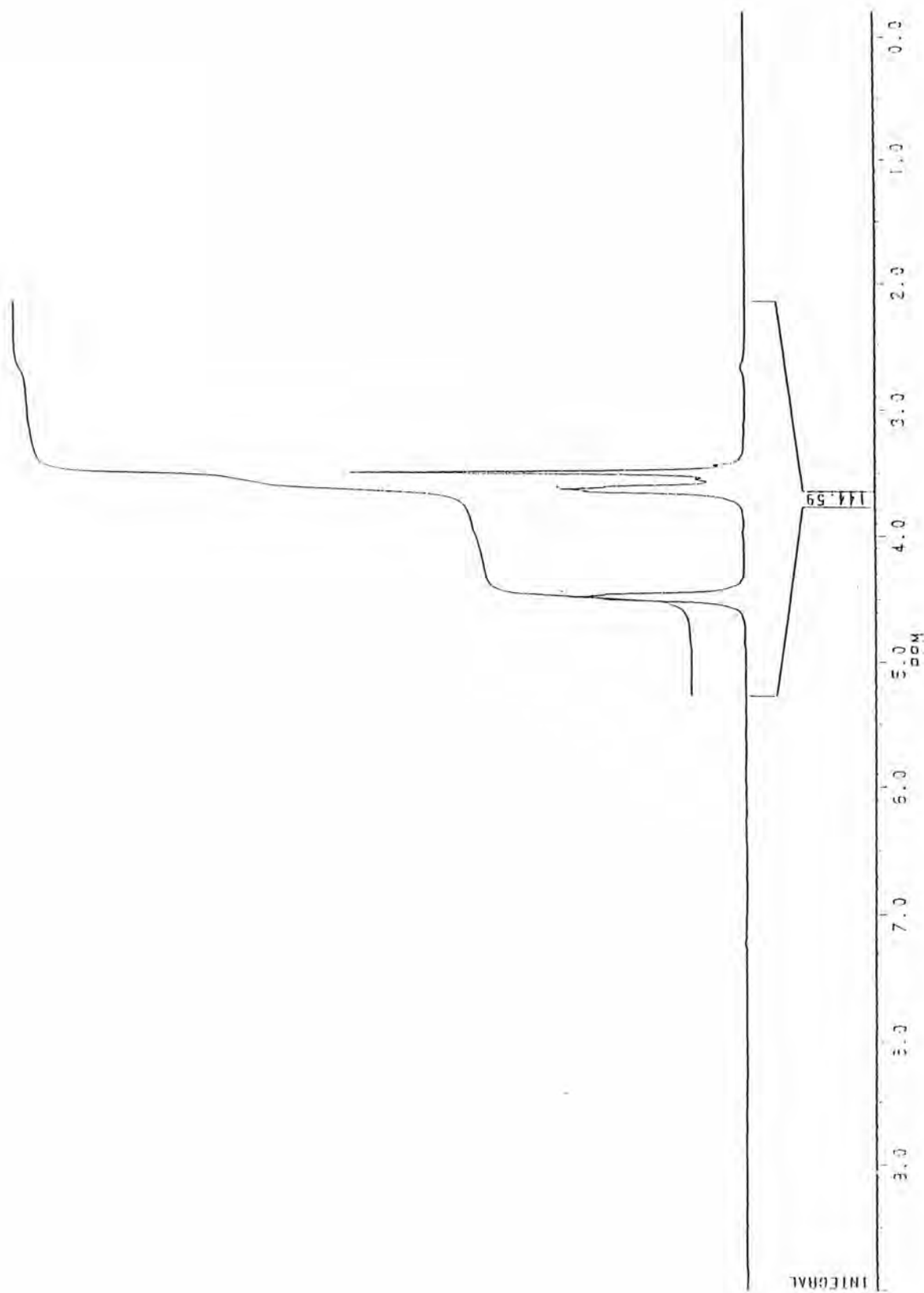


Figure A3 $^1\text{H-NMR}$ spectrum (CDCl_3) of triethylene glycol dinitrate

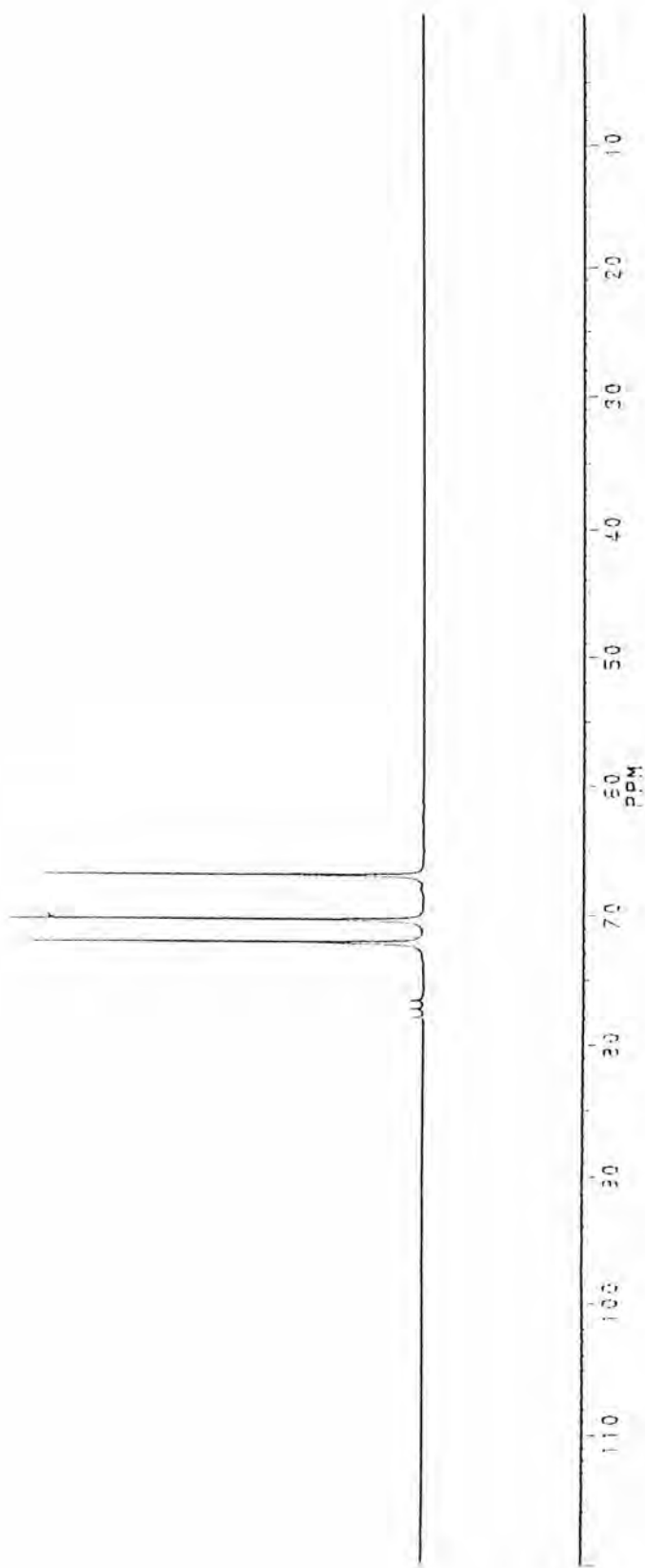


Figure A4 ^{13}C -NMR spectrum (CDCl_3) of triethylene glycol dinitrate

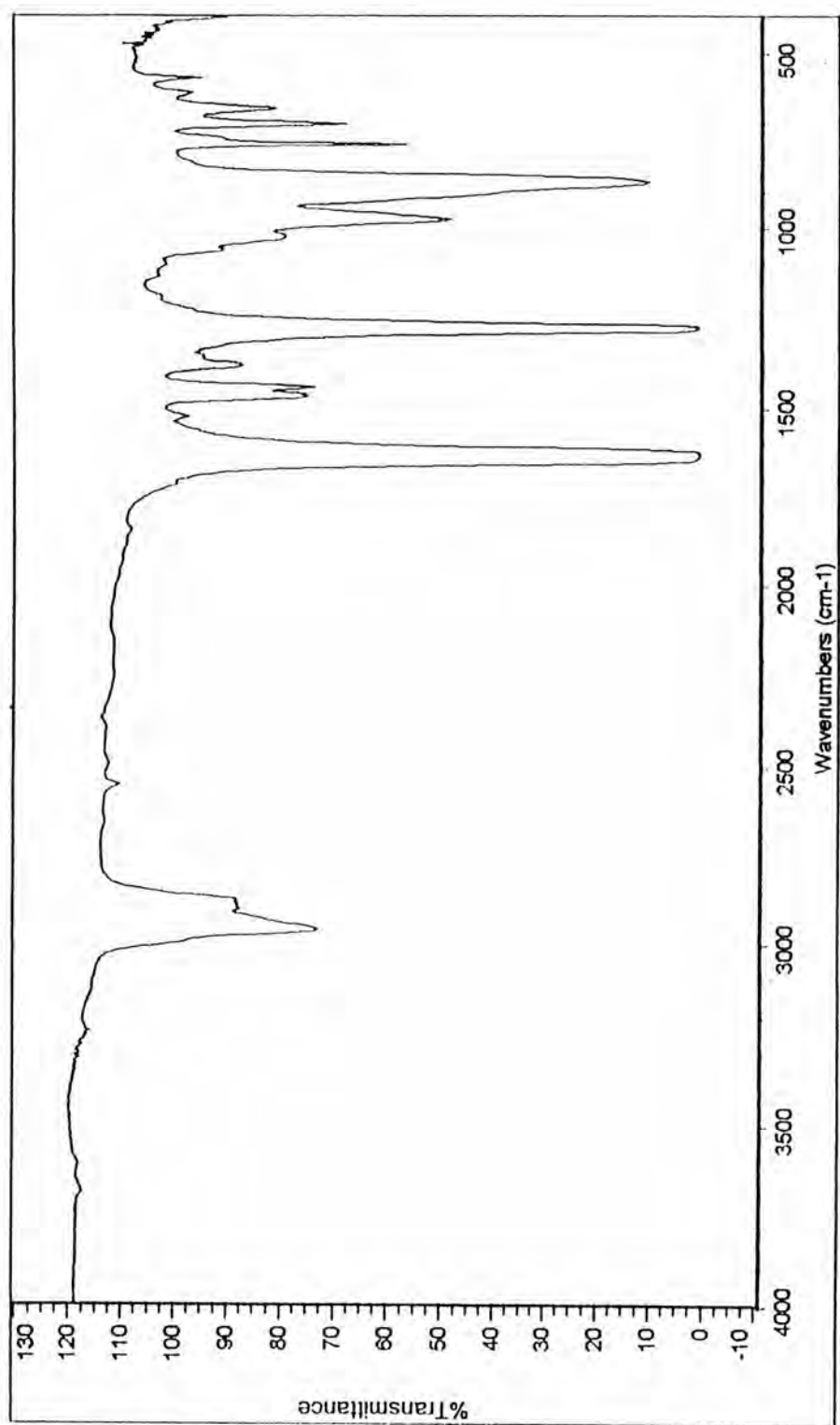


Figure A5 FTIR spectrum of 1,5-pentane dinitrate

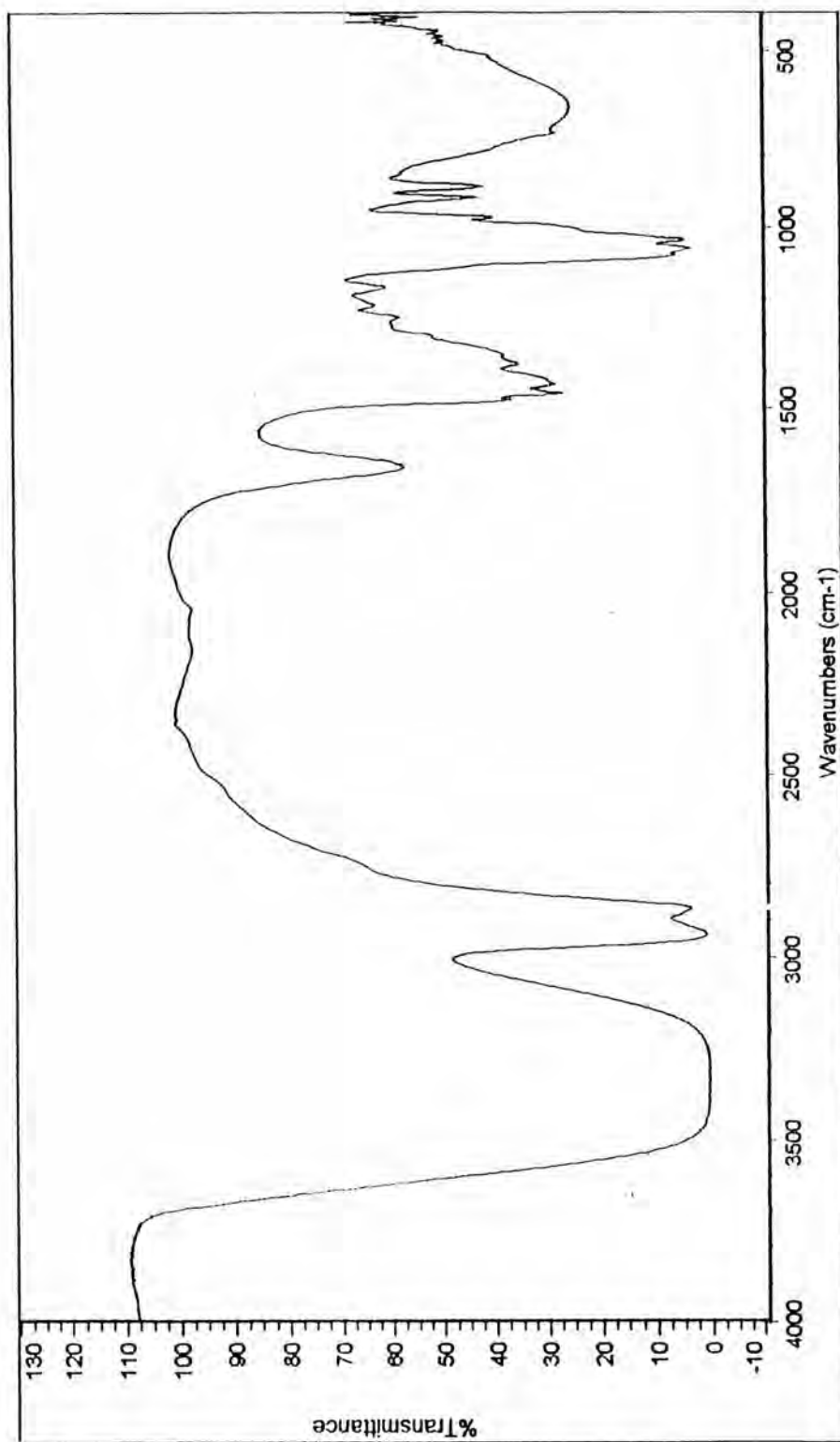


Figure A6 FTIR spectrum of 1,5-pentanediol

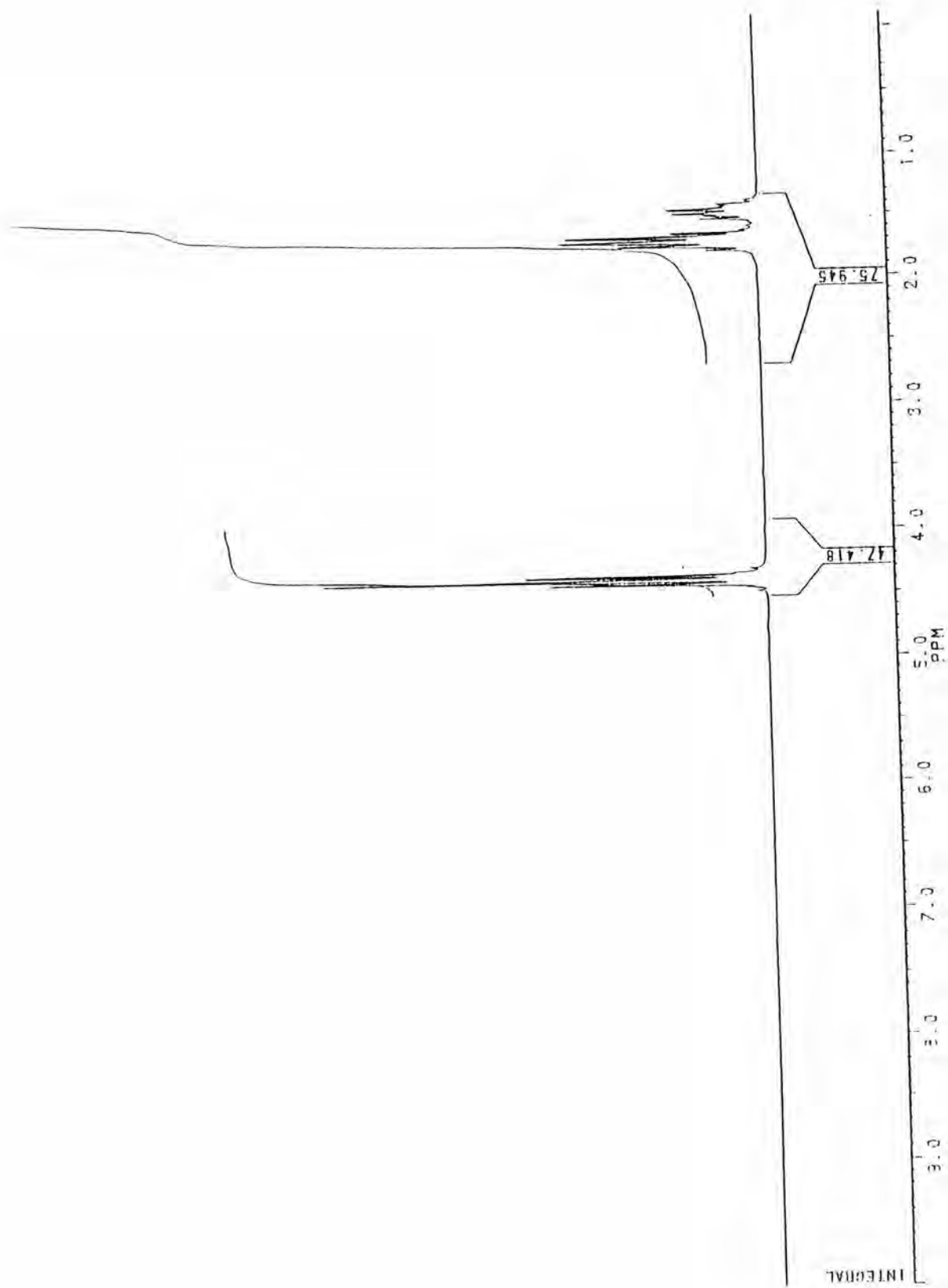


Figure A7 ¹H-NMR spectrum (CDCl₃) of 1,5-pentane dinitrate

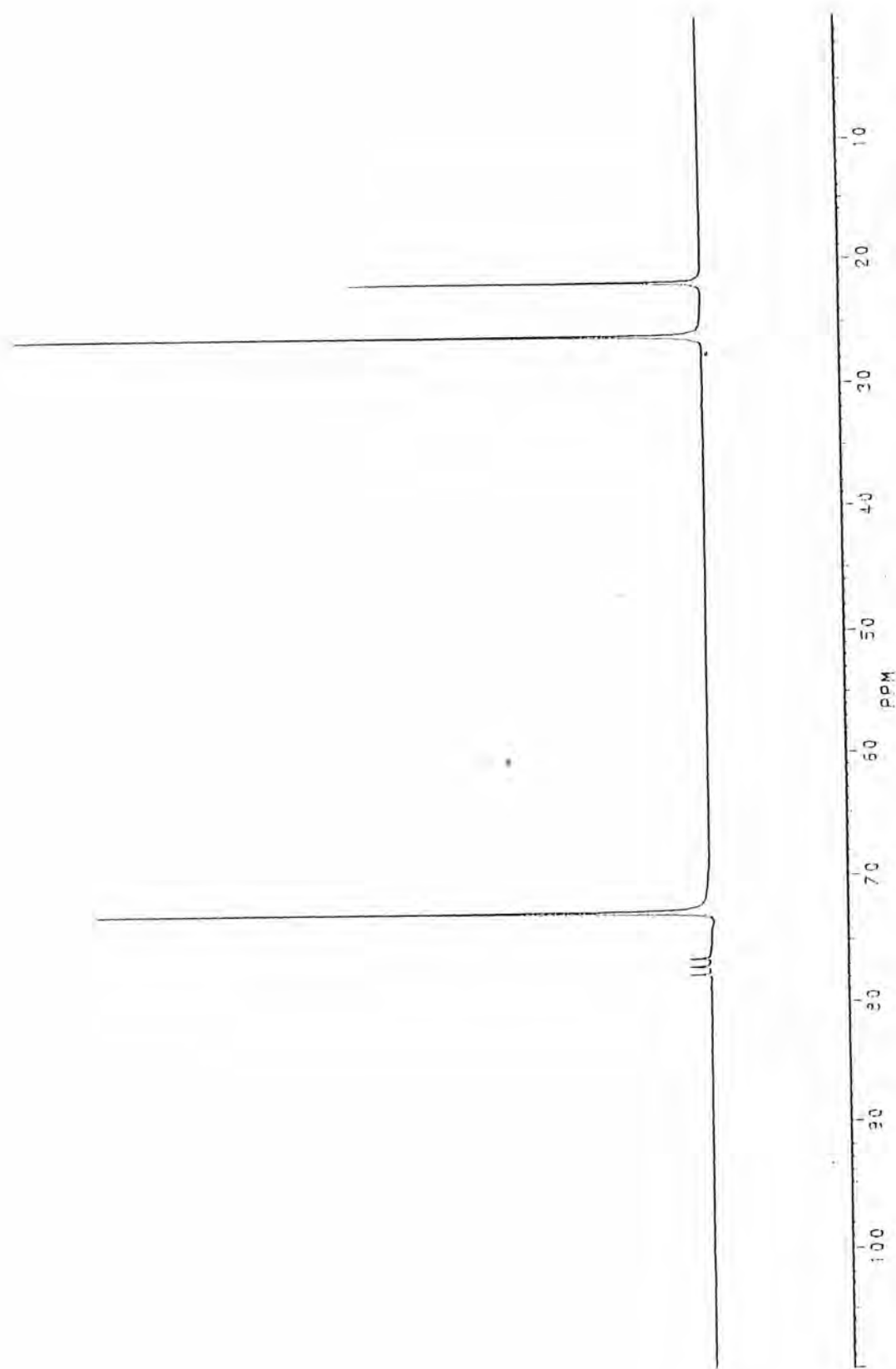


Figure A8 ^{13}C -NMR spectrum (CDCl_3) of 1,5-pentane dinitrate

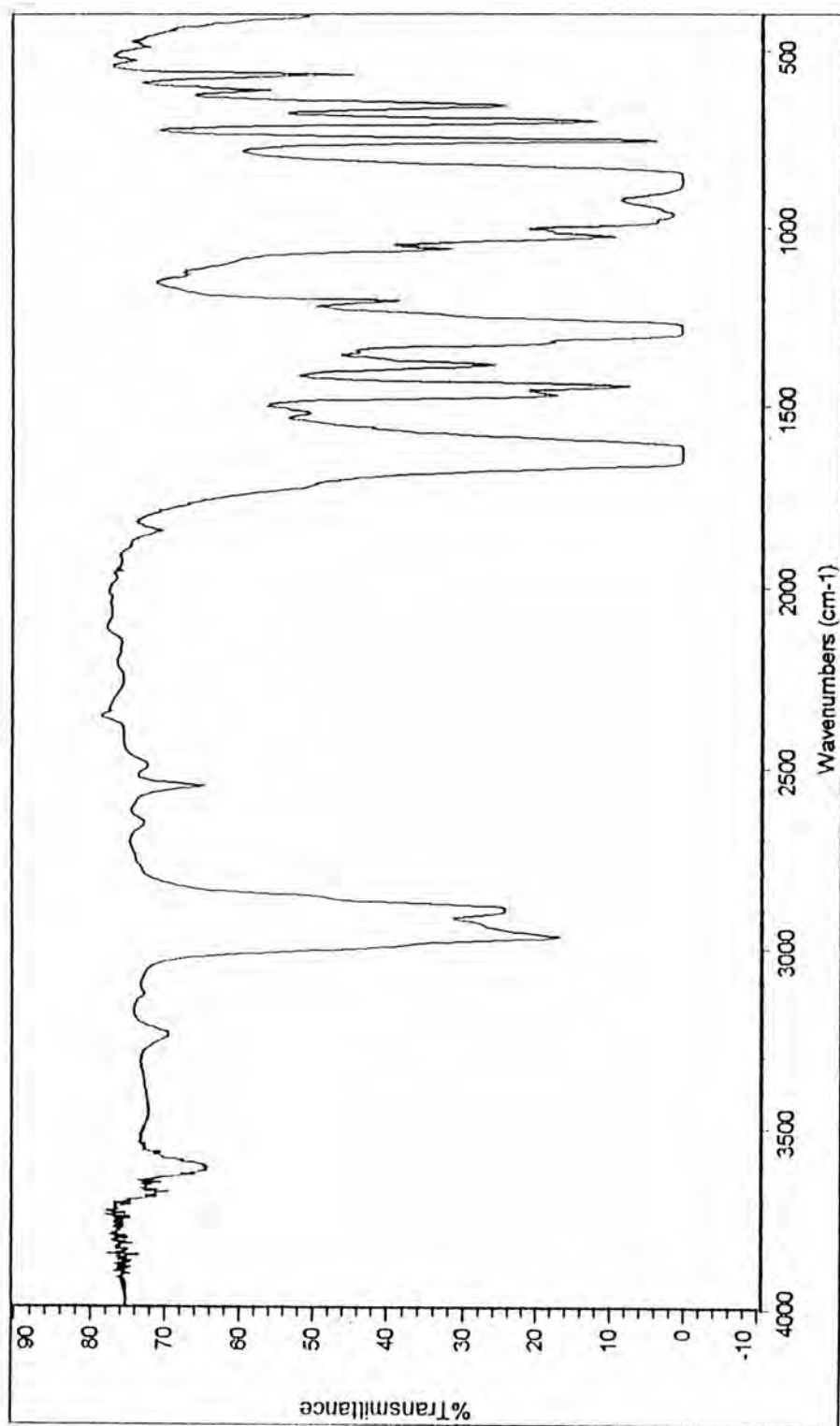


Figure A9 FTIR spectrum of 1,4-butane dinitrate

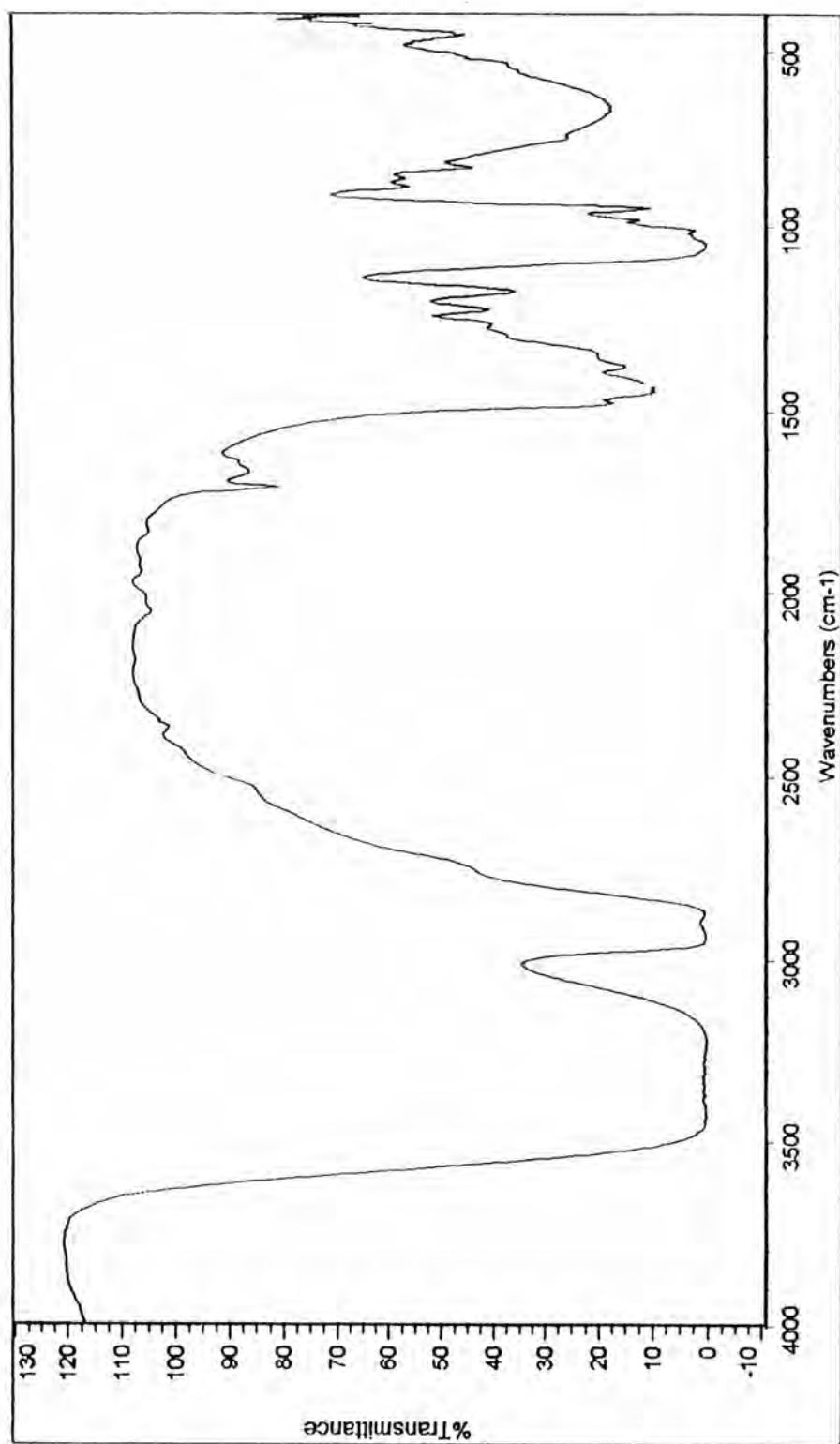


Figure A10 FTIR spectrum of 1,4-butanediol

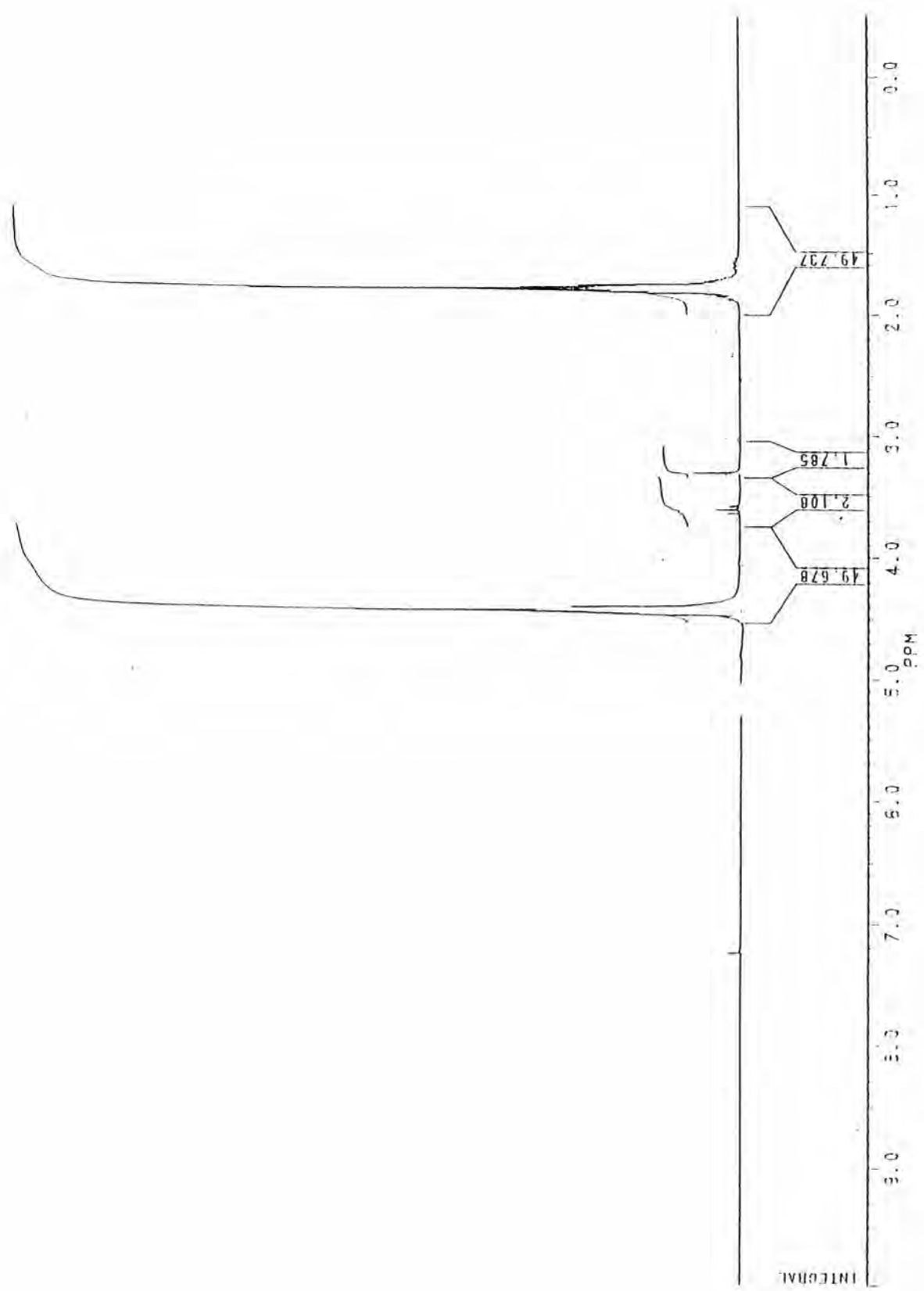


Figure A11 $^1\text{H-NMR}$ spectrum (CDCl_3) of 1,4-butane dinitrate

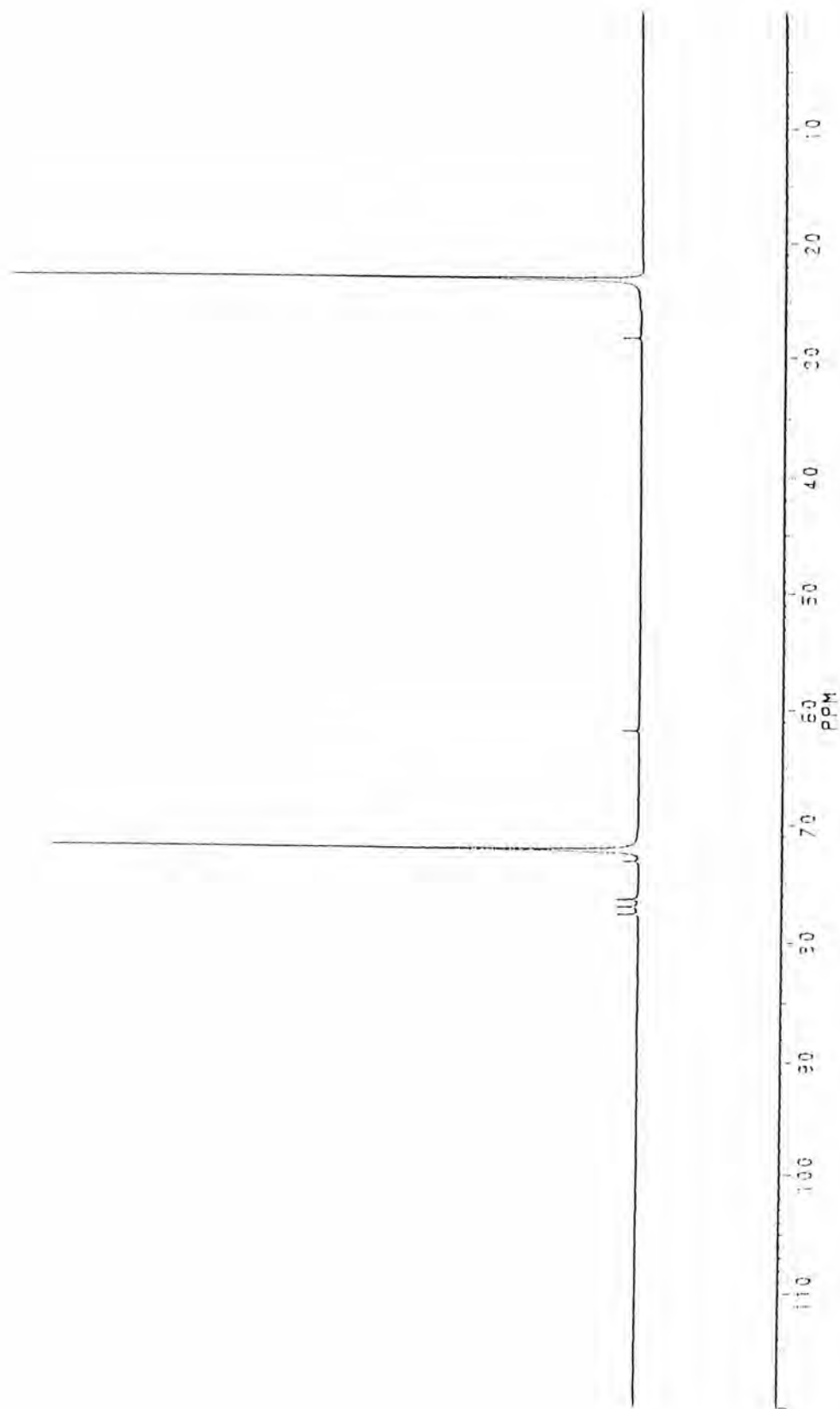


Figure A12 ^{13}C -NMR spectrum (CDCl_3) of 1,4-butane dinitrate

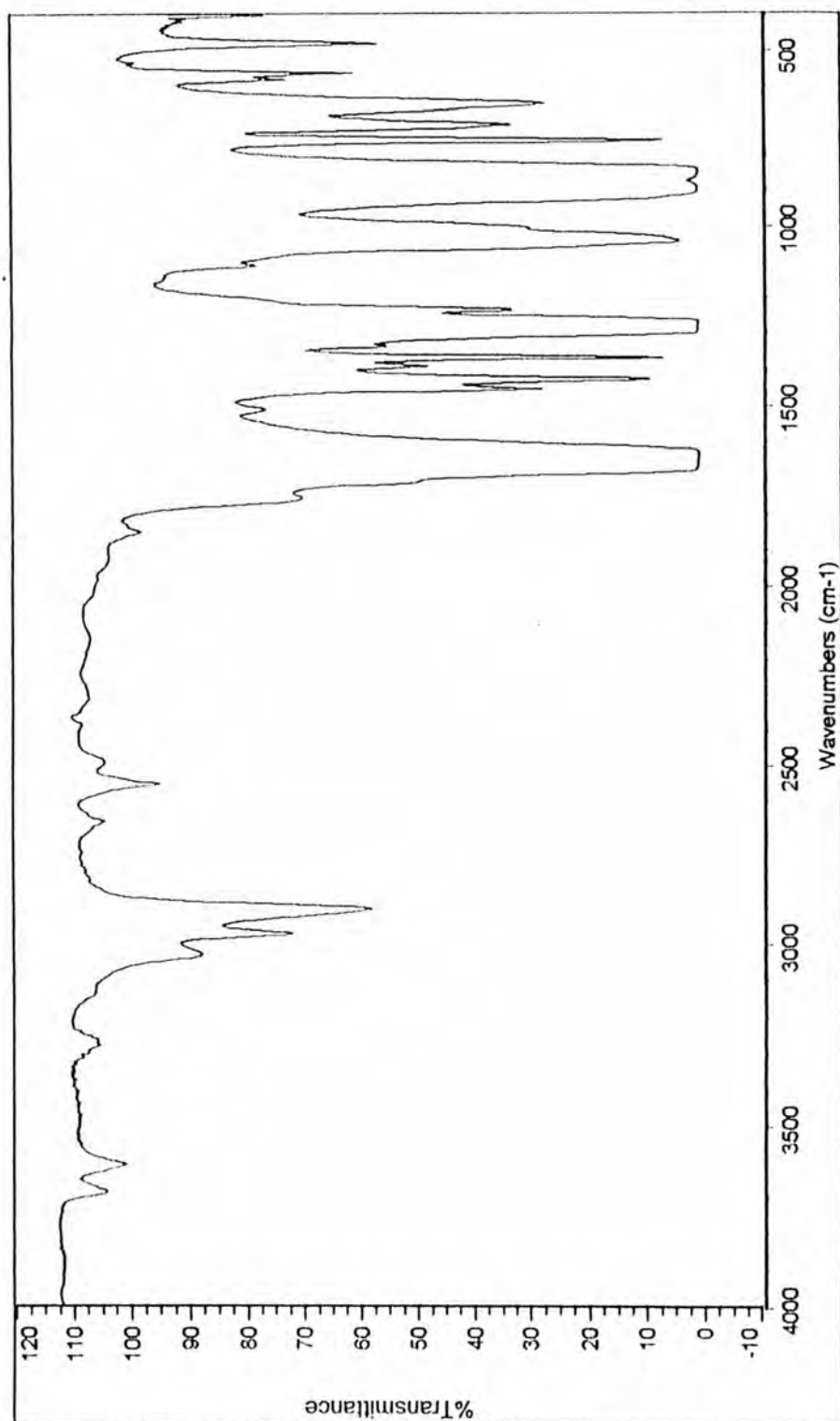


Figure A13 FTIR spectrum of 1,2-ethane dinitrate

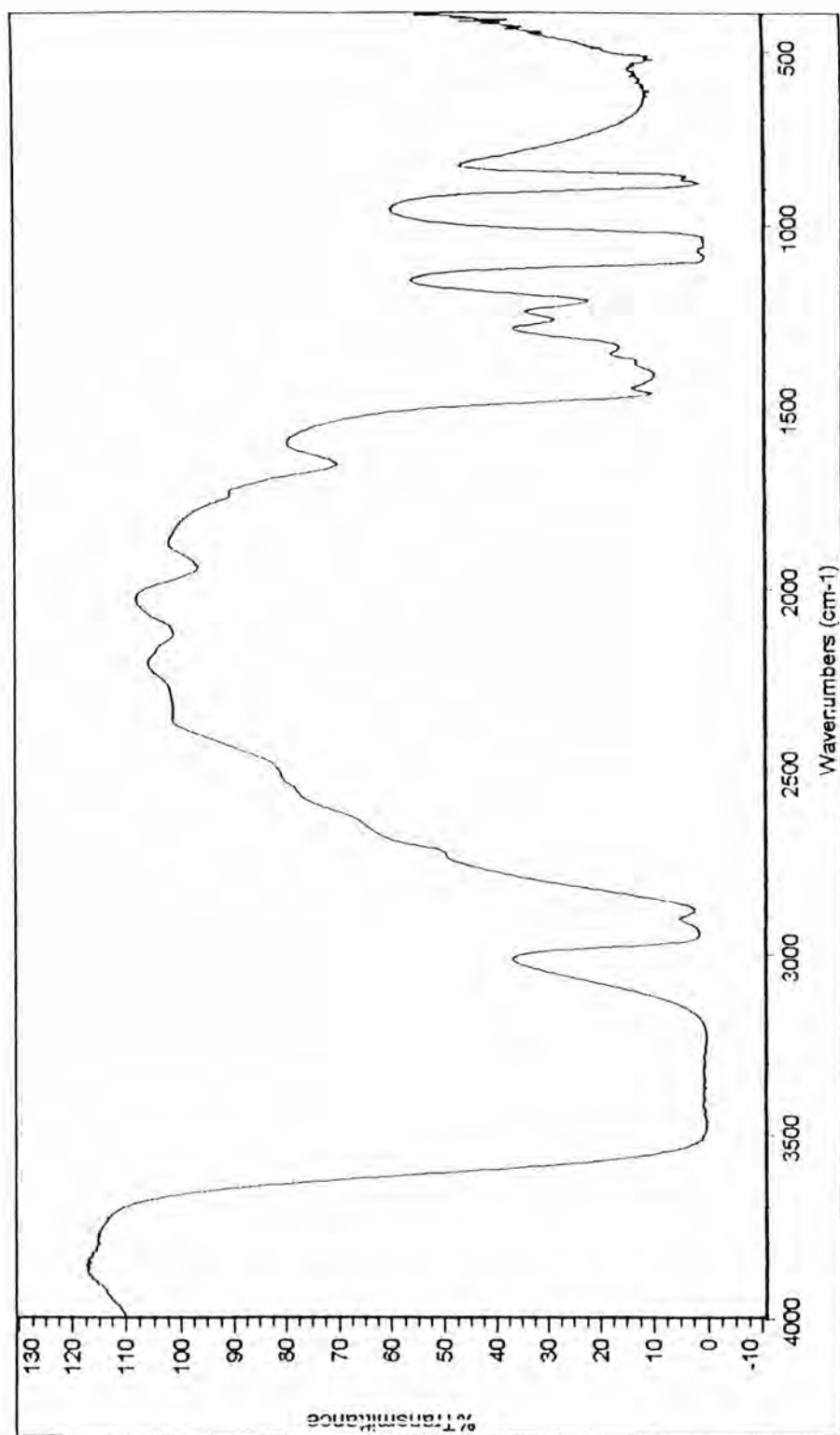


Figure A14 FTIR spectrum of 1,2-ethanediol

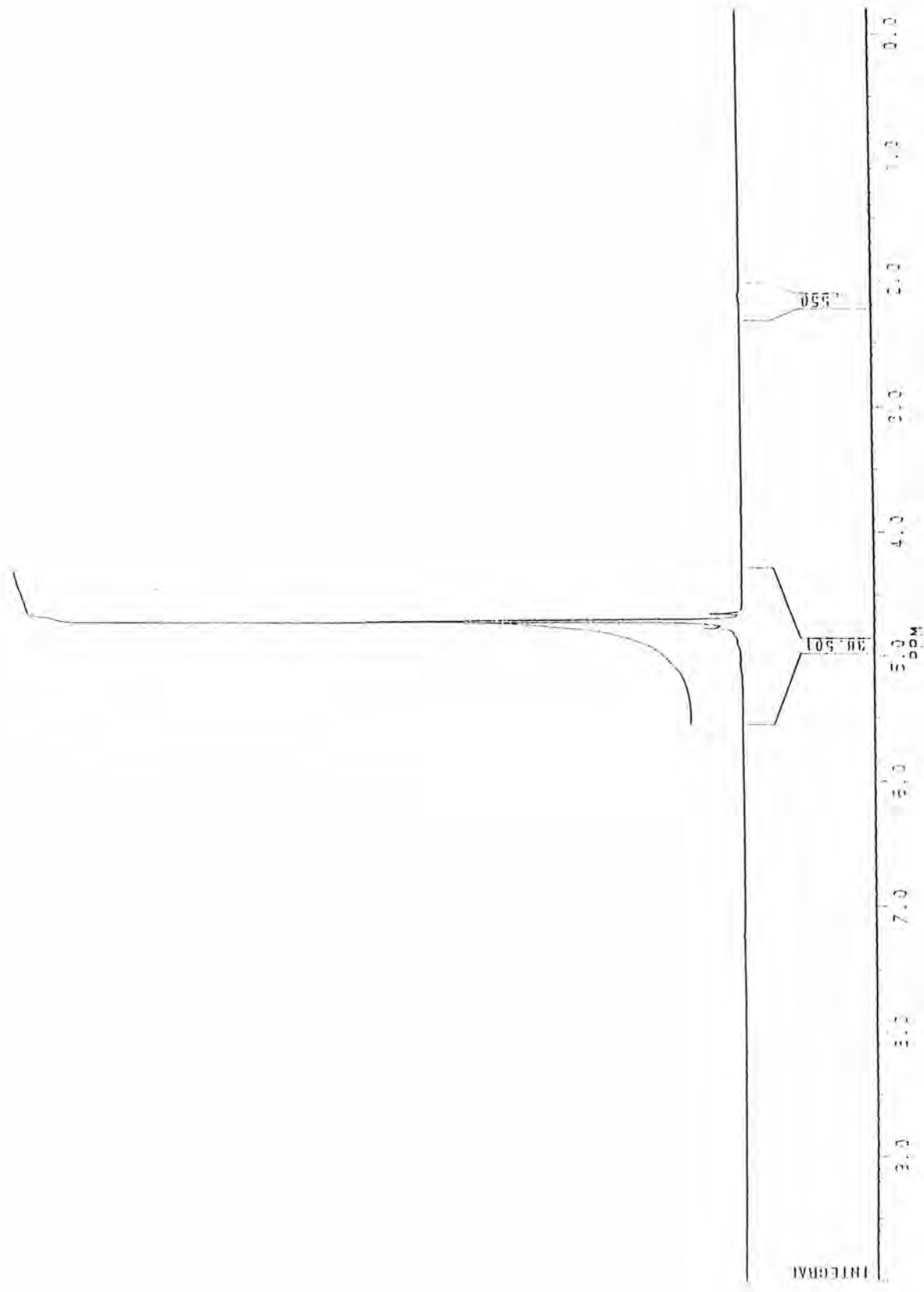


Figure A15 ¹H-NMR spectrum (CDCL₃) of 1,2-ethane dinitrate

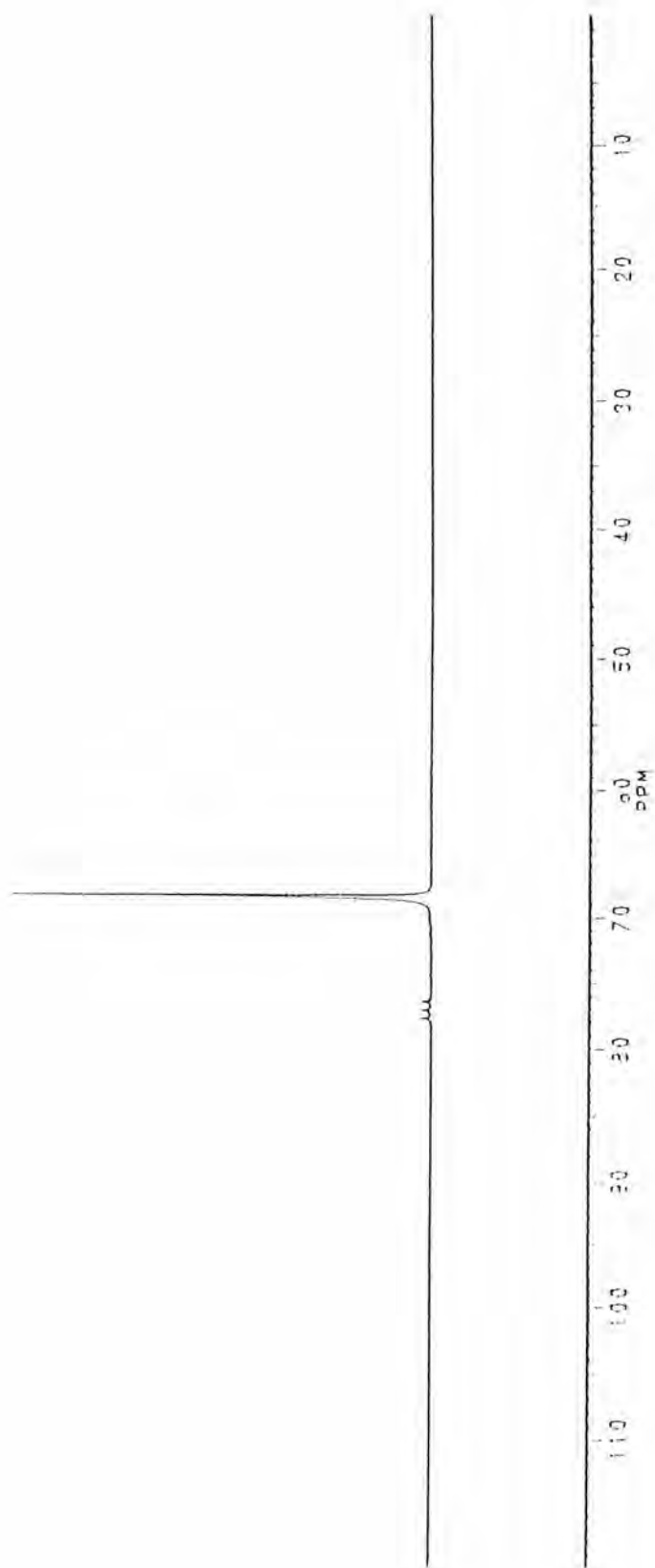


Figure A16 ^{13}C -NMR spectrum (CDCl_3) of 1,2-ethane dinitrate

APPENDIX B

THE CALCULATION OF CETANE INDEX.

The Calculated Cetane Index was determined from the following equation:

1. When it is not applicable to fuels containing additives for raising cetane number:

$$\text{Calculated cetane index} = -420.34 + 0.016G^2 + 0.192G \log M + 65.01 (\log M)^2 - 0.0001809M^2 \quad [B1]$$

2. When it is applicable to fuels containing additives for raising cetane number. The Calculated Cetane Index is determined from the equation B1 plus equation B2

$$\text{Improver value} = 0.1742(0.1G)^{1.4444}(0.01M)^{1.0052} \{\ln(1+17.5534D)\} \quad [B2]$$

where

G = API gravity, determined by Test Method D287 or D 1298

M = mid-boiling temperature, °F, determined by Test Method D 86 and corrected to standard barometric pressure.

D = percent weight of cetane improver, % wt.

For example;

-Determine the cetane index of the blended diesel fuel with triethylene glycol dinitrate when percent weight of cetane improver at 0.10 % wt., mid-boiling point at 525.56 °F, API gravity = 37.3

Solution;

From the equation B1,

$$\begin{aligned} \text{CCI} &= -420.34 + 0.016(37.3)^2 + 0.192(37.3)\{\log(525.56)\} + 65.01\{\log(525.56)\}^2 \\ &\quad - 0.0001809(525.56)^2 \\ &= 52.65 \end{aligned}$$

And from the equation B2,

$$\begin{aligned} \text{Improver value} &= 0.1742\{0.1(37.3)\}^{1.4444} \{0.01(525.56)\}^{1.0052} \\ &\quad \{\ln(1+17.5534(0.10))\} \\ &= 6.27 \end{aligned}$$

Therefore;

$$\begin{aligned} \text{CCI Improver} &= \text{CCI} + \text{Improver value} \\ &= 52.65 + 6.27 \\ &= 58.92 \end{aligned}$$

APPENDIX C

GENERAL PHYSICAL PROPERTIES TEST OF DIESEL FUEL.

Test items	ASTM D	Limits
1. API Gravity @ 60 °F	1298	report
2. Specific Gravity @ 15.6 /15.6 °C -HSD(0.05%S), HSD(0.25%S)	1298	0.81-0.87
3. Calculated Cetane Index -HSD(0.05%S), HSD(0.25%S)	976	47 min
4. Kinematic Viscosity @40 °C, cSt -HSD(0.05%S), HSD(0.25%S)	445	1.8-4.1
5. Pour Point, °C -HSD(0.05%S), HSD(0.25%S)	97	10 max
6. Sulphur Content, %wt. -HSD(0.05%S) -HSD(0.25%S)	4294 or 1552	0.05 max 0.25 max
7. Copper Strip Corrosion, Number (3 hrs. @ 50 °C)	130	No.1 max
8. Carbon Residue, %wt.	189 or 4530	0.05 max
9. Water & Sediment, %vol. -HSD(0.05%S), HSD(0.25%S)	2709	0.05 max
10. Ash, %wt. -HSD(0.05%S), HSD(0.25%S)	482	0.01 max
11. Flash Point, 9 P.M), °C	93	52 min
12. Distillation, °C -IBP -10% recovered -50% recovered -90% recovered -End Point	86	report report report 357 max report
13. Colour, ASTM -HSD(0.05%S), HSD(0.25%S)	1500	2.0 max

VITA

Jongchai Vasaruchtragul was born on February 16, 1970 in Bangkok, Thailand. He received his Bachelor's degree of Science in Industrial Chemistry, King Mongkut's Institute of Technology North Bangkok University in 1993. He continued his Master's degree of Science in Petrochemistry and Polymer Science at Chulalongkorn University in 1995 and finished in 1998.