Table 5. Results obtained by AMINE for the four "unknown" amines.

<table>
<thead>
<tr>
<th>Amine (prefix only)</th>
<th>Conditions</th>
<th>Solutions (prefix only)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-(3-methylbutyl)-1,5-dimethylhexyl</td>
<td>1.5</td>
<td>N-(3-methylbutyl)-1,5-dimethylhexyl</td>
<td>-</td>
</tr>
<tr>
<td>N-(3-methylbutyl)-2-ethylhexyl</td>
<td>1.5</td>
<td>N-(3-methylbutyl)-2-ethylhexyl</td>
<td>-</td>
</tr>
<tr>
<td>N-heptyl-N-(3-methylbutyl)-2-ethylhexyl</td>
<td>1.5</td>
<td>N-heptyl-N-(3-methylbutyl)-2-ethylhexyl</td>
<td>1 (tied)</td>
</tr>
<tr>
<td>N-pentyl-N-(3-methylbutyl)-2-ethylhexyl</td>
<td>2.25\textsuperscript{a}</td>
<td>N-pentyl-N-(3-methylbutyl)-2-ethylhexyl</td>
<td>1 (tied)</td>
</tr>
<tr>
<td>N-pentyl-N-(3,3-dimethylbutyl)-3,5,5-trimethylhexyl</td>
<td>2.25\textsuperscript{a}</td>
<td>2-ethyl-1,5,5,7,7-pentamethyl-1-(2,2-dimethylpropyl)octyl</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N-pentyl-N-(3,3-dimethylbutyl)-3,5,5-trimethylhexyl</td>
<td>2 (tied)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N,N-di(tert-butyl)-2-methyl-2-(2,2-dimethylpropyl)hexyl</td>
<td>2 (tied)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N-tert-butyl-1,1,3-trimethyl-3-(2,2-dimethylpropyl)octyl</td>
<td>2 (tied)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-ethyl-1,1,5,7,7-pentamethyl-5-(2,2-dimethylpropyl)octyl</td>
<td>2 (tied)</td>
</tr>
</tbody>
</table>

\textsuperscript{a} With DELTA = 1.5 ppm, no structures were found for this amine.
Figure captions

Figure 1. A schematic illustration of R, the alkyl chain-end to be tested by the PRUNER. The group X contains the Nitrogen atom, along with any carbons and hydrogens not included in R.

Figure 2. The hierarchy of pre-tests used by the PRUNER. A "?" attached to an atom indicates that the neighbors of that atom are unknown at testing time.

Figure 3. A case in which r and o do not match when n = N C, even though the simple test is passed.

Figure 4. Sample output from program AMINE (PDP-10 version). The solution structure is written in polish-prefix notation as described in Reference 3a.
Figure 1
Figure 2.

X = C-?
- CH₂-C-? → Class 1 tests
- CH₂-N-? → Class 2, 3 and 4 tests
- CH< C-? → Class 5 tests
- CH< N-? → CH< NH₂ → Class 6 tests
- CH< NH-C → Class 7 tests
- CH< C-? → Class 8 tests
- C< C-? → Class 9 tests
- C< N-? → C< NH₂ → Class 10 tests
- C< NH-C → Class 11 tests
- C< C-? → Class 12 tests

X = N-?
- NH₂ (Class 13 test)
- NH-C-? → Class 14 tests
- N< C-? → Class 15 tests
Figure 3.
CASE TITLE: N-ETYLYDIPENTYLAMINE
THE AMINE HAS 12 CARBONS
GOODNESS-OF-FIT CRITERION IS 1.500
STANDARD IS TMS
INPUT SHIFTS: 54.00 27.80 30.10 23.00 14.30 47.8

SOLUTION STRUCTURES:

N...C.C.C.C.C.C.C.C.C.C.C
SHIFTs: 54.299 27.881 30.239 22.960 14.210 54.299
27.881 30.239 22.960 14.210 47.667 12.868
DELMIN = 0.37

CASE FINISHED. PROCESSING TIME (IN SEC.) WAS 9.711
SIGNIFICANCE
SIGNIFICANCE

Because of the interdisciplinary character of this research, it has a significant impact in medicine, organic chemistry, and computer science. GC/MS has become one of the most powerful techniques available to the organic and biochemist. The potential applications of these techniques in medical research and in the clinic have just begun to be explored. These techniques are of unique importance to medical science since they alone of the current physical methods have sufficient sensitivity and analytical precision to study human biochemistry at the molecular level. Computer automation of these techniques, both at the instrumentation and interpretive levels, would permit the rapid, exhaustive analysis of body fluids across large populations of individuals in various medical contexts and may provide new discoveries important to public health.

In our study of errors of metabolism, accurate diagnosis of the accumulated metabolite provides insight into the biochemical pathogenesis and into therapeutic approaches to the control of such errors. In the case of inherited errors, accurate diagnosis allows reference to published data on the mode of inheritance and, thus, expresses the recurrence risk for genetic counseling purposes. The GC/MS system, with its potential for identification of any metabolites, provides the diagnostic accuracy necessary for a clinical program. GC/MS also provides the methodology for detecting previously unrecognized metabolic errors.

From the point of view of computer science, mass spectrometry is an advantageous environment in which to investigate the concepts necessary for the emulation of lower-level cognitive and manipulative functions as well as for the study of various forms of knowledge representation and automatic theory formation. Those concepts will be common in some form to all "intelligent" systems and must be more fully developed from their present primitive state. Mass spectrometry is ideal as a milieu for this research in that it has tremendous practical importance to medicine, is sufficiently complex to challenge the human intellect, and is structured to an extent amenable to computer program formulation within the current state-of-the-art.
COLLABORATIVE ARRANGEMENTS
This project is an interdisciplinary research effort involving day-to-day collaboration between Professor J. Lederberg (Department of Genetics), Professor C. Djerassi (Department of Chemistry), Professor E. Feigenbaum (Department of Computer Science), Professor H. Cann (Department of Pediatrics), Dr. S. Buchanan (Computer Science), Dr. A. Duffield (Genetics), Dr. D. Smith (Chemistry), Dr. M. Sridharan (Computer Science), and the Instrumentation Research Laboratory of the Department of Genetics. We are also soliciting additional participation of clinical research interests of the Departments of Medicine and Psychiatry as well as other members of the Department of Genetics (Professors Cavalli-Sforza and Herzenberg). The proximity of these people and facilities in a medical environment offers a highly unique opportunity for collaborative interaction.
FACILITIES AVAILABLE
We will derive much of the clinically significant material for analysis from patients in the Premature Research Center and the Clinical Research Center of the Department of Pediatrics at Stanford. Analyses will be performed on existing gas chromatograph and mass spectrometer instrumentation. We have available a GC-coupled Finnigan 1015 quadrupole instrument in the Department of Genetics and a GC-coupled Varian-MAT 711 instrument in the Department of Chemistry, also available in the Department of Chemistry are MS-9 and Varian-MAT Ch-4 instruments.

We will derive our computing resources from existing PDP-11/20 mini-computer systems which interface the mass spectrometer instruments as well as from the ACME follow-on 170/150 computer at Stanford for data reduction and graphics support. Artificial intelligence program development will be carried out on the Stanford Computation Center IBM 360/67 and machines available over the ARPA computer network. GC/MS data will be interfaced to these programs through standard communication links.
HUMAN SUBJECTS
HUMAN SUBJECTS

As a part of this research project, GC/MS analysis techniques will be applied to human body fluids in collaboration with clinical investigators and blood and urine specimens will be collected from human subjects. Collection of VOIDED URINE SPECIMENS presents no risk to the patient. Collection of 5-10 ml of blood by venepuncture is a procedure attended by minimal risk; infection is a remote possibility, especially from deep venepuncture (e.g. femoral tap). However, superficial veins are usually used in children, and even infants. It is only the occasional infant that requires a femoral tap and this procedure would be deferred for this project unless the specimen was essential for diagnosis.
In the following budget estimates, the abbreviations listed below are used to denote departmental affiliation or professional specialty:

G - Genetics  
CS - Computer Science  
Ch - Chemistry  
E - Electrical Engineering
BUDGET - PART A

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

TO MASS SPECTROMETRY
### PERSONNEL

<table>
<thead>
<tr>
<th>NAME (Last, first, initial)</th>
<th>TITLE OF POSITION</th>
<th>Time or Effort</th>
<th>Amount Requested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lederberg, Joshua G</td>
<td>Principal Investigator or Program Director</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Feigenbaum, Edward A (1)</td>
<td>C Co-Principal Invest.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Buchanan, Bruce G. (1, 2)</td>
<td>CS Associate Invest.</td>
<td>50</td>
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<tr>
<td>Duffield, Alan C</td>
<td>Ch Associate Invest.</td>
<td>25</td>
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<tr>
<td>Smith, Dennis Ch</td>
<td>Ch Research Associate</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Hammernum, Steen Ch</td>
<td>Ch Research Associate</td>
<td>50</td>
<td></td>
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<tr>
<td>Sridharan, Natesa CS</td>
<td>Research Associate</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Reiss, Steve CS</td>
<td>CS Computer Programmer</td>
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<tr>
<td>Hjelmeland, Larry CS</td>
<td>Research Assistant</td>
<td>100</td>
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<tr>
<td>Masiinter, Larry CS</td>
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<td>50</td>
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<tr>
<td>Stefik, Mark CS</td>
<td>Research Assistant</td>
<td>50</td>
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<tr>
<td>Wharton, Kathy Admin. Assistant</td>
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<tr>
<td>Larson, Dee</td>
<td>Secretary</td>
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</table>

1. See Budget Notes
2. In first year only 9/1/74-4/30/75 covered

**Total** = $80,624

### CONSULTANT COSTS

<table>
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<tr>
<th>Item</th>
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### EQUIPMENT

<table>
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<tr>
<th>Item</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Itemizes</td>
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### SUPPLIES

<table>
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<tr>
<td>Office supplies</td>
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### STAFF TRAVEL

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<tr>
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<tr>
<td>Foreign</td>
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### PATIENT COSTS

<table>
<thead>
<tr>
<th>Category</th>
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<tr>
<td>Inpatient and Outpatient</td>
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### ALTERATIONS AND RENOVATIONS

<table>
<thead>
<tr>
<th>Category</th>
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<tbody>
<tr>
<td>Itemize per Instructions</td>
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### OTHER EXPENSES

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Telephone, postage, etc.</td>
<td>$200</td>
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<tr>
<td>Publication costs</td>
<td>$700</td>
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<tr>
<td>Computer terminal rent</td>
<td>$3,200</td>
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<tr>
<td>Computer usage costs</td>
<td>$36,000</td>
</tr>
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</table>

**Subtotal - Items 1 thru 8** = $123,574

### STIPENDS

#### TRAINEE EXPENSES

<table>
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<tr>
<th>Category</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Postdoctoral</td>
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<tr>
<td>Predoctoral</td>
<td>$</td>
</tr>
<tr>
<td>Research (Special)</td>
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</tr>
<tr>
<td>Dependency Allowance</td>
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</tr>
</tbody>
</table>

**Total Stipend Expenses** = $ |

### TRAINING GRANTS

<table>
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<th>Category</th>
<th>Amount</th>
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<tr>
<td>Tuition and Fees</td>
<td>$</td>
</tr>
<tr>
<td>Trainee Travel (Describe)</td>
<td>$</td>
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</tbody>
</table>

**Subtotal - Trainee Expenses** = $ |

### TOTAL DIRECT COST

**Total Direct Cost** = $123,574
### BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE

**DIRECT COSTS ONLY** (Omit Cents)

<table>
<thead>
<tr>
<th>Description</th>
<th>1st Period (Same as Detailed Budget)</th>
<th>Additional Years Support Requested (This application only)</th>
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<tbody>
<tr>
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<td>1st Year</td>
<td>2nd Year</td>
</tr>
<tr>
<td>PERSONNEL COSTS</td>
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<tr>
<td>CONSULTANT COSTS (Include fees, travel, etc.)</td>
<td></td>
<td>1,100</td>
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<tr>
<td>EQUIPMENT</td>
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<td></td>
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<tr>
<td>SUPPLIES</td>
<td>350</td>
<td>400</td>
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<tr>
<td>TRAVEL</td>
<td>1,400</td>
<td>1,600</td>
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<tr>
<td>PATIENT COSTS</td>
<td></td>
<td></td>
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<tr>
<td>ALTERATIONS AND RENOVATIONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER EXPENSES</td>
<td>40,100</td>
<td>45,450</td>
</tr>
<tr>
<td>TOTAL DIRECT COSTS</td>
<td>123,574</td>
<td>143,825</td>
</tr>
</tbody>
</table>

**TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD (Enter on Page 1, Item 4)** → $421,269

**REMARKS:** Justify all costs for the first year for which the need may not be obvious. For future years, justify equipment costs, as well as any significant increases in any other category. If a recurring annual increase in personnel costs is requested, give percentage. (Use continuation page if needed.)

See attached budget justification notes.
BUDGET - PARTS B (i) AND B (ii)

MASS SPECTROMETER DATA SYSTEM DEVELOPMENT

AND

ANALYSIS OF THE CHEMICAL CONSTITUENTS OF BODY FLUIDS
# Substitute Detailed Budget for First 12-Month Period

**SUBSTITUTE THIS PAGE FOR DETAILED BUDGET PAGE**

**SECTION II**

**PERIOD COVERED**

<table>
<thead>
<tr>
<th>FROM</th>
<th>THROUGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/1/74</td>
<td>4/30/75</td>
</tr>
</tbody>
</table>

**GRANT NUMBER**


## 1. Personnel

<table>
<thead>
<tr>
<th>NAME (Last, first, initial)</th>
<th>TITLE OF POSITION</th>
<th>%/HRS.</th>
<th>AMOUNT REQUESTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lederberg, Joshua G</td>
<td>Principal Investigator or Program Director</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Duffield, Alan Ch</td>
<td>Associate Investig.</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Pereira, Wilfred Ch</td>
<td>Research Associate</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Summons, Roger Ch</td>
<td>Post Doctoral Fellow</td>
<td>100</td>
<td></td>
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<tr>
<td>Rindfleisch, Thomas E</td>
<td>Research Associate</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Veizades, Nicholas E</td>
<td>Research Engineer</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Reynolds, Walter E</td>
<td>Research Engineer</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Tucker, Robert Ch</td>
<td>Computer Programmer</td>
<td>75</td>
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<tr>
<td>Wegmann, Annemarie Ch</td>
<td>Sr. Research Assist.</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Steed, Ernest E</td>
<td>Research Engineer</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Pearson, Dale E</td>
<td>Electronics Tech.</td>
<td>100</td>
<td></td>
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<tr>
<td>DeFrancisci, Richard</td>
<td>Machinist</td>
<td>100</td>
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<tr>
<td>Allan, Muriel</td>
<td>Secretary</td>
<td>25</td>
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</tr>
</tbody>
</table>

**TOTAL** $139,830

## 2. Consultant Costs

- Include Fees and Travel

## 3. Equipment

- Computer Terminal

## 4. Supplies

- Office supplies - $750
- Chemicals, glassware, and lab apparatus - $2,500
- GC supplies (gases, phases, columns, etc.) - $950
- Dry ice and liquid nitrogen - $1,500
- Electronic supplies and parts - $3,500
- GC/MS data recording media - $2,100
- Mini-computer supplies - $1,500
- Mass spectrometer repairs and parts - $7,600

**TOTAL** $20,400

## 5. Staff Travel

### Domestic

- East Coast: $500
- Mid-West: $350
- West Coast: $150

**TOTAL** $1,000

### International

- APO: $1,000

## 6. Patient Costs

- Separate inpatient and outpatient

## 7. Alterations and Renovations

- Mass spectrometer laboratory air conditioning and power modifications

**TOTAL** $2,500

## 8. Other Expenses

- Telephone and data communications - $1,200
- Publication costs - $1,000
- Mini-computer maintenance contract - $4,600
- Computing costs from ACME follow-on - $64,000

**TOTAL** $70,800

## Subtotal - Items 1 thru 8

**TOTAL** $237,530

## 10. Trainee Expenses

### Stipends

#### Predoctoral

- No. Proposed

#### Postdoctoral

- No. Proposed

#### Other (Specify)

- No. Proposed

#### Dependency Allowance

**TOTAL STIPEND EXPENSES**

## Subtotal - Trainee Expenses

**TOTAL** $237,530

## Subtotal - Items 9 and 11, and enter on Page 1

**TOTAL** $237,530

---

*For Forms PHS 398 and PHS 2499-1*
### BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE

**DIRECT COSTS ONLY (Omit Cents)**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>1ST PERIOD (SAME AS DETAIL BUDGET)</th>
<th>ADDITIONAL YEARS SUPPORT REQUESTED (This application only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERSONNEL COSTS</td>
<td>139,830</td>
<td>148,066, 156,775</td>
</tr>
<tr>
<td>CONSULTANT COSTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Include fees, travel, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT</td>
<td>3,000</td>
<td>3,000, 3,000</td>
</tr>
<tr>
<td>SUPPLIES</td>
<td>20,400</td>
<td>21,050, 22,250</td>
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<tr>
<td>TRAVEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOMESTIC</td>
<td>1,000</td>
<td>1,000, 1,000</td>
</tr>
<tr>
<td>FOREIGN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PATIENT COSTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALTERATIONS AND RENOVATIONS</td>
<td>2,500</td>
<td>-</td>
</tr>
<tr>
<td>OTHER EXPENSES</td>
<td>70,800</td>
<td>75,000, 79,500</td>
</tr>
<tr>
<td>TOTAL DIRECT COSTS</td>
<td>237,530</td>
<td>248,116, 262,525</td>
</tr>
</tbody>
</table>

**TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD (Enter on Page 1, Item 4)** → $748,171

**REMARKS:** Justify all costs for the first year for which the need may not be obvious. For future years, justify equipment costs, as well as any significant increases in any other category. If a recurring annual increase in personnel costs is requested, give percentage. (Use continuation page if needed.)

See attached budget justification.
BUDGET – PART C

EXTENSION OF THE THEORY OF

MASS SPECTROMETRY BY COMPUTER
### 1. PERSONNEL (List all personnel engaged on project)

<table>
<thead>
<tr>
<th>NAME (Last, first, initial)</th>
<th>TITLE OF POSITION</th>
<th>%/HRS.</th>
<th>AMOUNT REQUESTED (Omit cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lederberg, Joshua G</td>
<td>Principal Investigator or Program Director</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Feigenbaum, Eduard A. (1)</td>
<td>Co-Principal Invest.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buchanan, Bruce G. (1,2)</td>
<td>Associate Invest.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Sridharan, Natesa CS</td>
<td>Research Associate</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Hammerum, Steen Ch</td>
<td>Research Associate</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>White, William CS</td>
<td>Computer Programmer</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Farrell, Carl CS</td>
<td>Research Assistant</td>
<td>100</td>
<td></td>
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<tr>
<td>Warton, Kathy</td>
<td>Admin. Assistant</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Larson, Dee</td>
<td>Secretary</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

(1) See budget notes
(2) Covers 9/1/74-4/30/75 in year 1

### 2. CONSULTANT COSTS (Include Fees and Travel)

- $ -

### 3. EQUIPMENT (Itemize)

- $ -

### 4. SUPPLIES

- $ 350

### 5. STAFF TRAVEL (See Instructions)

| a. DOMESTIC | $ 1,400 |
| b. FOREIGN  | $ -     |

### 6. PATIENT COSTS (Separate Inpatient and Outpatient)

- $ -

### 7. ALTERATIONS AND RENOVATIONS

- $ -

### 8. OTHER EXPENSES (Itemize per instructions)

- Telephone, postage, etc. $ 200
- Publication costs $ 700
- Computer terminal rental $ 1,600
- Computer usage $ 21,000

- $ 23,500

### 9. Subtotal - Items 1 thru 8

- $ 73,771

### 10. TRAINEE EXPENSES (See Instructions)

- **FOR TRAINING**
  - a. STIPENDS
    - PREDOCTORAL
      - No. Proposed
      - $ 
    - POSTDOCTORAL
      - No. Proposed
      - $ 
    - OTHER (Specify)
      - No. Proposed
      - $ 
    - DEPENDENCY ALLOWANCE
      - $ 

- **GRANTS ONLY**
  - b. TUITION AND FEES
  - c. TRAINEE TRAVEL (Describe)
  - Subtotal - Trainee Expenses

- **TOTAL STIPEND EXPENSES**

- $ 

### 11. TOTAL DIRECT COST (Add Subtotals, Items 9 and 11, and enter on Page 1)

- $ 73,771
### SECTION II - PRIVILEGED COMMUNICATION

#### BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE

**DIRECT COSTS ONLY (Omit Cents)**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>1ST PERIOD (ISAN, AS IN MAILED BUDGET III)</th>
<th>ADDITIONAL YEARS SUPPORT REQUESTED (This application only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2ND YEAR</td>
<td>3RD YEAR</td>
</tr>
<tr>
<td>PERSONNEL COSTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONSULTANT COSTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Include fees, travel, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPLIES</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td>TRAVEL</td>
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</tr>
<tr>
<td>DOMESTIC</td>
<td>1,400</td>
<td>1,600</td>
</tr>
<tr>
<td>FOREIGN</td>
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<td></td>
</tr>
<tr>
<td>PATIENT COSTS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALTERATIONS AND RENOVATIONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER EXPENSES</td>
<td>23,500</td>
<td>27,650</td>
</tr>
</tbody>
</table>

**TOTAL DIRECT COSTS**

| TOTAL DIRECT COSTS | 73,771 | 90,844 | 97,355 |          |          |          |

**TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD (Enter on Page 1, Item 4)**

$ 261,970

**REMARKS:** Justify all costs for the first year for which the need may not be obvious. For future years, justify equipment costs, as well as any significant increases in any other category. If a recurring annual increase in personnel costs is requested, give percentage. (Use continuation page if needed.)

See attached budget justification notes.