



# DECUS

## PROGRAM LIBRARY

DECUS NO.

8-542

TITLE

RADIOACTIVE DECAY

AUTHOR

A. L. Al-Nuaimi

COMPANY

Ontario Hydro  
Pickering, Ontario, Canada

DATE

April 10, 1972

SOURCE LANGUAGE

FORTRAN-D

DECUS

PROGRAM LIBRARY



NO.	NAME	DATE	REMARKS

## Radioactive Decay

DECUS Program Library Write-up

DECUS NO. 8-542

### 1) Program

This program solves the radioactive decay equation:

$$A = A_0 e^{-\lambda t}, \quad A = (A_0) * \text{EXP}(-DT)$$

for any one of the four variables:

A=activity after decay

A<sub>0</sub>=activity before decay=original activity

TH=half-life of the radioisotope

T=time of decay, where:

D=the decay constant( $\lambda$ )= .69315/TH.

### 2) Operation

The program is written in FORTRAN-D and is loaded by FOSL. See DEC's Introduction to Programming(1970) p.8-40.

When started the program requests the code of the variable to be calculated. The code is as follows:

A=1      A<sub>0</sub>=2      T=3      TH=4

The program then requests the number of calculations to be made. A maximum of 30 is permitted.

Depending on the variable to be calculated the program then requests the values of the other three variables to be inputted.

When the input data is complete the program outputs, in tabulated form, the input data together with the calculated variable.

The program is endless i.e. after completing a set of computations it re-starts itself.

3) Sample Run

.  
\*FOSL  
\*IN-R:  
\*  
\*OPT-  
†  
\*READY  
†

TYPE CODE OF VARIABLE TO BE CALCULATED

A=1 A0=2 T=3 TH=4 :1 typed 1 followed by a space  
HOW MANY CALCULATIONS ?2 typed 2 followed by a space  
TYPE A0,T,TH

10000. 8.02 8.02 ) typed a value for A0,space,value for T,space,  
100. 8.02 8.02 ) value for TH and carriage return

TH	T	A0	A
0.802000E+1	0.802000E+1	0.100000E+5	0.499999E+4
0.802000E+1	0.802000E+1	0.100000E+3	0.499999E+2

TYPE CODE OF VARIABLE TO BE CALCULATED

A=1 A0=2 T=3 TH=4 :2  
HOW MANY CALCULATIONS ?2  
TYPE A,T,TH

5000 8.02 8.02  
50 8.02 8.02

TH	T	A0	A
0.802000E+1	0.802000E+1	0.100000E+5	0.500000E+4
0.802000E+1	0.802000E+1	0.100000E+3	0.500000E+2

TYPE CODE OF VARIABLE TO BE CALCULATED

A=1 A0=2 T=3 TH=4 :3  
HOW MANY CALCULATIONS ?2,  
TYPE A,A0,TH

100 200 8.02  
5000 10000 8.02

TH	T	A0	A
0.802000E+1	0.801997E+1	0.200000E+3	0.100000E+3
0.802000E+1	0.801995E+1	0.100000E+5	0.500000E+4

TYPE CODE OF VARIABLE TO BE CALCULATED  
A=1 A0=2 T=3 TH=4 :

#### 4) Characteristics

- a. All input and output is via the teletype.
- b. The units of time T and TH must be identical i.e. seconds, minutes, days etc...
- c. The units of activity in A and AØ must be identical i.e. Ci(Curie), uCi, counts/sec. etc...
- d. The variables code (lto4) and the number of calculations (up to 30) are integers. However, they can be terminated by a space, comma, period, carriage return etc...
- e. For clarity it is best to terminate each group of three input data by a carriage return and terminate an individual number by one or more spaces.
- f. Core storage for the program and the FORTRAN-D operating system is 4K.

## 5) Listing

```
C      RADIOACTIVE DECAY BY A.L.AL-NUAIMI, APRIL 1972.
C      TO SOLVE THE DECAY EQUATION      A=(A0)*EXP(-DT)
C      FOR A,A0,T OR TH WHERE:
C      A =ACTIVITY AFTER DECAY.
C      A0=ACTIVITY BEFORE DECAY=ORIGINAL ACTIVITY.
C      D =DECAY CONSTANT=.69315/TH.
C      TH=HALF LIFE OF THE ISOTOPE.
C      T =TIME OF DECAY.

      DIMENSION TH(30),T(30),A0(30),A(30),G(30),E(30)
1      TYPE 6
      TYPE 7
      ACCEPT 8,L
      TYPE 20
      ACCEPT 8,N

      GO TO (30,40,50,60),L
30     TYPE 9
      DO 32 I=1,N
      ACCEPT 15,A0(I),T(I),TH(I)
32     CONTINUE
      DO 35 I=1,N
      G(I)=.69315*T(I)/TH(I)
      E(I)=EXPF(-G(I))
      A(I)=A0(I)*E(I)
35     CONTINUE
      TYPE 16
      DO 38 I=1,N
      TYPE 17,TH(I),T(I),A0(I),A(I)
38     CONTINUE
      GO TO 1

40     TYPE 10
      DO 42 I=1,N
      ACCEPT 15,A(I),T(I),TH(I)
42     CONTINUE
      DO 45 I=1,N
      G(I)=.69315*T(I)/TH(I)
      E(I)=EXPF(-G(I))
      A0(I)=A(I)/E(I)
45     CONTINUE
      TYPE 16
      DO 48 I=1,N
      TYPE 17,TH(I),T(I),A0(I),A(I)
48     CONTINUE
      GO TO 1
```

5) Listing (continued)

```

50     TYPE 11
      DO 52 I=1,N
      ACCEPT 15,A(I),A0(I),TH(I)
52     CONTINUE
      DO 55 I=1,N
      G(I)=.69315/TH(I)
      E(I)=LOGF(A0(I))-LOGF(A(I))
      T(I)=E(I)/G(I)
55     CONTINUE
      TYPE 16
      DO 58 I=1,N
      TYPE 17,TH(I),T(I),A0(I),A(I)
58     CONTINUE
      GO TO 1

60     TYPE 12
      DO 62 I=1,N
      ACCEPT 15,A(I),A0(I),T(I)
62     CONTINUE
      DO 65 I=1,N
      G(I)=.69315*T(I)
      E(I)=LOGF(A0(I))-LOGF(A(I))
      TH(I)=G(I)/E(I)
65     CONTINUE
      TYPE 16
      DO 68 I=1,N
      TYPE 17,TH(I),T(I),A0(I),A(I)
68     CONTINUE
      GO TO 1

6     FORMAT(///// "TYPE CODE OF VARIABLE TO BE CALCULATED")
7     FORMAT("/A=1  A0=2  T=3  TH=4 :")
8     FORMAT(I)
9     FORMAT("/TYPE A0,T,TH"/)
10    FORMAT("/TYPE A,T,TH"/)
11    FORMAT("/TYPE A,A0,TH"/)
12    FORMAT("/TYPE A,A0,T"/)
15    FORMAT(E,E,E)
16    FORMAT("/      TH          T          A0          A")
17    FORMAT(/E,E,E,E)
20    FORMAT("/HOW MANY CALCULATIONS ?")
      END

```

\*

