ASD

AEROSPACE SYSTEMS DEPARTMENT

GENERAL ELECTRIC

HOUSTON, TEXAS

NASA CR-
160206

TECHNICAL INFORMATION RELEASE

TIR 741-MED-3014

FROM	TO
D. G. Fitzjerrell	J. A. Rummel, Ph.D.

DATE	WORK ORDER REF:	WORK STATEMENT PARA:	REFERENCE:
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SUBJECT

Fluid and Electrolyte Balance Model

This model follows the effect of various oral input water loads on solute and water distribution throughout the body. It is a three compartment model; the three compartments being plasma, interstitial fluid and cellular fluid. Sodium, potassium, chloride and urea are the only major solutes considered explicitly. The control of body water and electrolyte distribution is affected via drinking hormone levels.

D. G. Fitzjerrell

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Attachment
/db

CONCURRENCES

Counterpart:

Medical Projects Unit Manager: CWFulcher

Engrg. & Advanced Programs Subsection Mgr. WJBeittel

DISTRIBUTION GE/AGS: Central Product File
R. F. Hassell
R. C. Croston
V. J. Marks

NASA/JSC: Technical Library/JM6 (1979 distribution)

ASD 4028

PROGRAM DESCRIPTION

A. IDENTIFICATION

Program Name - Fluid and Electrolyte Balance Model (FEB)

Programmer's Name - Ronald J. White and Larry Neal

Date of Issue - December 4, 1972

Versions Obsolesced by this Program - Body Water and Electrolyte Balance (WATBAL), by Thomas G. Cleaver

B. GENERAL DESCRIPTION

This model follows the effect of various oral input water loads on solute and water distribution throughout the body. It is a three compartment model, the three compartments being plasma, interstitial fluid and cellular fluid. Sodium, potassium, chloride and urea are the only major solutes considered explicitly. The control of body water and electrolyte distribution is affected via drinking and hormone levels.

C. USAGE AND RESTRICTIONS

Machine and Compiler Required - Xerox Sigma 3 - ANSI FORTRAN

Peripheral Equipment Required - Card reader and line printer.

Approximate Amount of Memory Required - +1402 hexidecimal.

D. PARTICULAR DESCRIPTION

Equations Used and Derivations - See TIR No. 741-MED-3010

Definitions of Terms Used - Particular effort was made to see that all terms and arrays used in the program were defined on comment cards in the program deck.

Detailed Description - This program simulates the changes in levels of the twenty-three quantities listed in description of input when a person of average size consumes a quantity of water after having no oral water intake for six hours.

The user of the program may select as many as nine of the twenty-three quantities and have their levels printed out in column form at ten-minute increments after consumption of the water (sixty-minute increments before consumption).

The program is presently designed to use cards as the input mechanism and printed page (132 columns) as the output mechanism. Each data card should have an integer right justified in card column 5. The integer in the first data card tells the quantity of water consumed (in milliters).

The integer in column 5 of the second data card tells how many (from 1 to 9) columns of information are requested. Then that number of data cards follows, one for each column of information requested, arranged in the order in which the user wants the columns to be printed. Each of these remaining data cards should have an integer from one to twenty-three right justified to card column 5 together with any appropriate column heading (preferably centered) in columns 10 thru 17 for the quantity which that integer represents, according to the list in description of input.

The output will consist of a statement of the quantity of water consumed followed by the column headings which the user selected (in the order in which the data cards are arranged) and the levels of these quantities at ten-minute increments after the water is consumed. The output may be considered accurate to at most three signficant figures in spite of the figures given.

E. DESCRIPTION OF INPUT

1. Control and Program Cards - (Begin column 1)

```
!JØB
!FØRTRAN

 (Source Deck - See Appendix A)

!EØD
!OLØAD
!$RØØTƀ512,,GØ
!$END
!XEQ

 (Data)

!EØD
```

2. Data Cards (Columns, format, name, definition)

1-5	I5	NØMLWC	No. of ml of H_2O consumed
1-5	I5	NØREQ	No. of items requested, max = 9 of 23 available
1-5	I5	NUMBER	Item number, 1-23
6-9			Blank
10-13	A4	ALPHA	4 character column heading
14-17	A4	BETA	4 character column heading

One card for each item requested, maximum 9 out of following 23 possible.

Number (Columns 4 & 5)	Suggested Headings (Columns 10 thru 17)	Quantity (Units)
1	BELLYØVØ	Vol. of water in stomach (ML)
2	ØGUTØVØØ	Vol. of water in intestines (ML)
3	PLASMAØV	Vol. of water in plasma (ML)
4	INTERSØV	Vol. of water in interstitial space (ML)
5	CELLØFØV	Vol. of water in cell fluid (ML)
6	TOTALØVØ	Total water vol. in above 3 (ML)
7	UØML/MIN	Rate or production of urine (ML/MIN)
8	PLASMAØS	Total solute in plasma (m Osmols)
9	INTERSØS	Total solute in interstitial space (m Osmols)
10	ALLØSOLØ	Total solute in plasma, interstitial space and cells (m Osmols)
11	UØSØRATE	Rate of production of solutes in urine (m Osmols/Min)
12	ØØØADHØØ	ADH
13	ØRENINØØ	Renin
14	ANGIOTEN	Angiotensin
15	ALDOSTER	Aldosterone
16	ØNAØLOSS	Sodium Loss Rate (m Osmols/Min)
17	ØØKØLOSS	Potassium Loss Rate (m Osmols/Min)
18	ØØCLØLOSS	Chloride Loss Rate(m Osmols/Min)
19	UREAØLOSS	Urea Loss Rate (m Osmols/Min)
20	PLASMAØO	Plasma Osmolarity (m Osmols/Liter)
21	INTERSØO	Interstitial Osmolarity (m Osmols/Liter)
22	CELLØFØO	Cell Fluid Osmolarity (m Osmols/Liter)
23	URINEØOØ	Urine Osmolarity (m Osmols/Liter)

F. DESCRIPTION OF OUTPUT

Printer Output - First a statement of the quantity of water consumed, then column headings which the user has selected and the levels of these quantities at 10 second increments after water is consumed.

Example:

The following input data will give the sample output: (See Appendix A)

COLUMN NUMBER

1-5	6-9	10-17
1500		
5		
3	Ø	PLASMAØV
20	Ø	PLASMAØO
7	Ø	UØML/MIN
23	Ø	URINEØOØ
2	Ø	ØGUTØVØØ

G. INTERNAL CHECKS AND EXITS

None.

H. INDEPENDENT SUBROUTINES

None.

I. SYSTEM SUBROUTINES

No special subroutines

J. COMPLETION OR FINAL CHECKOUT DATE - 12/4/72

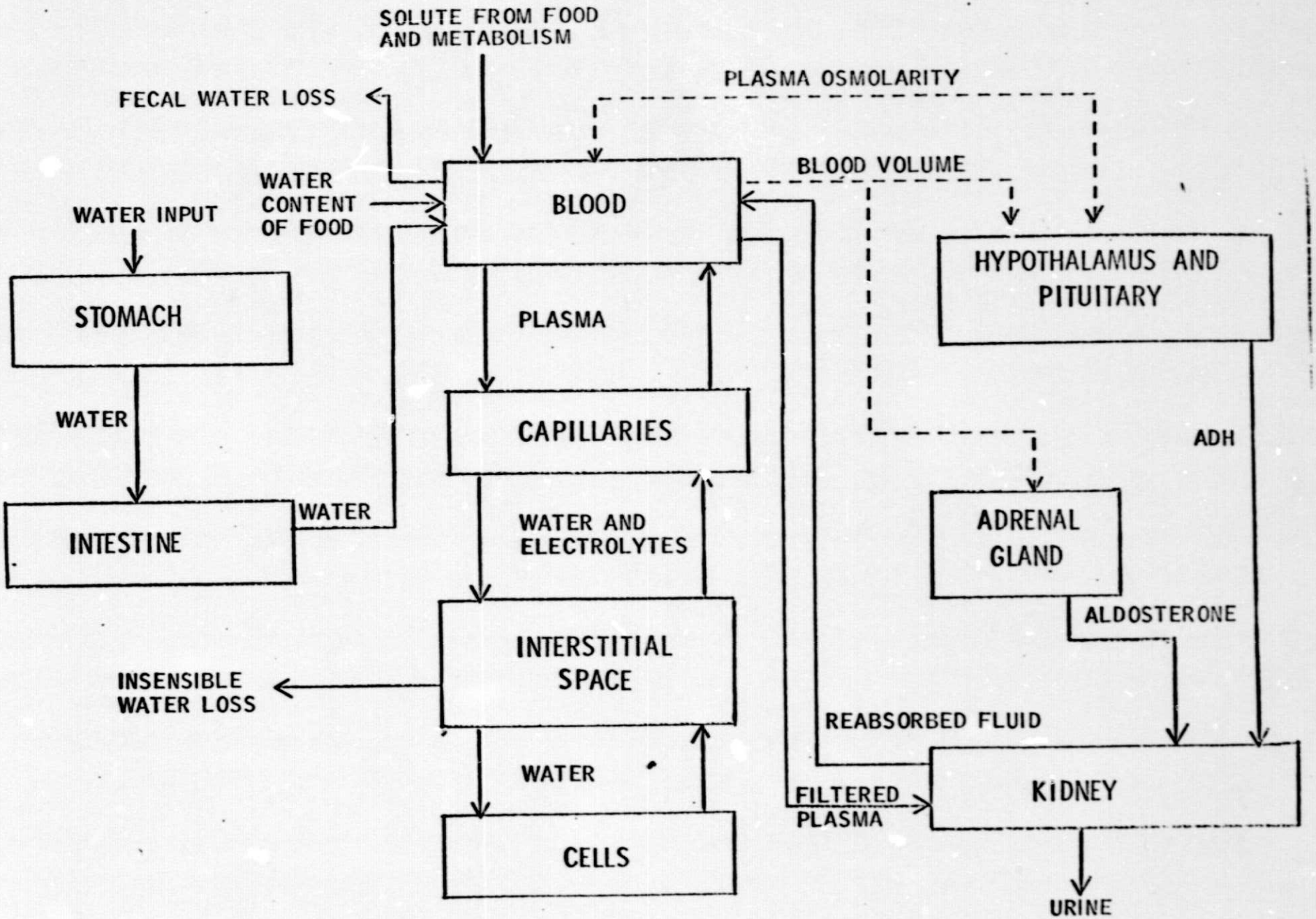
Source listing and logic diagram is given in Appendix A.

APPENDIX A

SOURCE LISTING

AND

SAMPLE CASE



GENERAL FLOW CHART OF WATER AND ELECTROLYTE BALANCE.

```
C      AFTER FASTING FOR 6 HOURS, THE SUBJECT CONSUMES A GIVEN QUANTITY OF WATER.
C      SPECIFY THIS QUANTITY IN ML AS AN INTEGER RIGHT JUSTIFIED IN COLUMN 5 OF
C      THE FIRST DATA CARD.
C
C      FROM THE FOLLOWING LIST, YOU MAY SELECT AS MANY AS NINE OF THE
C      TWENTY-THREE QUANTITIES THAT YOU ARE INTERESTED IN.
C      THE PRINT OUT WILL CONSIST OF A COLUMN OF THE INDEPENDENT TIME
C      VARIABLE IN TEN MINUTE INCREMENTS AFTER CONSUMPTION (60 MIN INCREMENTS
C      BEFORE CONSUMPTION) FOLLOWED BY COLUMNS OF THE INFORMATION YOU REQUEST,
C      IN THE ORDER IN WHICH THEY ARE REQUESTED, AT EACH TEN MINUTE INCREMENT.
C      THE INPUT SHOULD CONSIST OF A SECOND DATA CARD HAVING AN INTEGER
C      FROM 1 TO 9 IN COLUMN 5 TELLING HOW MANY QUANTITIES YOU SELECT,
C      FOLLOWED BY THAT NUMBER OF DATA CARDS, EACH HAVING AN INTEGER FROM 1 TO 23
C      RIGHT JUSTIFIED IN COLUMN 5 TOGETHER WITH ANY APPROPRIATE COLUMN HEADING
C      (PREFERABLY CENTERED) IN COLUMNS 10 - 17 FOR THE QUANTITY WHICH THAT
C      INTEGER CODES, ACCORDING TO THE FOLLOWING LIST:
C       1 - VOL OF WATER IN STOMACH
C       2 - VOL OF WATER IN INTESTINES
C       3 - VOL OF WATER IN PLASMA
C       4 - VOL OF WATER IN INTERSTITIAL FLUID
C       5 - VOL OF WATER IN CELL FLUID
C       6 - TOTAL WATER VOLUME IN PLASMA, INTERSTITIAL SPACE, AND CELLS
C       7 - RATE OF PRODUCTION OF URINE
C       8 - TOTAL SOLUTE IN PLASMA
C       9 - TOTAL SOLUTE IN INTERSTITIAL FLUID
C      10 - TOTAL SOLUTES IN PLASMA, INTERSTITIAL SPACE AND CELLS
C      11 - RATE OF PRODUCTION OF SOLUTES IN URINE
C      12 - ADH
C      13 - RENIN
C      14 - ANGIOTENSIN
C      15 - ALDOSTERONE
C      16 - SODIUM LOSS
C      17 - POTASSIUM LOSS
C      18 - CHLORIDE LOSS
C      19 - UREA LOSS
C      20 - PLASMA OSMOLARITY
C      21 - INTERSTITIAL FLUID OSMOLARITY
C      22 - CELL FLUID OSMOLARITY
C      23 - URINE OSMOLARITY
C
C      VOLUME IS GIVEN IN ML, TIME IN MINUTES, AMOUNTS OF SOLUTE IN
C      MILLIOSMOLES, AND OSMOLARITY IN MILLIOSMOLES/LITER
C
C**** THIS IS THE PROGRAM FOR BODY WATER AND ELECTROLYTE BALANCE
C**** VARIABLES AND CONSTANTS USED IN THIS PROGRAM WILL BE USED
C**** ACCORDING TO THE FOLLOWING FORMAT
C**** ALPHABETIC VARIABLES AND CONSTANTS
C**** A - ALDOSTERONE
C**** B - BLOOD VOLUME
C**** C - CHLORIDE
C**** D - DELTA T (THE INTEGRATING TIME INTERVAL)
C**** E - ERYTHROCYTE VOLUME
C**** F
C**** G - ANGIOTENSIN
C**** H - ADH
C**** I - CONSTANTS RELATED TO CAPILLARIES
C**** J - CONSTANTS RELATED TO CELL-INTERSTITIAL INTERFACE
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C**** K = POTASSIUM (MILLIOSMOLES)
C**** L = CONSTANTS RELATED TO ADH PRODUCTION
C**** M = CONSTANTS RELATED TO ALDOSTERONE PRODUCTION
C**** N = SODIUM (MILLIOSMOLES)
C**** O = OSMOLARITY (MILLIOSMOLES/LITER)
C**** P = PRESSURE (MILLIMETERS OF MERCURY)
C**** Q = TOTAL SOLUTE (MILLIOSMOLES)
C**** R = RENIN
C**** S = SOLUTE OTHER THAN NA, K, CL, U (MILLIOSMOLES)
C**** T = TIME CONSTANT OR TIME (MINS)
C**** U = UREA (MILLIOSMOLES)
C**** V = VOLUME (MILLILITERS)
C**** W = CONSTANTS RELATED TO THE KIDNEY
C**** X = PLASMA PROTEIN
C**** Y = CONSTANTS RELATING URINE OUTPUT TO UREA OUTPUT
C**** Z = A MEASURE OF KIDNEY SENSITIVITY TO ADH
C**** SUBSCRIPTS
C**** 1 = D/DT (TIME DERIVATIVE)
C**** 2 = EXTERNAL INPUT OR OUTPUT
C**** 3 = STOMACH
C**** 4 = INTESTINE
C**** 5 = PLASMA
C**** 6 = INTERSTITIAL FLUID
C**** 7 = CELL FLUID
C**** 8 = URINE
C**** 9 = OTHER
C**** 0 = AVERAGE, DESIRED OR REFERENCE VALUE
      REAL  V(167),Q(167),O(9),N,K,I1,I2,I3,I4,I5,I6,J
      REAL  L0,L1,L2,L3,L4,L5,M1,M2,M3,M4,M5,M6,M7,M8,N3,K3,N2,K2,N1
      REAL  K34,K45
      DIMENSION CAL(23), ALPHA(9), BETA(9)
C
C     NOMLWC IS THE NUMBER OF ML. OF WATER CONSUMED.

      READ (5,2000) NOMLWC
 2000 FORMAT(I5)
      WRITE (6,2010) NOMLWC
 2010 FORMAT(34X,'AFTER FASTING FOR 6 HOURS, THE SUBJECT CONSUMES'I5,1X,
     1'ML OF WATER.'/)
C     VWC = VOLUME OF WATER CONSUMED = NOMLWC
      VWC=NOMLWC
C
C     NOREQ = NUMBER OF COLUMNS OF INFORMATION REQUESTED
      READ (5,2200) NOREQ
 2200 FORMAT(I5)
C***************** INITIALIZE VARIABLES AND DEFINE CONSTANTS ******************
C****
C**** THE SUBJECT TAKES A DRINK OF WATER AT TIME T5
      T5 = 361.
C**** V(50), V(60) AND V(70) ARE THE NORMAL VALUES OF
C**** THE PLASMA, INTERSTITIAL FLUID AND CELLS, RESPECTIVELY IN ML
C     ACCORDING TO GUYTON'S TEXTBOOK OF MEDICAL PHYSIOLOGY (1966),
C     V(50)=3000, V(60)=12000, V(70)=25000, AND E=2000 ML.
C     V(50) = 3200.
      V(50) = 3000.
C     V(60) = 13800.
      V(60) = 12000.
C     V(70) = 28000.
      V(70) = 25000.
```

```
C**** 80 IS THE NORMAL OSMOLARITY OF BODY FLUID IN MOSMOL/LITER
      80 = 300.
C**** V(90) IS NORMAL TOTAL BODY WATER
      V(90)=V(50)+V(60)+V(70)
C**** D IS THE INTEGRATING INTERVAL IN MINUTES
      D=1.
C**** V(23) IS THE INPUT WATER LOAD
C     V(23)=.64
C     .64 ML/MIN OF WATER ARE SWALLOWED IN SALIVA.
      RATE=.64
C**** N, K, C, AND U ARE THE TOTAL AMOUNTS OF THE SOLUTES NA, K,
C**** CL AND UREA DISSOLVED IN THE BODY FLUIDS, RESPECTIVELY
C***************** GENERAL ************************************************
      N=V(90)*130./1000.
      K=V(90)*5.1/1000.
      C=N+K
      U=V(90)*5.0/1000.
C**** S IS ALL OTHER SOLUTES IN THE BODY FLUID
      S=(80/1000.)*V(90)-N-K-C-U
C**** Q(9) IS THE TOTAL INITIAL SOLUTE IN THE BODY
      Q(9)=N+K+C+U+S
C***************** STOMACH ************************************************
C**** V(34) IS THE VOLUME THAT HAS FLOWED FROM STOMACH TO INTESTINE IN ML
C     V(34)=0.
      T3=20.
      K34=1./T3
C***************** GUT ****************************************************
C     V(45)=0.
      T4=18.
      K45=1./T4
C***************** BLOOD **************************************************
      V(156)=0.
      V(165)=0.
      V(18)=0.
      V(159)=.1
      V(125)=1.
      V(5)=V(50)
      Q(156)=0.
      Q(165)=0.
      Q(18)=0.
      Q(159)=80*V(159)/1000.
      Q(5)=Q(9)*V(50)/V(90)
C***************** INTERSTITIAL FLUID *************************************
      V(167)=0.
      V(162)=.5
      Q(162)=.2*V(162)
      V(6)=V(60)
      Q(6)=Q(9)*V(60)/V(90)
C***************** CELLS **************************************************
      V(7)=V(70)
      Q(7)=Q(9)*V(70)/V(90)
C***************** CAPILLARIES ********************************************
C     E=3000.
      E=2000.
      B0=E+V(50)
      I1=25.3/B0
      I2=9.0/B0
      P6=-7.
      I3=1./280.
```

```
      X2=69.
      P7=26.
      X=28.0*V(50)
      I4=1.7
      P5=4.5
      I5=1.7
      I6=1400.
C***************** ADH ************************************************************
      J=800.
      L0=.9
      L1=20.
      L2=90./L0
      L3=00
      L4=.2
      L5=1440./L0
      H6=600.
      H7=H6
      H8=H6
      H9=H6
      H5=5.0*V(50)
      T9=24.4
C***************** ALDOSTERONE ****************************************************
      B1=7000.
      T0=100.
      T1=T0
      T2=T0
      M1=V(50)
      M2=V(50)
      M3=V(50)
      M4=(.755-.148),(T0*T1*T2*(B1-B0))
      R2=M1*(B1-B0)*T0
      G2=R2*M2*T1/V(50)
      A2=G2*M3*T2/V(50)
      M6=.04/((B1-B0)*T0*T1*T2)
      M7=(1.0/.0051)*A2/T2
      M8=.5
      M5=.755*V(90)/N
C***************** KIDNEY *********************************************************
      H=5.
      T8=180.
      Z=H*T8
      W1=3.
      W2=.4
      W3=.8
      Y1=50.
      Y2=1.5
      Y3=.3
      N3=.15+0.13*N/Q(9)
      K3=.04+0.13*K/Q(9)
      C3=N3+K3
      U3=.32+0.13*N/Q(9)
      S3=.03+0.13*S/Q(9)
      Q(125)=N3+K3+C3+U3+S3
      N2=0.
      K2=N2
      U2=N2
      C2=N2
      S2=.03
C****
```

```
C*****************************************************************
C****
C****************** STMMACH ***************************************
C       DO 3900 NT=1,1701
        DO 3900 NT=1,1061
        T=NT
C       IF (T-T5) 2230,2220,2220
C2220 V(23)=1500
C2230 V(3)=V(23)-V(34)
        V(3)=(RATE/K34)*(1.-EXP(-K34*T))
        IF (T-T5) 2230,2220,2220
 2220 V(3)=V(3)+VWC*EXP(-K34*(T-T5))
C       V(134)=V(3)/T3
C       V(34)=V(34)+V(134)*D
C****************** GUT*******************************************
C       V(4)=V(34)-V(45)
 2230 V(4)=(K34*RATE/(K45-K34))*((1./K34)*(1.-EXP(-K34*T))-
     1(1./K45)*(1.-EXP(-K45*T)))
        IF(T-T5) 2250,2240,2240
 2240 V(4)=V(4)+(K34*VWC/(K45-K34))*(EXP(-K34*(T-T5))-EXP(-K45*(T-T5)))
C       V(145)=V(4)/T4
 2250 V(145)=V(4)/T4
C       V(45)=V(45)+V(145)*D
C****************** BLOOD *****************************************
        V(15)=V(145)+V(165)-V(156)-V(18)+V(125)-V(159)
        V(5)=V(5)+V(15)*D
        Q(15)=Q(165)-Q(156)-Q(18)+Q(125)-Q(159)
        Q(5)=Q(5)+Q(15)*D
        B(5)=Q(5)*1000./V(5)
C****************** INTERSTITIAL SPACE ****************************
        V(16)=V(156)-V(165)-V(167)-V(162)
        V(6)=V(6)+V(16)*D
        Q(16)=Q(156)-Q(165)-Q(162)
        Q(6)=Q(6)+Q(16)*D
        B(6)=Q(6)*1000./V(6)
C****************** CELLS *****************************************
        V(17)=V(167)
        V(7)=V(7)+V(17)*D
        B(7)=Q(7)*1000./V(7)
C****************** CAPILLARIES ***********************************
        V(9)=V(5)+V(6)+V(7)
        B=E+V(5)
        P1=T1*B
        P2=T2*B
        P3=P6+T3*(V(6)-V(60))
        P4=X/V(5)
        IF (P4-P7) 2790,2800,2800
 2790 X=X+X2*D
 2800 V(156)=T4*(P1-P3-P4+P5)**2/(P1-P2)
        V(165)=T4*(P2-P3-P4+P5)**2/(P1-P2)+T5
        Q(156)=T6*(B(5)-B(6))/1000.
C****************** CELL-INTERSTITIAL INTERFACE *******************
        V(167)=J*(B(7)-B(6))/1000.
C****************** ADH *******************************************
        H1=(1.-L0)*(L2*(B0*B0/B+L1-B0)-L5*EXP(L4*(L3-B0*B0/B)))
        H2=L0*(L2*(B(5)+L1-B0)-L5*EXP(L4*(L3-B(5))))
        IF (H2) 3040,3050,3050
 3040 H2=0.
 3050 IF (H1) 3060,3070,3070
```

```
 3060 H1=0.
 3070 H3=H1+H2
      T6=20.0+H/2.
      H6=H6+(H3-H6)*D*4.0/T6
      H7=H7+(H6-H7)*D*4.0/T6
      H8=H8+(H7-H8)*D*4.0/T6
      H9=H8+(H8-H9)*D*4.0/T6
      H5=H5+(H9-H5/T9)*D
      H=H5/V(5)
C**************** ANGIOTENSIN ***************************************************
      R1=M1*(B1-R)
      IF (R1) 3316,3320,3320
 3316 R1=0.
 3320 R2=R2+(R1-R2/T0)*D
      R=R2/V(5)
      G1=M2*R
      G2=G2+(G1-G2/T1)*D
      G=G2/V(5)
      A1=M8*M3*G+(1.0-M8)*M7*K/V(9)
      A2=A2+(A1-A2/T2)*D
      A=A2/V(5)
      N1=M4*A
      N2=M5*N/V(9)-N1
      IF (N2) 3430,3440,3440
 3430 N2=0.
 3440 K2=M6*A
C**************** KIDNEY ********************************************************
      Z1=H-Z/T8
      Z=Z+Z1*D
      IF (Z1) 3530,3530,3527
 3527 Z1=0.
 3530 V(18)=W1/(W2+H)+(.05+1.0/(W2+H))*(-Z1)*W3
      IF (V(18)) 3550,3560,3560
 3550 V(18)=0.
 3560 U2=Y1*(1.0+Y2*(1.0-EXP(-Y3*V(18))))*U/V(9)
      C2=N2+K2
      Q(18)=N2+K2+C2+U2+S2
      V(18)=V(18)+Q(18)*1000./1600.
      U2=Y1*(1.0+Y2*(1.0-EXP(-Y3*V(18))))*U/V(9)
      Q(18)=N2+K2+S2+U2+C2
      B(8)=Q(18)*1000./V(18)
      Q8=(Q(159)+Q(162))/Q(9)
      N=N+(N3-N2-N*Q8)*D
      K=K+(K3-K2-K*Q8)*D
      C=C+(C3-C2)*D
      U=U+(U3-U2-U*Q8)*D
      S=S+(S3-S2-S*Q8)*D
      Q(9)=N+K+C+U+S
C**************** PRINT OUT *****************************************************
      COL(1)=V(3)
      COL(2)=V(4)
      COL(3)=V(5)
      COL(4)=V(6)
      COL(5)=V(7)
      COL(6)=V(9)
      COL(7)=V(18)
      COL(8)=Q(5)
      COL(9)=Q(6)
      COL(10)=Q(9)
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      COL(11)=Q(1R)
      COL(12)=H
      COL(13)=R
      COL(14)=G
      COL(15)=A
      COL(16)=N2
      COL(17)=K2
      COL(18)=C2
      COL(19)=U2
      COL(20)=B(5)
      COL(21)=B(6)
      COL(22)=B(7)
      COL(23)=B(8)
      IF(T-1.) 3700,3605,3700
 3605 DO 3619 IT=1,NOREQ
      READ (5,3610) NUMBER, ALPHA(IT),BETA(IT)
 3610 FORMAT(I5,4X,2A4)
      GO TO (3611,3612,3613,3614,3615,3616,3617,3618,3619),IT
 3611 NC1=NUMBER
 3612 NC2=NUMBER
 3613 NC3=NUMBER
 3614 NC4=NUMBER
 3615 NC5=NUMBER
 3616 NC6=NUMBER
 3617 NC7=NUMBER
 3618 NC8=NUMBER
 3619 NC9=NUMBER
      GO TO (3621,3622,3623,3624,3625,3626,3627,3628,3629),NOREQ
 3621 WRITE (6,3631) ALPHA(1),BETA(1)
      GO TO 3700
 3622 WRITE(6,3632) (ALPHA(IS),BETA(IS), IS=1,2)
      GO TO 3700
 3623 WRITE(6,3633) (ALPHA(IS),BETA(IS), IS=1,3)
      GO TO 3700
 3624 WRITE(6,3634) (ALPHA(IS),BETA(IS), IS=1,4)
      GO TO 3700
 3625 WRITE(6,3635) (ALPHA(IS),BETA(IS), IS=1,5)
      GO TO 3700
 3626 WRITE(6,3636) (ALPHA(IS),BETA(IS), IS=1,6)
      GO TO 3700
 3627 WRITE(6,3637) (ALPHA(IS),BETA(IS), IS=1,7)
      GO TO 3700
 3628 WRITE(6,3638) (ALPHA(IS),BETA(IS), IS=1,8)
      GO TO 3700
 3629 WRITE(6,3639) (ALPHA(IS),BETA(IS), IS=1,9)
 3631 FORMAT(57X,'TIME'7X,2A4/)
 3632 FORMAT(50X,'TIME'7X,2A4,6X,2A4/)
 3633 FORMAT(43X,'TIME'7X,2A4,2(6X,2A4)/)
 3634 FORMAT(36X,'TIME'7X,2A4,3(6X,2A4)/)
 3635 FORMAT(29X,'TIME'7X,2A4,4(6X,2A4)/)
 3636 FORMAT(22X,'TIME'7X,2A4,5(6X,2A4)/)
 3637 FORMAT(15X,'TIME'7X,2A4,6(6X,2A4)/)
 3638 FORMAT( 8X,'TIME'7X,2A4,7(6X,2A4)/)
 3639 FORMAT( 1X,'TIME'7X,2A4,8(6X,2A4)/)
C     F1=T-1.
 3700 F1=T-1.
      IF (T-(T5-10.)) 3720,3740,3740
 3720 F2=F1/60.
C     F6=F1
```

```
      GO TO 3750
 3740 F2=F1/10.
C     F6=T-T5
C3750 IF3=F2
 3750 IF6=T-T5
      IF3=F2
      F3=IF3
      F4=F3-F2
      IF (F4) 3900,3800,3900
 3800 GO TO (3801,3802,3803,3804,3805,3806,3807,3808,3809),NOREQ
C3800 WRITE (6,3810) F6,V(5),B(5),V(18),B(8),H
C3800 WRITE (108,3810) F6,V(5),B(5),V(18),B(8),H
C3810 FORMAT (6F15.5)
 3801 WRITE (6,3811) IF6,COL(NC1)
      GO TO 3900
 3802 WRITE (6,3812) IF6,COL(NC1),COL(NC2)
      GO TO 3900
 3803 WRITE (6,3813) IF6,COL(NC1),COL(NC2),COL(NC3)
      GO TO 3900
 3804 WRITE (6,3814) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4)
      GO TO 3900
 3805 WRITE (6,3815) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4),COL(NC5)
      GO TO 3900
 3806 WRITE (6,3816) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4),COL(NC5),
     1COL(NC6)
      GO TO 3900
 3807 WRITE (6,3817) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4),COL(NC5),
     1COL(NC6),COL(NC7)
      GO TO 3900
 3808 WRITE (6,3818) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4),COL(NC5),
     1COL(NC6),COL(NC7),COL(NC8)
      GO TO 3900
 3809 WRITE (6,3819) IF6,COL(NC1),COL(NC2),COL(NC3),COL(NC4),COL(NC5),
     1COL(NC6),COL(NC7),COL(NC8),COL(NC9)
 3811 FORMAT(57X,I4, F14.2)
 3812 FORMAT(50X,I4,2F14.2)
 3813 FORMAT(43X,I4,3F14.2)
 3814 FORMAT(36X,I4,4F14.2)
 3815 FORMAT(29X,I4,5F14.2)
 3816 FORMAT(22X,I4,6F14.2)
 3817 FORMAT(15X,I4,7F14.2)
 3818 FORMAT( 8X,I4,8F14.2)
 3819 FORMAT( 1X,I4,9F14.2)
 3900 CONTINUE
      STOP
      END
```

SAMPLE OUTPUT

AFTER FASTING FOR 6 HOURS, THE SUBJECT CONSUMES 1500 ML OF WATER.

TIME	PLASMA V	PLASMA B	U ML/MIN	URINE B	ADH
	3	20	5	24	1
-360	3000.90	300.20	1.00	750.98	4.99
-300	2992.40	300.46	1.10	693.11	4.65
-240	2996.96	300.46	1.06	716.69	4.73
-180	2998.26	300.48	1.06	718.07	4.70
-120	2999.19	300.51	1.04	731.43	4.74
-60	3000.14	300.53	1.03	741.75	4.79
-10	3000.75	300.54	1.03	745.04	4.82
0	3000.86	300.54	1.03	745.68	4.82
10	3140.03	295.04	1.19	690.85	4.40
20	3328.81	290.69	1.71	536.00	3.33
30	3457.05	287.83	2.51	395.45	2.28
40	3509.69	286.30	3.57	295.05	1.52
50	3502.04	285.83	4.81	225.93	1.01
60	3455.34	286.13	6.19	178.15	0.67
70	3388.01	286.99	7.62	144.95	0.45
80	3311.79	288.27	8.98	121.89	0.30
90	3232.60	289.80	10.19	105.95	0.20
100	3157.59	291.43	11.17	95.04	0.14
110	3090.76	293.09	11.89	87.69	0.09
120	3033.74	294.71	12.37	82.85	0.06
130	2986.77	296.24	12.47	80.87	0.05
140	2957.57	297.29	10.21	96.90	0.13
150	2958.01	297.67	7.09	135.76	0.35
160	2973.81	297.84	5.35	175.18	0.56
170	2989.96	297.96	4.67	198.22	0.68
180	3000.70	298.11	4.60	201.44	0.68
190	3004.68	298.32	4.90	190.45	0.60
200	3002.31	298.61	5.39	174.40	0.50
210	2995.36	298.97	5.82	162.08	0.42
220	2987.22	299.33	5.85	160.32	0.41
230	2984.20	299.50	4.80	190.20	0.56
240	2991.69	299.46	3.45	253.32	0.89
250	3003.73	299.37	2.76	308.37	1.16
260	3013.94	299.32	2.58	327.19	1.24
270	3019.91	299.32	2.72	313.57	1.17
280	3021.54	299.38	2.96	290.94	1.05
290	3020.40	299.47	3.09	279.27	0.98
300	3018.94	299.56	3.00	286.24	1.01
310	3018.98	299.61	2.74	309.22	1.12
320	3020.77	299.63	2.45	339.94	1.26
330	3023.56	299.64	2.22	370.29	1.40
340	3026.52	299.64	2.06	395.51	1.52
350	3028.98	299.65	1.99	407.73	1.60
360	3030.74	299.67	1.94	416.69	1.67
370	3031.95	299.69	1.90	424.22	1.72
380	3032.79	299.71	1.86	431.43	1.78
390	3033.39	299.73	1.82	438.94	1.83
400	3033.87	299.76	1.79	447.04	1.90