(NASA-CR-160225) USER'S INSTRUCTIONS FOR THE GRODINS' RESPIRATORY CONTROL MODEL USING THE UNIVAC 1110 REMOTE BATCH AND DEMAND PROCESSING (General Electric Co.) 74 p HC A04/MF A01 CSCL 06P G3/52

N79-24635

Unclas 22229

PROGRAM DESCRIPTION GUIDE

A. IDENTIFICATION

Program Name - Grodins (Respiratory Control Model)

Programmer's Name - Marks, Archer

Programmer Contact - V. J. Marks or G. T. Archer, GE/TSS, Houston

Date of Issue - 9/6/74

B. GENERAL DESCRIPTION

The purpose of this model is to illustrate the transient and steady-state responses of the respiratory control system, for variations in volumetric fractions of inspired gases and special system parameters. The program contains the capability to change workload.

The program is based on Grodins' respiratory control model and can be envisioned as a feedback control system comprised of a "plant" (the controlled system) and the regulating component (controlling system). The controlled system is partitioned into 3 compartments corresponding to lungs, brain, and tissue with a fluid interconnecting patch representing the blood.

C. USAGE AND RESTRICTIONS

Machine, Operating System, and Compiler Required - Univac 1110, EXEC 8, Fortran

Peripheral Equipment Required - Printer, Card Reader, Graphic Terminal

Approximate Memory Required - 18671

D. PARTICULAR DESCRIPTION

See TIR 741-MED-3047

E. DESCRIPTION OF INPUT

A Univac 1110 file (GRØDIN.) contains the source and relocatables of all the subroutines, the executable program, Batch and Demand data files (GRØDIN.GRØDAT and GRØDIN.GRØDATT), and Remote Batch run stream (GRØDIN.RUNB). Runs may require a data file and/or the Remote Batch run stream file to be modified. Since GRØDIN. is not protected, the user should copy

GRØDIN. into another file, and make his modifications to this other file. Examples to follow should explain.

1. Batch -
The print output will be generated at the 1110 (onsite).

a. Onsite Batch
The run will be in card deck form, and initiated at the 1110. A JSC form 588A should be submitted with the card deck.

(1) Job Stream Cards (Start Col. 1)

```
                                                          Col.61
@RUN,/R DBHØLD,7007-Q509-C,DB6-G03432,TT,PPP              NAME SKYLAB
  (TT=mins.run time, PPP=pages output, NAME=user
   name)
@ASG,AX GRØDIN.
@CØPY GRØDIN.,TPF$.
@FREE GRØDIN.
@XQT
  data cards
@FIN
```

(2) Data Cards (See Appendix A for example).

Card No.	Column	Format	Description
1	1-4	A4	Blank if Batch Mode. TTYb if Demand Mode.
2-49			Cards 2-49 are initializing cards for 48 variables (See Appendix A).
	6-20	F15.0	Variable value.
	26-33	2A4	Variable symbol (this is not used in the program).
50-N			Cards 50-N are workload cards.
	1-6	F6.2	Workload (watts).
	10-15	F6.2	*Run time (mins) for workload
N+1			*Workload card with time = 0.

*Length of computer run is determined when variable on card 16 (maximum length of computer run) is reached, or a workload card with 0 run time is read.

b. Remote Batch
The run is initiated from a teletype. The run stream and the data are in Univac 1110 files GRØDIN.RUNB and GRØDIN.GRØDAT. The data file is the same format as the Onsite Batch data cards. The following example shows copying GRØDIN. into another file

FILNEW.), modifying the run stream and data files, copying the run stream into another file (FILRUN.), then executing the run via a teletype.

TTY Input	Comments
@ASG,CP FILNEW.,F2	Catalog a new file named FILNEW.
@ASG,CP FILRUN.,F2	Catalog a new file to put run stream. Run stream must be in separate file to execute.
@COPY GRØDIN.,TPF$.	Copy GRØDIN. into temporary work file.
@ED,L RUNB,RUNB	To edit run stream.

The run stream is the following format:

```
                                                          ↓Col. 61
@RUN,/R DBHOLD,7007-Q509-C,DB6-G03432,TT,PPP              NAME  NODECK
    (TT= mins. run time, PPP = pages output)
@ASG,AX FILNEW.
@CØPY FILNEW.,TPF$.
@FREE FILNEW.
@XQT
@ADD GRØDAT
```

The user might want to change the run time or output pages in this run stream.

@ED,L GRØDAT,GRØDAT	To edit the data file.

The data file is in the same format as Onsite Batch data cards. The user can modify this base data file for his particular run.

@COPY TPF$.,FILNEW.	Copy temporary work file into FILNEW..
@COPY TPF$., FILRUN.	To get run stream into FILRUN..
@FREE FILRUN.	
@START FILRUN.RUN	Start Remote Batch execution.

NOTE: After above TTY input, FILNEW. contains the latest run stream and data files. FILNEW. is not a permanent file, but it might be several days before NASA deletes it. The next time the user wants to modify these files, he may substitute the first three TTY inputs with @COPY FILNEW.,TPF$. until FILNEW. is deleted.

2. Demand (Time-Share) -
The run is initiated from a teletype, and the printout will be to the teletype. A data file (GRØDIN.GRØDATT) is required to initialize the 49 input variables. Workloads are then input by the user via responding to questions asked by the program. Options are available so all workloads can be input before the program executes, or intermediate results may be requested before continued input. Note following example (Appendix B also contains an example):

TTY Input	Comments
@COPY GRODIN.,TPF$.	Copy GRØDIN. into temporary work file.
@ED,L GRODATT,GRODATT	To edit Demand Data File.

The Demand Data File is in the same format as Batch Data File except the first card record contains TTY in first three columns, and the 49th card record ends the data file (no workload cards). Card record 16 (maximum length of computer run) and record 40 (time increment for printout) are ignored by the program in the Demand Mode. The user can modify this data file for his particular run.

@XQT	Execute program.
ADD DATA...	Program request.
@ADD GRØDATT	User answer.

The 48 input variables will then be printed out.

INPUT WORK CARDS...	Program outputs an explanation of parameters on work card records.
WØRK = WØRK LØAD (WATTS)...	
MINS = TIME FØR WØRK LØAD...	
PRINT = TIME INCREMENT (MINS) FOR PRINTØUT	
EXEC...	
MØRE = INPUT MØRE BEFØRE EXEC...	
RUN = EXEC. WITH ABØVE, THEN CAN INPUT AGAIN...	
STØP = EXEC. WITH ABØVE, THEN STØP...	
BACK = ERASE PREVIØUS WØRK RECØRD...	
WØRK MINS PRINT EXEC (F6.2,IX,F6.2,IX,F6.2,	Prog.asks for work record
0. .2 .1 MØRE IX, A4)	User answer.
.00 .20 .10 MØRE	Prog. outputs user input.
WØRK MINS PRINT EXEC (F6.2,IX,F6.2,IX,F6.2,	Prog.asks for work record
100. 10. .2 RUN IX,A4)	User answer.
100.00 10.00 .2ORUN	Prog.outputs user input.

The program executes and outputs the results for the preceding input, then (since EXEC was RUN) the program will ask for additional work records.

WØRK MINS PRINT EXEC (F6.2,IX,F6.2,IX,F6.2,IX,A4)...Prog.asks for work record

Etc.

Until the program finishes executing a work record with an EXEC parameter = STØP.

F. DESCRIPTION OF OUTPUT

(See Appendix B for Demand example)
(See Appendix C for Batch example)
(See Appendix D for normal values)

TIME (mins)
ALVEOLAR, ARTERIAL, BRAIN, TISSUE, V BRAIN, and V TISSUE volumetric fractions of CO_2, O_2, and N_2.

ALVEOLAR, ARTERIAL, BRAIN, TISSUE, CSF, V BRAIN, and V TISSUE partial pressures of CO_2, O_2, and N_2. (mm Hg)

ALVEOLAR, BRAIN, TISSUE, and CSF derivatives of the partial pressures of CO_2, O_2, and N_2. (mm Hg)

ARTERIAL, BRAIN, TISSUE, CSF, V BRAIN, and V TISSUE hydrogen ion (H+) concentrations (nanomoles) and pH.

ARTERIAL, V BRAIN, and V TISSUE concentrations of HbO_2 (oxyhemoglobin), (liters O_2 - STPD)

ALVEOLAR RQ

RQ DIFF

TRANSPORT TIMES (mins)
AB = Lung to brain
VB = Brain to lung
VT = Tissue to lung
AT = Lung to tissue
AC = Lung to carotid body

VI = Inspired ventilation (liters/min)

VE = Expired ventilation (liters/min)

Q = Cardiac output (liters/min)

FB = Brain blood flow (liters/min)

DERIVATIVES of Q and FB

RESP FREQ (breaths/min)

MINUTE VOLUME (liters/min)

DEAD SPACE VENTILATION (liters/min)

HEART RATE (beats/min)

ARTERIAL VENOUS O_2 DIFFERENCE (liters O_2/liters blood)

DEAD SPACE VOLUME (liters)

CHANGE IN WØRK LØAD (watts)

METABOLIC RATE CHANGE ØF CO_2 AND O_2 CØNSUMPTION IN TISSUE

At termination of a run, the final values for the 2nd thru 15th input variables (see Appendix A) are printed out. If the 38th input variable (constant involved in controller equation) $\leq .00001$, it is recalculated and printed at the termination of the run.

G. INTERNAL CHECKS AND EXITS

1. Batch
   The run terminates when time becomes greater than the 16th input variable (maximum length of computer run), or when a workload card with 0 time is read.

2. Demand
   Up to 50 work records can be input before letting the program execute. If this limit is reached, the program will execute using an EXEC parameter = RUN. The EXEC parameter is checked for validity. The run terminates when a work record with an EXEC parameter = STOP is finished executing.

H. INDEPENDENT SUBROUTINES

See Appendix E for listing of all subroutines.

I. SYSTEM SUBROUTINES

No special system subroutines required. Library File TEK. is required to supply terminal graphic subroutines.

J. COMPLETION OR FINAL CHECKOUT DATE

9/6/74

Appendix A - Data Card Example
Appendix B - Demand Example
Appendix C - Batch Example
Appendix D - Normal Values
Appendix E - Program listing

APPENDIX A

INITIALIZING CARDS FOR INPUT VARIABLES

Card No.	Variable	Normal Initial Value	Symbol	Description
1	ITTY			Blank for Batch Mode. TTY in 1st 3 cols. if Demand Mode.
2	C(1)	.17827	FA(CO2)	Alveolar gas fractions (dry),
3	C(2)	.53459	FA(O2)	volumetric fraction of gas,
4	C(3)	.28714	FA(N2)	dimensionless
5	C(4)	.64121	CB(CO2)	Concentration of gas in brain,
6	C(5)	.00116	CB(O2)	liters (STPD)/liter brain.
7	C(6)	.00105	CB(N2)	
8	C(7)	.61553	CT(CO2)	Concentration of gas in tissue
9	C(8)	.00147	CT(O2)	compartment. Liters (STPD)/
10	C(9)	.00105	CT(N2)	liter tissue
11	C(10)	6.00000	Q	Cardiac output blood flow,
12	C(11)	.74913	QB	liters/min. Cerebral blood flow, liters/min.
13	C(12)	48.17427	PCSF(CO2)	Partial pressure of gas in
14	C(13)	36.69498	PCSF(O2)	cerebrospinal fluid compart-
15	C(14)	61.17176	PCSF(N2)	ment, mm Hg.
16	C(15)	40.0000	TMAX	Maximum length of computer run, min. A workload card with time=0 will also end a Batch computer run. Demand Mode ignores this variable.
17	C(16)	0.0000	CENT SENS PT	Central sensitivity partition. Weighting of the H+ concentration in CSF with that of venous blood in the brain. With C(16) =0, zero weight is given to venous blood at level of the brain and a weight of one is given to H+ concentration in CSF.
18	C(17)	.2000	HB	Blood oxygen capacity, liters (STPD)/liter blood
19	C(18)	.1000	R1	Time constants for cardiac output response (R1) and cere-
20	C(19)	.1000	R2	bral blood flow response (R2) for changes in blood chemical composition.
21	C(20)	1.1380	CNT SENS COF	Controller sensitivity weight-
22	C(21)	1.1540	CRTD BDY SCF	ings; i.e.,

Card No.	Variable	Normal Initial Value	Symbol	
				$V_1 = 1.138C_{CSF(H^+)} + 1.1540 (t-\tau ao) + TERM\text{-}V_{1(N)}$ where τao = Blood transport delay from lung to carotid body, V_1 defined in C(37), and TERM = function of $F_{A(02)}$.
23	C(22)	3.0000	KL	Volumes of lung (alveoli), brain, and tissue compartments, liters.
24	C(23)	1.0000	KB	
25	C(24)	39.0000	KT	
26	C(25)	.0500	MRB (C02)	Metabolic rates by brain, liters (STPD)/min.
27	C(26)	.0500	MRB (02)	
28	C(27)	81.9900	D (C02)	Diffusion coefficient for gas across "blood-brain", liters(10)$^{-7}$ (STPD)/min. per mm Hg.
29	C(28)	4.3610	D (02)	
30	C(29)	2.5240	D (N2)	
31	C(30)	260.0000	B	Barometric pressure, mm Hg.
32	C(31)	.0192	F1 (C02)	Volumetric fraction of gas (dry inspired), dimensionless
33	C(32)	.7000	F1 (02)	
34	C(33)	.2808	F1 (N2)	
35	C(34)	.1000	KCSF	Volume of cerebrospinal fluid, liters
36	C(35)	.0000	T	Initial time.
37	C(36)	.0078125	H	Size of computer time step, min.
38	C(37)	87.5500	V1(N)	Constant that is involved in the controller equation (See C(21)). Determines the normal level of alveolar ventilation so that $P_{A(C02)} \approx 40.0$ at rest, breathing air at sea level. When the controller sensitivity weightings are changed V1(N) should be altered accordingly.
39	C(38)	5.3900	V1 (SS)	Value used for normal resting alveolar ventilation. This is not used in the program if V1(N) is known.

Card No.	Variable	Normal Initial Value	Symbol	Description
40	C(39)	.2500	PRINT AL TIM	Output printed in these time increments (mins). Demand Mode ignores this variable.
41	C(40)	0.0000	UNKNOWN	Importance related to C (39), but doesn't seem to be of any real significance.
42 43 44 45	BC(1) BC(2) BC(3) BC(4)	.5470 .5850 .5850 .5850	BHCO3 Blood	Standard bicarbonate content, liters CO_2 (STPD)/liter X, 37° where X = Blood, brain, tissue, CSF.
46 47	RMT(1) RMT(2)	.1820 .2150	RMT(CO2) RMT(O2)	Metabolic rates by tissue, liters (STPD)/min.
48 49	DJ(1) DJ(2)	.0000 .0000	DJ1 DJ2	Used in performing Dejours experiment (not utilized in present runs). Brief description of Dejours work relating O_2 and CO_2 threshold effects is given in Grodins' paper.

In Demand Mode, the 49th card record ends the data file.

If for Batch Mode, cards 50 thru N are workload cards.

Example:

Card No.	Variable	Columns	Format	Description
50-N	WØRK2	1-6	F6.2	Workload (watts).
	DURAT	10-15	F6.2	Run time for workload (mins).

The last workload card should have Run Time = 0. Length of computer run (Batch Mode) will be when C(15) is reached, or a workload card with 0 run time is read.

APPENDIX B

EXAMPLE OF DEMAND INPUT/OUTPUT

```
@XQT

   GRODINS: RESPIRATORY CONTROL MODEL


 ADD DATA...
>@ADD GRODATT


  *RESPIRATORY CHEMOSTAT -- INPUT DATA*

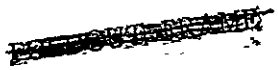
 1       .1783     .5346     .2871     .6412     .0012
 6       .0011     .6155     .0015     .0011    6.0000
11       .7491   48.1742   36.6949   61.1717   40.0000
16       .0000     .2000     .1000     .1000    1.1380
21      1.1540    3.0000    1.0000   39.0000     .0500
26       .0500   81.9900    4.3610    2.5240  260.0000
31       .0192     .7000     .2800     .1000     .0000
36       .0078   87.5500    5.3900     .2500     .0000
41       .5470      5850     .5850     .5850
45       .1820     .2150     .0000     .0000


 DO YOU WANT GRAPHIC INSTEAD OF TABULAR OUTPUT? (Y/N)
>N

 INPUT WORK CARDS...
 WORK= WORK LOAD(WATTS)...
 MINS= TIME FOR WORK LOAD...
 PRINT= TIME INCREMENT(MINS)FOR PRINTOUT...
 EXEC ...
  MORE= INPUT MORE BEFORE EXEC...
  RUN = EXEC WITH ABOVE,THEN CAN INPUT AGAIN...
  STOP= EXEC WITH ABOVE THEN STOP...
  BACK= ERASE PREVIOUS WORK RECORD...
 WORK    MINS    PRINT   EXEC  (F6.2,1X,F6.2,1X,F6.2,1X,A4)...
>0.      1.       .5      STOP
     .00    1.00     .50STOP

 ********************************************
 WORK LOAD CHG.(    .00WATTS FOR    1.00MINS) AT     .0000MINS

 TIME      .0000MINS    ALV RQ      .8782   RQ DIFF  -.0027
         ALVEOLAR ARTERIAL    BRAIN    TISSUE       CSF  V BRAIN V TISSUE
  CO2       .1783     .5652     .6412     .6155                .6320     .5998
   O2       5346      .2021     .0012     .0015                .1352     .1615
   N2       2871      .0010     .0011     .0011                .0011     .0011
 DHB      -.0007               -.0000     .0000    -.0000
 IMAT      .0010                .0002    -.0000    -.0108
 DUES     -.0003               -.0000    -.0000     .0025
 PCO2    37.9715   37.9715   48.1741   42.7791   48.1742   48.1741   42.7791
  PO2   113.8677  113.8677   36.6162   46.4015   36.6949   36.6162   46.4015
  PN2    61.1608   61.1608   61.1888   61.1888   61.1717   61.1888   61.1888
 (H+)               37.6556   42.3511   39.0214   44.0727   42.9989   40.0941
   PH                7.4242    7.3731    7.4087    7.3558    7.3665    7.3969
 HBO2                 .1985                                  .1340     .1600
 TRANSPORT TIMES
              AB        VB        VT        AT        AC        VI
           .1970     .1114     .5912     .3170     .1877    6.0593
              VE         Q        FB    DERIVATIVES
         5.9291    6.0000     .7491     .0000     .0003
      RESP FREQ  MIN VOL D.S.VENT  HEART R   AVO2DF    DSVOL
        12.1685   7.5753   1.5811  66.1070  43.9640    .1519
```



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```
@XQT

   GRODINS: RESPIRATORY CONTROL MODEL


 ADD DATA...
>@ADD GRODATT


  *RESPIRATORY CHEMOSTAT -- INPUT DATA*

  1       .1783     .5346     .2871     .6412    .0012
  6       .0011     .6155     .0015     .0011   6.0000
 11       .7491   48.1742   36.6949   61.1717  40.0000
 16       .0000     .2000     .1000     .1000   1.1300
 21      1.1540    3.0000    1.0000   39.0000    .0500
 26       .0500   81.9900    4.3610    2.5240 250.0000
 31       .0192     .7000     .2800     .1000    .0000
 36       .0078   87.5500    5.3900     .2500    .0000
 41       .5470     .5850     .5850     .5850
 45       .1820     .2150     .0000     .0000


 DO YOU WANT GRAPHIC INSTEAD OF TABULAR OUTPUT? (Y/N)
>Y



 INPUT WORK CARDS...
 WORK= WORK LOAD(WATTS)...
 MINS= TIME FOR WORK LOAD...
 PRINT= TIME INCRIMENT(MINS)FOR PRINTOUT...
 EXEC
  MORE= INPUT MORE BEFORE EXEC...
  RUN = EXEC WITH ABOVE,THEN CAN INPUT AGAIN...
  STOP= EXEC WITH ABOVE THEN STOP..
  BACK= ERASE PREVIOUS WORK RECORD...
 WORK    MINS    PRINT   EXEC   (F6.2,1X,F6.2,1X,F6.2,1X,A4)...
>0       2.       .5      MORE
     .00    2.00      .50MORE
 WORK    MINS    PRINT   EXEC   (F6.2,1X,F6.2,1X,F6.2,1X,A4)...
>200.    1.       .1      MORE
 200.00    1.00      .10MORE
 WORK    MINS    PRINT   EXEC   (F6.2,1X,F6.2,1X,F6.2,1X,A4)...
>200.    7        .5      RUN
 200.00    7.00      .50RUN
TYPE SHIFT-OUT (SO) AND RETURN-->
```

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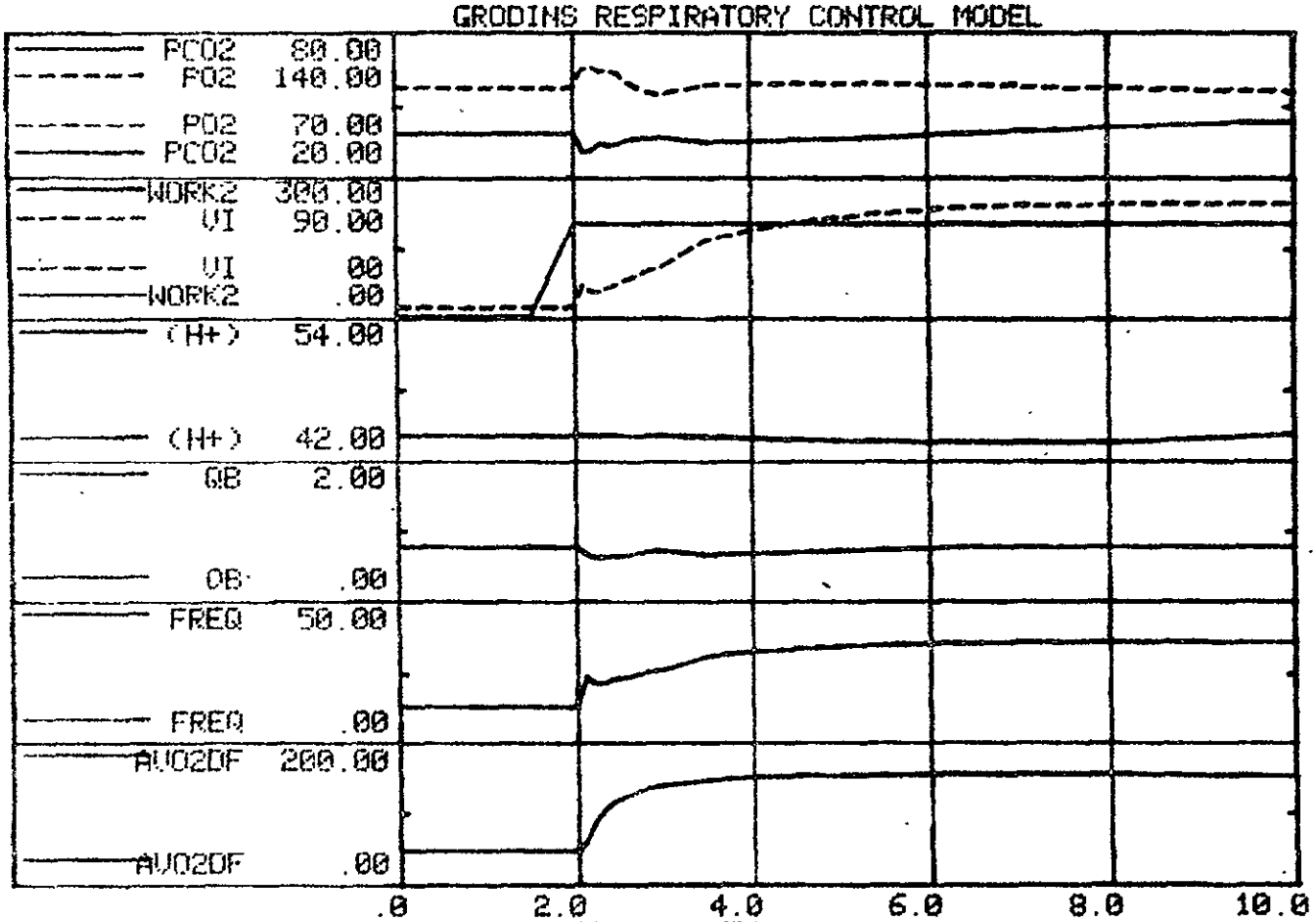
```
          GRAPHIC OUTPUT(Y,N,S),TIME INTERVALS,STARTX,STOPX,(A2,3F5.0)..
>Y 5.    0.    10.
   PCO2                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             1.  80.   20.
    PO2                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             1.  140.  70.
  WORK2                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             2.  300.  0.
   (H+)                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             2.  KKK
>Y             3.  54.   42.
     VI                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             2.  90.   0.
     QB                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             4.  2.    0.
   FREQ                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
>Y             5.  50.   0.
 AVO2DF                    Y SCALE   (A4,8X,F4.0,2F6.0)
 PLOT(Y,N,S) LOC HIGH  LOW    ...
 Y             6.  200.  0.
```


GRODINS RESPIRATORY CONTROL MODEL
PCO2 80.00
PO2 140.00
PO2 70.00
PCO2 20.00
WORK2 300.00
VI 90.00
VI 00
WORK2 .00
(H+) 54.00
(H+) 42.00
QB 2.00
QB .00
FREQ 50.00
FREQ .00
AVO2DF 200.00
AVO2DF .00
.0
2.0
4.0
6.0
8.0
10.0
TIME (MINS)
HARD COPY WANTED(Y,N)...
Y

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```
      GRAPHIC OUTPUT(Y,N,S),TIME INTERVALS,STARTX,STOPX,(A2,3F5.0)..
>N

 FINAL VALUES FOR FOLLOWING VARIABLES.
  1              .20746
  2              .52266
  3               26988
  4              .66543
  5               00122
  6              .00100
  7              .77849
  8              .00054
  9              .00100
 10            18.96434
 11              .77073
 12            48.84239
 13            36.28547
 14            60.42884
```

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APPENDIX C

BATCH EXAMPLE

APPENDIX C
BATCH EXAMPLE

RESPIRATORY CHEMOSTAT -- INPUT DATA

1	.1783	.5336	.2881	.6413	.0012
6	.0011	.6153	.0015	.0012	6.0000
11	.7496	48.1202	36.6316	70.6804	40.0000
16	.0000	.2000	.1000	.1000	1.1380
21	1.1540	3.0000	1.0000	39.0000	.0500
26	.0500	81.9900	4.3610	2.5240	260.0000
31	.0192	.7000	.2808	.1000	.0000
36	.0078	87.5500	5.3900	.2500	.0000
41	.5470	.5850	.5850	.5850	
45	.1820	.2150	.0000	.0000	

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****
WORK LOAD CHG.(.00WATTS FOR .50MINS) AT .0000MINS

TIME .0000

	CO2	O2	N2	D E R I V A T I V E S			PCO2	PO2	ALV RQ / PN2	.9026 / (H+)	RQ DIFF / PH	-.0271 / HBO2
ALVEOLAR	.1783	.5336	.2881	-.0059	.0102	-.0043	37.9779	113.6568	61.3653			
ARTERIAL	.5653	.2021	.0011				37.9779	113.6568	61.3653	37.6596	7.4241	.1985
BRAIN	.6413	.0012	.0011	.0006	-.0024	-.0000	48.1939	37.8788	64.1026	42.3632	7.3730	
TISSUE	.6153	.0015	.0012	.0001	-.0003	-.0000	42.7330	47.3485	69.9301	38.9926	7.4090	
CSF				.0090	.1717	-.9675	48.1202	36.6316	70.6804	44.0233	7.3563	
V BRAIN	.6312	.1386	.0011				48.1939	37.8788	64.1026	43.0743	7.3658	.1374
V TISSUE	.5992	.1632	.0012				42.7330	47.3485	69.9301	40.0956	7.3969	.1617

TRANSPORT TIMES --	AB	VB	VT	AT	AC **	VI	VE	Q	FB	DERIVATIVES
	.1970	.1114	.5913	.3170	.1877	6.0077	5.9116	6.0000	.7496	.0000 -.0025
RESP FREQ 10.1710	MINUTE VOLUME		7.5496	DEAD SPACE VENT		1.5900		HEART RATE	66.1070	

TIME .2500

	CO2	O2	N2	D E R I V A T I V E S			PCO2	PO2	ALV RQ / PN2	.9057 / (H+)	RQ DIFF / PH	-.0302 / HBO2
ALVEOLAR	.1779	.5349	.2872	.0016	.0009	-.0025	37.8988	113.9349	61.1664			
ARTERIAL	.5649	.2022	.0010				37.8988	113.9349	61.1664	37.6076	7.4247	.1986
BRAIN	.6413	.0012	.0011	-.0002	-.0000	-.0000	48.1942	36.6339	63.6564	42.3634	7.3730	
TISSUE	.6153	.0015	.0012	.0000	-.0000	-.0000	42.7362	46.3936	69.6465	38.9946	7.4090	
CSF				.0087	-.0002	-.9970	48.1224	36.6352	70.4346	44.0254	7.3563	
V BRAIN	.6321	.1352	.0011				48.1942	36.6339	63.6564	43.0120	7.3664	.1341
V TISSUE	.5996	.1615	.0012				42.7362	46.3936	69.6465	40.0670	7.3972	.1600

TRANSPORT TIMES --	AB	VB	VT	AT	AC **	VI	VE	Q	FB	DERIVATIVES
	.1971	.1116	.5912	.3169	.1877	5.9578	5.8639	6.0000	.7471	.0000 -.0010
RESP FREQ 10.1710	MINUTE VOLUME		7.4971	DEAD SPACE VENT		1.5862		HEART RATE	66.1070	

****
WORK LOAD CHG.(40.00WATTS FOR .25MINS) AT .5000MINS

CHANGE IN METABOLIC RATES MRCO2= .1892 MRO2= .2150

TIME .5000

	CO2	O2	N2	D E R I V A T I V E S			PCO2	PO2	ALV RQ / PN2	.9010 / (H+)	RQ DIFF / PH	-.0255 / HBO2
ALVEOLAR	.1781	.5352	.2867	-.0008	.0020	-.0013	37.9345	113.9878	61.0777			
ARTERIAL	.5650	.2022	.0010				37.9345	113.9878	61.0777	37.6313	7.4245	.1986
BRAIN	.6412	.0012	.0011	-.0002	.0000	-.0000	48.1800	36.6644	63.2613	42.3547	7.3731	
TISSUE	.6153	.0015	.0012	-.0000	-.0000	-.0000	42.7361	46.2715	69.3700	38.9946	7.4090	
CSF				.0068	.0040	-1.0180	48.1244	36.6357	70.1826	44.0271	7.3563	
V BRAIN	.6320	.1353	.0011				48.1800	36.6644	63.2613	43.0049	7.3665	.1342
V TISSUE	.5997	.1613	.0012				42.7361	46.2715	69.3700	40.0629	7.3973	.1598

APPENDIX C
BATCH EXAMPLE

TRANSPORT TIMES --	AB	VB	VT	AT	AC **	VI	VE	Q	FB	DERIVATIVES	
	.1971	.1116	.5911	.3169	.1877	5.9726	5.8738	6.0000	.7480	.0000	.0005
RESP FREQ 10.1710	MINUTE VOLUME		7.5102	DEAD SPACE VENT		1.5870		HEART RATE	66.1070		

****

WORK LOAD CHG.(100.00WATTS FOR .25MINS) AT .7500MINS

CHANGE IN METABOLIC RATES MRCO2= .4367 MRO2= .4963

TIME .7500									ALV RQ	1.6623	RQ DIFF	-.7868
	CO2	O2	N2	D E R I V A T I V E S			PCO2	PO2	PN2	(H+)	PH	HBO2
ALVEOLAR	.1485	.5788	.2727	.0138	.0227	-.0365	31.6311	123.2812	58.0877			
ARTERIAL	.5283	.2033	.0010				31.6311	123.2812	58.0877	33.3900	7.4764	.1994
BRAIN	.6413	.0010	.0011	-.0124	-.0003	-.0000	48.1834	32.1767	62.9292	42.3568	7.3731	
TISSUE	.6160	.0011	.0012	.0039	-.0010	-.0000	42.8685	35.0427	69.0534	39.0773	7.4081	
CSF				.0068	-.6030	-1.0292	48.1274	36.5570	69.9266	44.0299	7.3563	
V BRAIN	.6355	.1217	.0011				48.1834	32.1767	62.9292	42.7587	7.3690	.1207
V TISSUE	.6071	.1345	.0012				42.8685	35.0427	69.0534	39.6795	7.4014	.1334

TRANSPORT TIMES --	AB	VB	VT	AT	AC **	VI	VE	Q	FB	DERIVATIVES	
	.1771	.1200	.5517	.2788	.1644	15.8417	16.7335	7.3924	.6117	1.5630	-.1929
RESP FREQ 12.3689	MINUTE VOLUME		18.9704	DEAD SPACE VENT		2.6828		HEART RATE	78.4258		

TIME 1.0000									ALV RQ	1.3762	RQ DIFF	-.5007
	CO2	O2	N2	D E R I V A T I V E S			PCO2	PO2	PN2	(H+)	PH	HBO2
ALVEOLAR	.1536	.5774	.2690	.0108	-.0202	.0094	32.7114	122.9827	57.3059			
ARTERIAL	.5350	.2032	.0010				32.7114	122.9827	57.3059	34.1311	7.4668	.1993
BRAIN	.6379	.0010	.0011	-.0110	.0000	-.0000	47.4443	31.8706	62.3184	41.9056	7.3777	
TISSUE	.6161	.0008	.0012	.0006	-.0005	-.0000	42.8917	26.4801	68.5792	39.0919	7.4079	
CSF				-.0820	-.6229	-1.0804	48.1176	36.3957	69.6638	44.0210	7.3563	
V BRAIN	.6323	.1212	.0011				47.4443	31.8706	62.3184	42.2958	7.3737	.1202
V TISSUE	.6146	.1052	.0012				42.8917	26.4801	68.5792	39.1903	7.4068	.1044

TRANSPORT TIMES --	AB	VB	VT	AT	AC **	VI	VE	Q	FB	DERIVATIVES	
	.1472	.1195	.4364	.2184	.1345	17.9397	18.6461	9.2192	.6102	2.7336	.0437
RESP FREQ 15.2405	MINUTE VOLUME		21.4438	DEAD SPACE VENT		3.1508		HEART RATE	94.5195		

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APPENDIX C
BATCH EXAMPLE

```
FINAL VALUES FOR FOLLOWING VARIABLES.
 1            .15357
 2            .57738
 3            .26904
 4            .63787
 5            .00101
 6            .00107
 7            .61609
 8            .00084
 9            .00118
10           9.21921
11            .61019
12          48.11764
13          36.39575
14          69.66384
```

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APPENDIX D

OUTPUT VARIABLES
NORMAL VALUES

Normal Variables Values are for conditions:

B = 260 mm Hg

$F_{I(CO_2)}$ = .0192

$F_{I(O_2)}$ = .7000

$F_{I(N_2)}$ = .2808

Physiological Variable	Computer Variable	Normal Value	Physiological Variable	Computer Variable	Normal Value
$F_{A(CO_2)}$	C(1)	.1783	$P_{CSF(CO_2)}$	C(12)	48.1743
$F_{A(O_2)}$	C(2)	.5346	$P_{CSF(O_2)}$	C(13)	36.6950
$F_{A(N_2)}$	C(3)	.2871	$P_{CSF(N_2)}$	C(14)	61.1718
$P_{a(CO_2)}$	F(7)	37.9705	$C_{a(CO_2)}$	CC(1)	.5652
$P_{a(O_2)}$	F(1)	113.8681	$C_{a(O_2)}$	F(9)	.2021
$P_{a(N_2)}$	PAN2	61.1614	$C_{a(N_2)}$	F(10)	.0010
$P_{B(CO_2)}$	CPB	48.1745	$C_{B(CO_2)}$	C(4)	.6412
$P_{B(O_2)}$	F(17)	36.6954	$C_{B(O_2)}$	C(5)	.0012
$P_{B(N_2)}$	F(18)	61.1616	$C_{B(N_2)}$	C(6)	.0010
$P_{T(CO_2)}$	CPT	42.7786	$C_{T(CO_2)}$	C(7)	.6155
$P_{T(O_2)}$	PT02	46.2605	$C_{T(O_2)}$	C(8)	.0015
$P_{T(N_2)}$	PTN2	61.1673	$C_{T(N_2)}$	C(9)	.0010
$C_{a(HbO_2)}$	CHB(1)	.1985	τ_{aB}	AB	.1970
$C_{VT(HbO_2)}$	CHB(3)	.1342	τ_{aT}	AT	.3170
$C_{VB(HbO_2)}$	CHB(2)	.1597	τ_{vB}	VB	.1114

Physiological Variable	Computer Variable	Normal Value
$C_{a(H^+)}$	CH(1)	37.6549
$C_{B(H^+)}$	CH(2)	42.3514
$C_{T(H^+)}$	CH(3)	38.0212
$C_{CSF(H^+)}$	CH(4)	44.0728
$C_{VB(H^+)}$	HVB	43.0032
$C_{VT(H^+)}$	HVT	40.0892
pH_a	CPH(1)	7.4242
pH_{CSF}	PHCSF	7.3558
pH_{VB}	PHVB	7.3665
pH_{VT}	PHVT	7.3970
pH_{BRAIN}	CPH(2)	7.3731
pH_{TISSUE}	CPH(3)	7.4087
AVO2DF	AVO2DF	44.1667
DSVOL	DSVOL	.1518

Physiological Variable	Computer Variable	Normal Value
τ_{vT}	VT	.5912
τ_{ao}	AC	.1877
VI	VI	6.0586
VE	VE	5.9248
Q	C(10)	6.0000
FB	C(11)	.7491
RESP FREQ	FREQ	12.1637
MINUTE VOL	TVNT	7.5723
DEAD SPACE VENT	DEADVT	1.5806
HEART RATE	HRATE	66.1070
ALVEOLAR RQ	RQ	.8754
RQ DIFF	QF(5)	.0001
WORK LOAD	WORK2	0.
$MRTCO_2$	RMT(1)	.1820
$MRTO_2$	RMT(2)	.2150

APPENDIX E

PROGRAM LISTING

```
B6-G03432*TPF$*GRODIN
      1              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      2             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      3             2          RC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      4             3          DQ(4)
      5       C      C(40)
      6       C   ALVEOLAR VOL GAS FUNCTIONS
      7       C        1    FA(CO2)
      8       C        2    FA( O2)
      9       C        3    FA(N2)
     10       C
     11       C   GAS CONCENTRATIONS IN BRAIN.
     12       C        4    CB(CO2)
     13       C        5    CB(O2)
     14       C        6    CB(N2)
     15       C
     16       C   GAS CONCENTRATIONS IN TISSUE.
     17       C        7    CT(CO2)
     18       C        8    CT(O2)
     19       C        9    CT(N2)
     20       C   CARDIAC OUTPUT.
     21       C       10    Q
     22       C   CEREBRAL BLOOD FLOW.
     23       C       11    QB
     24       C   GAS TENSION IN CSF.
     25       C       12    PCSF(CO2)
     26       C       13    PCSF(O2)
     27       C       14    PCSF(N2)
     28       C
     29       C   LENGTH OF SIMULATION RUN.
     30       C   (THIS IS NOT USED IN TTY MODE. IN BATCH,A WORK CARD WITH 0 TIME WILL
     31       C    ALSO STOP RUN).
     32       C       15    TMAX
     33       C   WEIGHTING OF H+CONC IN CSF VERSUS VENOUS BLOOD OF BRAIN.
     34       C       16    CENTRAL SENSITIVITY PARTITION
     35       C   BLOOD OXYGEN CAPACITY
     36       C       17    (HB)
     37       C   TIME CONSTANTS IN CARDIAC OUTPUT AND CEREBRAL BLOOD FLOW RESPONSES.
     38       C       18    R1
     39       C       19    R2
     40       C
     41       C   CONTROLLER EQUATION SENSITIVITY WEIGHTINGS.
     42       C       20    CENTRAL SENSITIVITY COEFFICIENT
     43       C       21    CAROTID BODY SENSITIVITY COEFFICIENT
     44       C
     45       C   VOLUMES OF LUNG,BRAIN,AND TISSUE
     46       C       22    KL
     47       C       23    KB
     48       C       24    KT
     49       C
     50       C   BRAIN METABOLIC RATE OF CO2 PRODUCTION.
     51       C       25    MRB(CO2)
     52       C   BRAIN METABOLIC RATE OF O2 CONSUMPTION.
     53       C       26    MRB(O2)
     54       C   GAS DIFFUSION COEFF.FOR BLOOD-BRAIN BARRIER.
     55       C       27    DCO2
     56       C       28    DO2
```

```
      C      29    DN2
      C
      C  BAROMETRIC PRESSURE.
      C      30    B
      C  VOL.FRACTION OF INSPIRED GAS.
      C      31    FI(CO2)
      C      32    FI(O2)
      C      33    FI(N2)
      C
      C  VOL.OF CSF.
      C      34    KCSF
      C  INITIAL TIME
      C      35    T
      C  COMPUTER TIME STEP.
      C      36    H
      C  CONTROLLER EQUATION CONSTANT(MAINTAINS RESTING PA(CO2) APPROX.40).
      C      37    VI(N)
      C  VALUE FOR RESTING ALVEOLAR VENTILATION.
      C      38    VI(SS)
      C  OUTPUT PRINT INCREMENTS (ALSO PRINTS AT .5MIN.INCRIMENTS).
      C      39    PRINT-ALL TIME
      C
      C      SV(18,50)
      C  ARTERIAL GAS CONCENTRATIONS AT LUNG EXIT.
      C       1    CA(CO2)
      C       2    CA(O2)
      C       3    CA(N2)
      C
      C  VENOUS GAS CONCENTRATIONS AT BRAIN EXIT.
      C       4    CVB(CO2)
      C       5    CVB(O2)
      C       6    CVB(N2)
      C
      C  VENOUS GAS CONCENTRATIONS AT TISSUE EXIT.
      C       7    CVT(CO2)
      C       8    CVT(O2)
      C       9    CVT(N2)
      C
      C  CARDIAC OUTPUT.
      C      10    Q
      C  CERBRAL BLOOD FLOW.
      C      11    QB
      C  TISSUE BLOOD FLOW.
      C      12    QT
      C  ARTERIAL H+ CONCENTRATION.
      C      13    CA(H+)
      C  ARTERIAL O2 TENSION.
      C      14    PA(O2)
      C
      C      15    --
      C  TOTAL GAS CONCENTRATIONS AT BRAIN EXIT.
      C      16    CVB(CO2) + CVB(O2) + CVB(N2)
      C  TOTAL GAS CONCENTRATIONS AT TISSUE EXIT.
      C      17    CVT(CO2) + CVT(O2) + CVT(N2)
      C  TIME.
      C      18    T
      C
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```
      C     VTRAN(18)
      C  ARTERIAL GAS CONCENTRATIONS AT BRAIN ENTRANCE.
      C        1    CAB(CO2) = CA(CO2)(T - TAB)
      C        2    CAB(O2) = CA(O2)(T - TAB)
      C        3    CAB(N2) = CA(N2)(T - TAB)
      C
      C  VENOUS BRAIN GAS CONCENTRATION AT LUNG ENTRANCE.
      C        4    CVB(CO2)(T - TVB)
      C        5    CVB(O2)(T - TVB)
      C        6    CVB(N2)(T - TVB)
      C
      C  VENOUS TISSUE GAS CONCENTRATION AT LUNG ENTRANCE.
      C        7    CVT(CO2)(T - TVT)
      C        8    CVT(O2)(T - TVT)
      C        9    CVT(N2)(T - TVT)
      C
      C  ARTERIAL GAS CONCENTRATIONS AT TISSUE ENTRANCE.
      C       10    CAT(CO2) = CA(CO2)(T - TAT)
      C       11    CAT(O2) = CA(O2)(T - TAT)
      C       12    CAT(N2) = CA(N2)(T - TAT)
      C
      C  ARTERIAL H+ CONCENTRATION AT CAROTID BODIES'SITE.
      C       13    CAO(H+) = CA(H+)(T - TAO)
      C  ARTERIAL O2 TENSION AT CAROTID BODIES'SITE.
      C       14    PAO(O2) = PA(O2)(T - TAO)
      C  ARTERIAL H+ CONCENTRATION AT BRAIN ENTRANCE.
      C       15    CAB(H+) = CA(H+)(T - TAB)
      C  TOTAL GAS CONCENTRATION FROM BRAIN AT LUNG ENTRANCE.
      C       16    (CVB(CO2) + CVB(O2) + CVB(N2))(T - TVB)
      C  TOTAL GAS CONCENTRATION FROM TISSUE AT LUNG ENTRANCE.
      C       17    (CVT(CO2) + CVT(O2) + CVT(N2))(T - TVT)
      C
      C     D(15)
      C   FOR D(15) THE SYMBOLS B=BAROMETRIC PRESSURE, 47=WATER VAPOR PRESS.,
      C  K=CONVERSION FACTOR FOR ATM TO MMHG, A=SOLUBILITY COEFF.OF GASES,
      C  H=COMPUTER TIME STEP, HB=BLOOD OXYGEN CAPACITY
      C        1    B - 47
      C        2    K ACO2
      C        3    K AO2
      C        4    K AN2
      C        5    K AN2 (B - 47)
      C        6    K AO2 (B - 47)
      C        7    K AN2 (B - 47)
      C        8    0.16 + 2.3(HB)
      C        9    863/(B - 47)
      C       10    0.62
      C       11    K ACSF(CO2)
      C       12    K ACSF(O2)
      C       13    K ACSF(N2)
      C       14    2*H
      C       15    1.99*H
      C     F(20)
      C  COMPARTMENTAL GAS TENSIONS AND CONCENTRATIONS.
      C        1    PA(O2)
      C        2    K ACO2 PA(CO2)
      C        3    PB(O2)
      C        4    K ACO2 PB(CO2)
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```
171      C       5    PT(O2)
172      C       6    K ACO2 PT(CO2)
173      C       7    PA(CO2)
174      C       8    PA(O2)
175      C       9    CA(O2)
176      C      10    CA(N2)
177      C      11    CA(CO2) + CA(O2) + CA(N2)
178      C      12    CVB(O2)
179      C      13    CVT(O2)
180      C
181      C  PRODUCT OF DIFFUSION COEFFS.AND GAS DIFFERENTIALS ACROSS BLOOD-BRAIN
182      C  BARRIER.
183      C      14    DCO2 (PB(CO2) - PCSF(CO2))
184      C      15    DO2 (PB(O2) - PCSF(O2))
185      C      16    DN2 (PB(N2) - PCSF(N2))
186      C
187      C      17    PB(O2)
188      C      18    PB(N2)
189            DIMENSION XNB(4,2), DJ(4), IDJ(2)
190            COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
191           1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
192           2        IRK, LOC, ITERX, INDEX, I, J, M, N
193            COMMON/R/ XDS,XMH,CXT,WORK,DUM1,DUM2,DUM3,WORK2,RMTB,RMTB2,TIMEOF
194           1  ,RMLIN,ITTY
195      C  ITTY =FLG FOR TTY MODE.
196      C       0= OUTPUT TO PRINTER (BATCH MODE).
197      C       'TTY '= TTY I/O AND 1ST TIME TO SUBROUTINE RC12.
198      C       1 = TTY I/O AND NOT 1ST TIME TO RC12.
199            DATA ITTTY/'TTY '/
200      C     DATA FOR INITIAL CONDITIONS
201            WRITE (6,5)
202          5 FORMAT (/'   GRODINS: RESPIRATORY CONTROL MODEL'//)
203      300   CONTINUE
204            WRITE(6,483)
205        483 FORMAT('0ADD DATA...')
206      C  READ INDICATION OC BATCH OR TTY MODE.
207            READ(5,480) ITTY
208        480 FORMAT(A4)
209            IF(ITTY .NE. ITTTY) ITTY = 0
210            WRITE(6,90)
211         90 FORMAT (1HI,1X,37H*RESPIRATORY CHEMOSTAT -- INPUT DATA*/)
212      C     DATA FOR INITIAL CONDITIONS
213            DO 10 I = 1,40
214      C  1106 HAS PROBLEM WITH END= , SO THIS ISNT USED TO
215      C   DETERMINE END OF RUN(NOO CAPABILITY TO START ANOTHER
216      C   MODEL RUN IN SAME COMPUTER RUN).
217            READ(5,190,END=301) C(I),(XN(I,J),J=1,2)
218         10 CONTINUE
219      C   ESTABLISH COMPUTER STEP INDEPENDENT OF INPUT DATA.
220            C(36)=.78125E-2
221        190 FORMAT (5X,F15.0,5X,2A4)
222            DO 20 I = 1,4
223            IP40 = I + 40
224            READ   (5,190) BC(I), (XNB(I,J), J = 1,2)
225         20 CONTINUE
226            DO 30 I = 1,2
227            READ  (5,190) RMT(I), (XNB(I,J), J = 1,2)
```

```
228             IP40 = I + 44
229          30 CONTINUE
230             DO 40 I = 1,2
231             READ    (5,190) DJ(I), (XNR(I,J), J = 1,2)
232             IP40 = I + 46
233          40 CONTINUE
234       C
235       C  OUTPUT INPUT DATA.
236             J = 1
237             DO 75 I = 1,8
238             JX = J + 4
239             WRITE(6,92) J,(C(I2),I2=J,JX)
240          92 FORMAT(' ',I2,2X,5(F9.4))
241             J = J + 5
242          75 CONTINUE
243             WRITE(6,92) J,(BC(I),I=1,4)
244             J = 45
245             WRITE(6,92) J,RMT(1),RMT(2),DJ(1),DJ(2)
246       C
247             COMMON/PLTBUF/NBUF,XBUF(181),YBUF(181,8),NA(8),KSTOPP,TMAX,KPLT
248             DATA KY/1HY/
249             TMAX=C(15)
250             WRITE (6,42)
251          42 FORMAT(/'DDO YOU WANT GRAPHIC INSTEAD OF TABULAR OUTPUT? (Y/N)')
252             READ (5,44) KYY
253          44 FORMAT(1A1)
254             IF (KYY.EQ.KY) KPLT=1
255       C  IF TTY I/O MAX-TIME WILL COME FROM WORK CARD.
256             IF(ITTY .NE. 0) C(15) = 9999999999.
257       C
258       C  FI(CO2)
259             DUM1=C(31)
260       C  FI(O2)
261             DUM2=C(32)
262       C  FI(N2)
263             DUM3=C(33)
264             WORK=0.
265             WORK2=0.
266       C  METABOLIC RATE OF O2 CONSUMPTION IN TISSUE.
267             RMTB=RMT(2)
268             RMTB2=RMT(2)
269       C
270             TIMEOF=0.
271             XDS=0.
272             XMH=10.*C(36)/0.0078125
273             MMM=0
274       201   CONTINUE
275             XDS=XDS+XMH
276             IF(MMM.EQ.1)XDS=XDS*C(36)
277             MMM=1
278             C(35)=0.
279             C(40)=0.
280       C
281       C       INITIAL GUESSES FOR ITERATIVE LOOPS
282       C  ARTERIAL CONCENTRATION OF CO2.
283             CC(1) = 0.6
284       C  BRAIN CONCENTRATION OF CO2.
```

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285             CC(2) = C(4)
286       C   TISSUE CONCENTRATION OF CO2.
287             CC(3) = C(7)
288       C   BRAIN CO2 TENSION.
289             CPB = 50.0
290       C   TISSUE CO2 TENSION.
291             CPT = 50.0
292             IF(XDS.GT.XMH) GOTO202
293       C       SETS VARIOUS CONSTANTS AND AGGREGATES OF CONSTANTS
294       C   TMAX.
295             C(15) = C(15) + .0001
296       C   PRINT ALL TIME.
297       C       C(39) = C(39) + .0001
298       C   FACTOR OF 1-E-7 MULTIPLYING DIFFUSION COEFFICIENTS.
299             DO 200 I = 27,29
300             C(I) = C(I) * 1.E-7
301         200 CONTINUE
302         202 CONTINUE
303             IRK = 1
304             M = 14
305             N = 5
306             IDJ(1) = 0
307       C        SOLUBILITY COEFFICIENTS.
308       C     A(1)= (ALPHA)CO2, A(2)= (ALPHA)O2, A(3)= (ALPHA)N2,
309       C     A(4)= (ALPHA)CO2, A(5)= (ALPHA)O2, A(6)= (ALPHA)N2
310             A(1) = 0.51
311             A(2) = 0.024
312             A(3) = 0.013
313             A(4) = 0.51
314             A(5) = 0.024
315             A(6) = 0.013
316       C   ATM/MMHG CONVERSION FACTOR.
317             SK = 0.00132
318       C   CARBONIC ACID DISSOCIATION CONSTANT.
319             CADK = 795.0
320       C   VOL(1)-VOL(10)= VOLUMES USED IN CALCULATION OF VARIABLE TIME DELAYS.
321             VOL(1) = 0.015
322             VOL(2) = 1.062
323             VOL(3) = 0.188
324             VOL(4) = 0.06
325             VOL(5) = 0.188
326             VOL(6) = 2.94
327             VOL(7) = 0.735
328             VOL(8) = 1.062
329             VOL(9) = 0.008
330             VOL(10)= 1.062
331       C
332       C (METABOLIC RATE OF CO2 IN BRAIN + TISSUE.) / SAME FOR O2
333             QF(6) = (C(25) + RMT(1))/(C(26) + RMT(2))
334       C     B=47
335             D(1)=C(30)-47.
336             DO 210 I = 2,4
337       C   PRODUCTS OF CONVERSION FACTORS AND SOLUBILITY COEFFICIENTS.
338             D(I) = SK*A(I-1)
339             D(I+9) = SK*A(I+2)
340       C
341             D(I+3) = D(1)*D(I)
```

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```
      210 CONTINUE
C  FACTOR USED IN ESTABLISHING CA(CO2)
          D(8) = 0.16 + 2.3*C(17)
C
          D(9) = 863.0/D(1)
C  FACTOR USED IN ESTABLISHING CB(CO2).
          D(10) = 0.62
C  MANIPULATION OF COMPUTER TIME STEP.
          D(14) = C(36)*2.0
          D(15) = D(14) - .01*C(36)
C
          CALL RC3
          CALL RC4
          CALL RC5 (CPB, F(4), C(4), BC(2))
          CALL RC21 (CHB(2), F(3), F(4), C(4), CH(2), CPH(2))
          CALL RC19 (CPB, CHB(2), CC(2), BC(1), F(4))
          CALL RC5 (CPT, F(6), C(7), BC(3))
          CALL RC21 (CHB(3), F(5), F(6), C(7), CH(3), CPH(3))
          CALL RC19 (CPT, CHB(3), CC(3), BC(1), F(6))
          CALL RC20
          CALL RC7
          CALL RC8
          CALL RC9
          CALL RC10
          CALL RC11
          CALL RC12
          GO TO 60
       50 CALL RC15
          CALL RC16
       60 CALL RC13
          CALL RC12
C
          IF(C(35).GE.XMH) GO TO 201
C
          IF (C(35) .GT. C(15)) GOTO80
          IF(CXT.GT.C(15)) GOTO 80
       70 CALL RC14
          UU = AMOD(C(35), D(14))
          IF (UU .LT. .0001 .OR. UU .GT. D(15))   GOTO50
          GOTO 60
       80 IF (KPLT.LT.1) GO TO 76
          KSTOPP=1
          CALL PLOT
       76 WRITE(6,78)
       78 FORMAT('1 FINAL VALUES FOR FOLLOWING VARIABLES.')
          IF (C(37) .GT. 1.0E-5)      GO TO 250
      220 CTERM = 0.0
          IF (VTRAN(14) - 104.0)       230, 240, 240
      230 CTERM = (23.6E-9)*((104.0 - VTRAN(14))**4.9)
      240 C(37) = C(20)*(C(16)*VTRAN(15) + (1.0 - C(16))*CH(4))
     1        + C(21)*VTRAN(13) + CTERM - VI
          I = 37
          WRITE(6,192)I,C(I), (XN(I,J), J = 1,2)
      250 DO 260 I = 1,14
          WRITE(6,192)I,C(I), (XN(I,J), J = 1,2)
      260 CONTINUE
          WRITE (6,194)
```

```
399               WRITE(6,830)
400           830 FORMAT('ONORMAL TERMATION')
401           301 CONTINUE
402               STOP
403           C   90 FORMAT (1H1,48X,37H*RESPIRATORY CHEMOSTAT -- INPUT DATA*///)
404           C   92 FORMAT (42X,I3,10XF10.4,10X,2A6)
405           C  190 FORMAT (5XF15.0,5X,2A6)
406              192 FORMAT(' ',I3,2X,F15.5,2X,2A4)
407              194 FORMAT (1H1)
408               END
```

```
B6=GD3432*TPF$.RC3
    1            SUBROUTINE RC3
    2            DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
    3           1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
    4           2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
    5           3          DQ(4)
    6            COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
    7           1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
    8           2        IRK, LOC, ITERX, INDEX, I, J, M, N
    9       C6969              FORMAT(1H 7HSUB RC3)
   10       C      SETS TIME-DEPENDENT EXPRESSIONS
   11       C  TISSUE BLOOD FLOW.
   12            QF(1) = C(10) - C(11)
   13       C  ARTERIAL O2 TENSION.
   14            F(1) = D(1)*C(2)
   15       C  ARTERIAL CO2 CONCENTRATION.
   16            F(2) = D(5)*C(1)
   17       C  BRAIN O2 CONCENTRATION / (CONV.FACTOR*SOLUBILITY COEFF.FOR O2)
   18            F(3) = C(5)/D(3)
   19       C  (CONV.FACTOR*SOLUBILITY COEFF.FOR CO2) * BRAIN CO2 TENSION.
   20            F(4) = D(2)*CPB
   21       C  TISSUE O2 CONCENTRATION / (CONV.FACTOR*SOLUBILITY COEFF.FOR O2)
   22            F(5) = C(8)/D(3)
   23       C  (CONV.FACTOR*SOLUBILITY COEFF.FOR CO2) * TISSUE CO2 TENSION.
   24            F(6) = D(2)*CPT
   25       C  ARTERIAL CO2 TENSION.
   26            F(7) = D(1)*C(1)
   27       C  ARTERIAL O2 TENSION.
   28            F(8) = D(1)*C(2)
   29            RETURN
   30            END

PRT,S RC4
```

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B6-G03432*TPFS.RC4

```
      SUBROUTINE RC4
      DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     3          DQ(4)
      COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     1       TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
     2       IRK, LOC, ITERX, INDEX, I, J, M, N
C     ITERATES FOR CC(1), ARTERIAL CO2 CONCENTRATION
C6969                 FORMAT(1H 7HSUB RC4)
  410 CALL RC21 (CHB(1), F(1), F(2), CC(1), CH(1), CPH(1))
      X = (CC(1) - F(2))/(0.01*F(7))
      X = RCF1(X)
C  SEE EQUATION 3.1,  X=.CA(CO2) .
      X = BC(1) + 0.375*(C(17) - CHB(1)) + F(2) - D(8)*(X - 0.14)
C  CC(1) = CA(CO2) .
      CALL RC6 (CC(1))
      CC(1) = CC(1) + 2.0*(X - CC(1))/3.0
C3000 FORMAT(1H ,5HCC(1),5X,E16.6)
      IF (ITERX)   420, 410, 420
  420 RETURN
      END
```

PRT,S RC5

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```
B6=GD3432*TPFS.RC5
    1              SUBROUTINE RC5 (CP, FB, CCB, BHC)
    2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
    3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
    4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
    5             3          DQ(4)
    6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
    7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
    8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
    9       C      ITERATES FOR BRAIN AND TISSUE PCO2
   10       C6969                FORMAT(1H 7HSUB RC5)
   11         510 X = (CCB - FB)/(0.01*CP)
   12              X = RCF1(X)
   13       C  SEE EQUATION 4.1,  X = PB(CO2) .
   14              X = (-BHC + CCB + D(10)*(X - 0.14))/D(2)
   15       C  CP = PB(CO2) .
   16              CALL RC6 (CP)
   17              CP = CP + (X - CP)/10.0
   18       C  CEREBRAL BLOOD FLOW.
   19              FB = D(2)*CP
   20       C3000 FORMAT(1H ,4HCP= ,E16.6,4HFB= E16.6,5HCCB= E16.6,5HBHC= E16.6)
   21              IF (ITERX)   520, 510, 520
   22         520 RETURN
   23              END
```

PRT,S RC6

```
B6-G03432*TPFS.RC6
    1              SUBROUTINE RC6 (Y)
    2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
    3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
    4             2           BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
    5             3           DQ(4)
    6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
    7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
    8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
    9       C     CHECKS CONVERGENCE OF ITERATIVE PROCEDURES
   10       C       RC4 : X=CA(CO2), Y=CC(1)  .
   11       C       RC5 : X=PB(CO2), Y=CP  .
   12       C      RC19 : X=CVB(CO2), Y=CVC .
   13       C6969                FORMAT(1H 7HSUB RC6)
   14              ITERX = 0
   15              DIFF = ABS ((X - Y)/Y)
   16              IF (DIFF - 1.0E-5)    620, 620, 630
   17          620 ITERX = 1
   18          630 RETURN
   19              END
```

```
PRT,S RC7
```

```
B6=G03432*TPFS,RC7
      1              SUBROUTINE RC7
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1        SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2        BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3        DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9              COMMON/R/ XDS,XMH,CAT,WORK,DUM1,DUM2,DUM3,WORK2,RMTB,RMTB2,TIMEOF
     10             1   ,RMLIN
     11        C6969                FORMAT(1H 7HSUB RC7)
     12        C      FILLS SV ARRAY WITH INITIAL CONDITIONS
     13               CALL RC16
     14               IF(XDS.GT.XMH) GOTO2
     15               DO 725 I = 1,17
     16               DO 720 J = 2,50
     17               SV(I,J) = SV(I,1)
     18           720 CONTINUE
     19           725 CONTINUE
     20        2      CONTINUE
     21               DO 730 J = 2,50
     22               SV(18,J) = SV(18,J - 1) - D(14)
     23           730 CONTINUE
     24        C3000 FORMAT(1H ,12H18SV S D(14),6(3X,E16.6)/1H ,6(3X,E16.6)/1H ,7(3X,E1
     25        C     C6.6))
     26               RETURN
     27               END
```

```
PRT,S RC8
```

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```
B6=G03432*TPFS.RC8
      1              SUBROUTINE RC8
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C     CALCULATES TRANSPORT TIMES
     10        C      EQUATIONS 8.10 THRU 8.14  .
     11        C6969                 FORMAT(1H 7HSUB RC8)
     12              DO 870 I = 1,5
     13              DT = C(35) - SV(18,1)
     14              ND = 1
     15              GO TO (810,812,814,816,810), I
     16          810 NC = 11
     17              NB = 10
     18              GO TO 820
     19          812 NC = 10
     20              NB = 11
     21              GO TO 820
     22          814 NC = 10
     23              NB = 12
     24              GO TO 820
     25          816 NC = 12
     26              NB = 10
     27              QA = QF(1)
     28              GO TO 822
     29          820 QA = C(NC)
     30          822 DO 860 J = 1,2
     31              GO TO (834,824), J
     32          824 NC = NB
     33              ND = K + 1
     34              IF (K)              826, 826, 832
     35          826 IF (NC - 12)        830, 828, 830
     36          828 QA = SV(NC,1) - (SV(NC,1) - QF(1))*DT/(C(35) - SV(18,1))
     37              GO TO 834
     38          830 QA = SV(NC,1) - (SV(NC,1) - C(NC))*DT/(C(35) - SV(18,1))
     39              GO TO 834
     40          832 QA = SV(NC,ND) - (SV(NC,K) - SV(NC,ND))*DT/D(14)
     41          834 IJ = 2*I + J - 2
     42              AB = VOL(IJ)
     43              AA = DT*(QA + SV(NC,ND))/2.0
     44              DO 838 K = ND,49
     45              IF (AA - AB)        836, 836, 840
     46          836 AA = AA + C(36)*(SV(NC,K) + SV(NC,K+1))
     47          838 CONTINUE
     48              WRITE (6,890) I
     49          840 DA = AA- AB
     50              K = K -1
     51              IF (K)             842, 842, 846
     52          842 DV = SV(NC,1) - QA
     53              IF (DV)             850, 844, 850
     54          844 DT = DA/QA
     55              GO TO 860
     56          846 DV = SV(NC,K+1) - SV(NC,K)
```

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```
      IF (DV)              850, 848, 850
  848 DT = DA/SV(NC,K)
      GO TO 860
  850 DT = (SV(NC,K+1) - SQRT (SV(NC,K+1)**2 - DV*DA/C(36)))/(DV/D(19))
  860 CONTINUE
      TAU(I) = C(35) - SV(18,K + I) - DT
  870 CONTINUE
      RETURN
  890 FORMAT (5X27HSV ARRAY EXCEEDED ON CYCLE I2)
      END
```

```
PRT,S RC9
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B6-G03432*TPF$.RC9

```
      SUBROUTINE RC9
      DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     3          DW(4)
      COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     1        TAU, CC, CHB, CH, CPH, DW, VE, VI, CPB, CPT, CADK, X, DT,
     2        IRK, LOC, ITERX, INDEX, I, J, M, N
C     SETS VALUES IN VTRAN ARRAY
C6969                 FORMAT(1H 7HSUB RC9)
      DO 960 I = 1,5
      TA = TAU(I) - (C(35) - SV(18,1))
      LOC = TA/D(14)
      IF (LOC - 49)     904, 904, 902
  902 WRITE (6,990) I,LOC
      LOC = 49
  904 XLOC = LOC
      TB = XLOC*D(14)
      DT = TA - TB
      GO TO (910,920,930,940,950), I
  910 DO 914 J = 1,3
C  LUNG TO BRAIN CO2,O2,N2 TIME DELAYED ARTERIAL CONCENTRATIONS.
      VTRAN(J) = RCF3(J)
  914 CONTINUE
C  LUNG TO BRAIN H+ TIME DELAYED ARTERIAL CONCENTRATION.
      VTRAN(15) = RCF3(13)
      GO TO 960
  920 DO 924 J = 4,6
C  BRAIN TO LUNG CO2,O2,N2 TIME DELAYED VENOUS CONCENTRATIONS.
      VTRAN(J) = RCF3(J)
  924 CONTINUE
C  BRAIN TO LUNG COMBINED CO2,O2,N2 TIME DELAYED VENOUS CONCENTRATIONS.
      VTRAN(16) = RCF3(16)
      GO TO 960
  930 DO 934 J = 7,9
C  TISSUE TO LUNG CO2,O2,N2 TIME DELAYED VENOUS CONCENTRATIONS.
      VTRAN(J) = RCF3(J)
  934 CONTINUE
C  TISSUE TO LUNG COMBINED CO2,O2,N2 TIME DELAYED VENOUS CONCENTRATIONS.
      VTRAN(17) = RCF3(17)
      GO TO 960
  940 DO 944 J = 1,3
C  LUNG TO TISSUE CO2,O2,N2 TIME DELAYED ARTERIAL CONCENTRATIONS.
      VTRAN(J+9) = RCF3(J)
  944 CONTINUE
      GO TO 960
C  LUNG TO CAROTID SITE H+ TIME DELAYED ARTERIAL CONCENTRATION.
  950 VTRAN(13) = RCF3(13)
C  LUNG TO CAROTID SITE O2 TIME DELAYED ARTERIAL TENSION.
      VTRAN(14) = RCF3(14)
  960 CONTINUE
C     NAMELIST/DONM/VTRAN
      RETURN
  990 FORMAT (5X27HSV ARRAY EXCEEDED ON CYCLE I2,12H WITH LOC = I4)
      END
```

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```
B6=G03432*TPFS.RC10
    1           SUBROUTINE RC10
    2           DIMENSION C(40), XN(40,2), SV(18,9), VTRAN(18), RK(14,4),
    3          1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
    4          2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
    5          3          DQ(4)
    6           COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
    7          1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
    8          2        IRK, LOC, ITERX, INDEX, I, J, M, N
    9      C6969              FORMAT(1H 8HSUB RC10)
   10      C       COMPUTES EMPIRICAL FUNCTIONS FOR ACRDIAC OUTPUT AND BRAIN BLOOD
   11      C       FLOW DIFFERENTIAL EQUATIONS
   12      C    F(8) > PA(O2) .
   13           IF (F(8) - 104.0)                1008, 1020, 1020
   14      C    (DELTA)Q(O2) , EQUATION 7.3 .
   15       1008 DQ(1) = ((-1.0033E-5*F(8) + 2.9241E-3)*F(8) - 0.2885)*F(8) +9.6651
   16      C    (DELTA)QB(O2) , EQUATION 7.9 .
   17           DQ(2) = (((7.6559E-8*F(8) - 2.324E-5)*F(8) + 2.6032E-3)*F(8)
   18          1        - 0.1323)*F(8) + 2.785
   19           IF (DQ(1))                       1012, 1016, 1016
   20       1012 DQ(1) = 0.0
   21       1016 IF (DQ(2))                      1024, 1028, 1028
   22       1020 DQ(1) = 0.0
   23       1024 DQ(2) = 0.0
   24      C       F(7) = PA(CO2) .
   25       1028 IF (F(7) - 60.0)                1032, 1032, 1036
   26      C
   27      C       IF PCO2 GT 60 DQ(3) STAYS AT ITS VALUE AT 60 - - OLD ROUTINE SETS
   28      C       THE VALUE OF DQ(3) EQUAL TO 0
   29       1032 IF (F(7) - 40.0)                2036, 1040, 1040
   30       2036 DQ(3)=0.
   31           GOTO1044
   32      C    (DELTA)Q(CO2) , REPLACES EQUATION 7.6 .
   33       1036  DQ(3)=6.0
   34      C
   35           GO TO 1044
   36      C    (DELTA)Q(CO2) , EQUATION 7.5 .
   37       1040 DQ(3) = 0.3*(F(7) - 40.0)
   38       1044 IF (F(7) - 38.0)                1048, 1052, 1052
   39      C    (DELTA)QB(CO2) , EQUATION 7.11 .
   40       1048 DQ(4) = (8.0163E-4*F(7) - 3.1073E-2)*F(7) + 2.3232E-2
   41           RETURN
   42       1052 IF (F(7) - 44.0)                1056, 1056, 1060
   43       1056 DQ(4) = 0.0
   44           RETURN
   45      C    (DELTA)QB(CO2) , EQUATION 7.13 .
   46       1060 DQ(4) = (((-2.1748E-7*F(7) + 9.3918E-5)*F(7) - 1.2947E-2)*F(7)
   47          1        + 0.7607)*F(7) - 15.58
   48      C       NAMELIST/DG/DQ,F
   49           RETURN
   50           END
```

```
:PRT,S RC11
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```
B6-GD3432*TPF$.RC11
      SUBROUTINE RC11
      DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     2           BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     3           DQ(4)
      COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
     2        IRK, LOC, ITERX, INDEX, I, J, M, N
C     CALCULATES DIFFERENTIAL EQUATIONS
C6969                 FORMAT(1H 8HSUB RC11)
      CALL RC17
C  EQUATION 10.1 .
      DC(1) = (VI*C(31) - VE*C(1) + D(9)*(C(11)*VTRAN(4) + QF(1)
     1         *VTRAN(7) - C(10)*CC(1)))/C(22)
C  EQUATION 10.2 .
      DC(2) = (VI*C(32) - VE*C(2) + D(9)*(C(11)*VTRAN(5) + QF(1)
     1         *VTRAN(8) - C(10)*F(9)))/C(22)
C  EQUATION 10.3 .
      DC(3) = (VI*C(33) - VE*C(3) + D(9)*(C(11)*VTRAN(6) + QF(1)
     1         *VTRAN(9) - C(10)*F(10)))/C(22)
C  EQUATION 10.4 .
      DC(4) = (C(25) + C(11)*(VTRAN(1) - CC(2)) - F(14))/C(23)
C  EQUATION 10.5 .
      DC(5) = (-C(26) + C(11)*(VTRAN(2) - F(12)) - F(15))/C(23)
C  EQUATION 10.6 .
      DC(6) = (C(11)*(VTRAN(3) - C(6)) - F(16))/C(23)
C  EQUATION 10.7 .
      DC(7) = (RMT(1) + QF(1)*(VTRAN(10) - CC(3)))/C(24)
C  EQUATION 10.8 .
      DC(8) = (-RMT(2) + QF(1)*(VTRAN(11) - F(13)))/C(24)
C  EQUATION 10.9 .
      DC(9) = QF(1)*(VTRAN(12) - C(9))/C(24)
C  EQUATION 7.1 .
      DC(10) = (-C(10) + 6.0 + DQ(1) + DQ(3))/C(18)
C  DEPENDANCE OF CARDIAC OUTPUT ON TISSUE
C  UTILIZATION OF OXYGEN.
C
      XAB=5.5 *(RMT(2)-.215)+6.-C(10)
      IF((RMT(2).GT..215).AND.(XAB.GT.0.))DC(10)=DC(10)+XAB/.010
C
C
C  EQUATION 7.7 .
      DC(11) = (-C(11) + 0.75 + DQ(2) + DQ(4))/C(19)
C  EQUATION 1.10 .
      DC(12) = F(14)/(C(34)*D(11))
C  EQUATION 1.11 .
      DC(13) = F(15)/(C(34)*D(12))
C  EQUATION 1.12 .
      DC(14) = F(16)/(C(34)*D(13))
C     NAMELIST/AB/DC
      RETURN
      END

PRT.S RC12
```

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B6-G03432*TPFS.RC12

```
      SUBROUTINE RC12
      DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     3          DQ(4)
      COMMON/2/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
     2        IRK, LOC, ITERX, INDEX, I, J, M, N
      COMMON/R/ XDS,XMH,CXT,WORK,DUM1,DUM2,DUM3,WORK2,RMTB,RMTB2,TIMEOF
     1  ,RMLIN,ITTY
      COMMON/PLTBUF/NBUF,XBUF(181),YBUF(181,8),NA(8),KSTOPP,TMAX,KPLT
      DATA NA/'  PCO2    PO2 WORK2  (H+)     VI     QB  FREQAVO2DF'/
      DATA IRUN/'RUN '/,ISTOP/'STOP'/,MORE/'MORE'/
      DATA IBACK/'BACK'/
      DIMENSION WRKTTY(50,3)
C6969                 FORMAT(1H 8HSUB RC12)
C     OUTPUT -- PUNCHED CARDS AND PRINTED
      CXT=C(35)+XDS-10.
      IF(CXT.LE.0.)CXT=+0.
C  DEAD SPACE VOLUME
      DSVOL=0.140+0.002*VE
C  RESPIRATORY FREQUENCY.
      FREQ=((1.+(.726*VE)/DSVOL)**.5-1.)/.363
C  DEAD SPACE VENTILATION
      DEADVT=1.+.098*VE
C     C(31)=(DEADVT*C(1)+VE*DUM1)/(DEADVT+VE)
C     C(32)=(DEADVT*C(2)+VE*DUM2)/(DEADVT+VE)
C     C(33)=(DEADVT*C(3)+VE*DUM3)/(DEADVT+VE)
C  MINUTE VOLUME.
      TVNT=DEADVT+(VE+VI)/2.
C  HEART RATE.
      HRATE=43.8*(RMT(2)+C(26))+54.5
C
C
      IF(CXT .LT. TIMEOF) GO TO 203
C
C  HERE IF NEED TO READ A NEW WORK LOAD CARD.
C          BRANCH IF IN BATCH MODE.
      IF(ITTY .EQ. 0) GO TO 500
C
C
C   HERE IF TTY MODE.....
        IF(ITTY .EQ. 1) GO TO 550
C  HERE IF TTY MODE, AND 1ST TIME THIS ROUTINE CALLED.
        ITTY = 1
        WRITE(6,505)
  505 FORMAT('0INPUT WORK CARDS...'/
     1 ' WORK= WORK LOAD(WATTS)...'/
     2 ' MINS= TIME FOR WORK LOAD...'/
     3 ' PRINT= TIME INCRIMENT(MINS)FOR PRINTOUT...'/
     4 ' EXEC...'/
     5 '  MORE= INPUT MORE BEFORE EXEC...'/
     6 '  RUN = EXEC.WITH ABOVE,THEN CAN INPUT AGAIN...'/
     7 '  STOP= EXEC.WITH ABOVE THEN STOP...'/
     8 '  BACK= ERASE PREVIOUS WORK RECORD...')
  504 ITTYIN = 0
```

```
      ITTYOT = J
C
  501 IF(ITTYIN .LT. 50) GO TO 506
C  HERE IF BUFFER FOR WORK LOAD CARDS IS FULL.
      WRITE(6,511)
  511 FORMAT('0BUFFER FOR WORK LOAD RECORDS FULL.'/
     1 ' WILL USE EXEC= RUN.')
      LEXEC = IRUN
      GO TO 551
C
  506 ITTYIN = ITTYIN + 1
      IF (KSKP.GT.1 .AND. KPLT.GT.0) CALL PAGE3
  509 WRITE(6,507)
  507 FORMAT(' WORK    MINS    PRINT   EXEC   ',
     1 '(F6.2,1X,F6.2,1X,F6.2,1X,A4).',')
      READ(5,502,ERR=509) (WRKTTY(ITTYIN,J),J=1,3),LEXEC
  502 FORMAT(F6.2,1X,F6.2,1X,F6.2,1X,A4)
      WRITE(6,503) (WRKTTY(ITTYIN,J),J=1,3),LEXEC
  503 FORMAT(3(' ',F6.2),A4)
      IF(LEXEC .NE. IBACK) GO TO 518
      ITTYIN = ITTYIN - 1
      IF(ITTYIN .LT. 1) ITTYIN = 1
      GO TO 509
C
  518 IF(LEXEC .EQ. IRUN .OR. LEXEC .EQ. ISTOP) GO TO 551
      IF(LEXEC .EQ. MORE) GO TO 501
      WRITE(6,510)
  510 FORMAT(' EXEC.PARAMETER WRONG. TRY AGAIN.')
      GO TO 509
C
C  HERE IF 1ST TIME THIS ROUTINE CALLED.
C SEE IF MORE WORK CARDS IN BUFFER(WRKTTY(50,3))
  550 IF(ITTYOT .LE. ITTYIN) GO TO 551
C  HERE IF EXAUSTED WORK CARD BUFFER (WRKTTY(50,3)).
      IF(LEXEC .EQ. IRUN) GO TO 504
C  FORCE END OF COMPUTER RUN WHEN LEXEC= 'STOP'.
      C(15) = 0.
      GO TO 1210
C
  551 WORK2 = WRKTTY(ITTYOT,1)
      DURAT = WRKTTY(ITTYOT,2)
      C(39) = WRKTTY(ITTYOT,3)
      ITTYOT = ITTYOT + 1
      KSTOPP=2
      IF (KSKP.LT.1 .OR. KPLT.LT.1) GO TO 557
      CALL PLOT
  557 KSKP=2
      KSTOPP=0
      GO TO 606
C
C
C
  203 IF(MARKER.EQ.0) GOTO101
     1    WORK=WORK2
      MARKER=1
C  SYSTEM RESPONSES: TIME CONSTANTS FOR WORK LOAD LEVELS(INCREASING).
      IF(WORK.LE.0.)GOTO2
```

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```
      IF(WORK.GE.50.) TCT=2.3/(2.*WORK/200.)
      IF(WORK.LT.50)TCT=4.6
C     TISSUE O2 METABOLIC RATE.
      RMT(2)=SSO2W(WORK)-(SSO2W(WORK)-RMTB2)*EXP(-TCT*(CXT  -TIMEON))
      VTIME=1.1-1.1*EXP(-TCT*(CXT-TIMEON)/1.92)
C     TERM USED IN VI THAT IS A COMPONENT OF TRANSIENT RESPONSE RELATED
C     TO WORK LOAD.
      RMLIN =SSO2W(WORK)-(SSO2W(WORK)-RMTB2)*(1.-VTIME)
      IF(VTIME.GE.1.) RMLIN=SSO2W(WORK)
C     TISSUE CO2 METABOLIC RATE.
      RMT(1)=.88*RMT(2)
      IF(TVNT.GT.37.) RMT(1)=(TVNT+40.77)*RMT(2)/88.5
      IF(C(35).LT.C(40)) GOTO2
      IF (KPLT.GT.0) GO TO 2
      WRITE (6,333) RMT(1),RMT(2)
333   FORMAT(  '0',1X,25HCHANGE IN METABOLIC RATES,5X,7HMRCO2= ,F10.4,
     1  5X,6HMRO2= ,F10.4,/)
C
C
2     CONTINUE
C     U = AMOD(C(35), 0.5)
C     IF (U .LT. 1.0E-5 .OR. U .GT. .4999)        GO TO 1210
      IF(C(35).LT.C(40))GOTO1230
      C(40)=C(40)+C(39)
C     ARTERIAL N2 TENSION.
1210  PAN2 = D(1)*C(3)
C     TISSUE O2 TENSION.
      PTO2 = C(8)/D(3)
C     TISSUE N2 TENSION.
      PTN2 = C(9)/D(4)
C     CEREBROSPINAL FLUID PH , EQUATION 6.2 .
      PHCSF = 9. - RCF1(CH(4))
C     VENOUS BRAIN H+ CONCENTRATION , EQUATION 4.7 .
      HVB   = CADK*F(4)/(CC(2) - F(4))
C     VENOUS BRAIN PH , EQUATION 4.6 .
      PHVB  = 9. - RCF1(HVB)
C     VENOUS TISSUE H+ CONCENTRATION , EQUATION 5.7 .
      HVT   = CADK*F(6)/(CC(3) - F(6))
C     VENOUS TISSUE PH , EQUATION 5.6 .
      PHVT  = 9. - RCF1(HVT)
C     RESPIRATORY QUOTIENT (ALVEOLAR).
      RQ = ((C(11)*VTRAN(4) + QF(1)*VTRAN(7))/C(10) - CC(1))/
     1       (F(9) - (C(11)*VTRAN(5) + QF(1)*VTRAN(8))/C(10))
      QF(5) = QF(6) - RQ
      AVO2DM=(F(9)*C(10)-F(13)*(C(10)-C(11))-F(12)*C(11))*1000.
      AVO2DF=AVO2DM/C(10)
C
C
C     HERE WHEN READY TO PRINT.
C          SEE IF TTY MODE.
      IF(ITTY .EQ. 0) GO TO 610
C
      NBUF=NBUF+1
      IF (NBUF.GT.181) NBUF=181
      XBUF(NBUF)=CXT
      YBUF(NBUF,1)=F(7)
      YBUF(NBUF,2)=F(1)
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171             YBUF(NBUF,3)=WORK2
172             YBUF(NBUF,4)=CH(4)
173             YBUF(NBUF,5)=VI
174             YBUF(NBUF,6)=C(11)
175             YBUF(NBUF,7)=FREQ
176             YBUF(NBUF,8)=AVO2DF
177             IF (KPLT.GT.0) CALL PLOT
178             IF (KPLT.GT.0) GO TO 1230
179       C
180       C  HERE IF TTY OUTPUT.
181             WRITE(6,700) CXT,RQ,QF(5)
182         700 FORMAT('0TIME',F10.4,'MINS',3X,'ALV RQ',F10.4,
183            1 3X,'RQ DIFF',F8.4/
184            2 7X,'ALVEOLAR ARTERIAL     BRAIN    TISSUE',6X,
185            3 'CSF   V BRAIN V TISSUE')
186             WRITE(6,701) C(1),CC(1),C(4),C(7),CC(2),CC(3)
187         701 FORMAT('  CO2 ',4(F9.4),9X,2(F9.4))
188             WRITE(6,702) C(2),F(9),C(5),C(8),F(12),F(13)
189         702 FORMAT('   O2 ',4(F9.4),9X,2(F9.4))
190             WRITE(6,703) C(3),F(10),C(6),C(9),C(6),C(9)
191         703 FORMAT('   N2 ',4(F9.4),9X,2(F9.4))
192             WRITE(6,704) DC(1),DC(4),DC(7),DC(12)
193         704 FORMAT(' DER  ',F9.4,9X,3(F9.4))
194             WRITE(6,705) DC(2),DC(5),DC(8),DC(13)
195         705 FORMAT(' IVAT ',F9.4,9X,3(F9.4))
196             WRITE(6,706) DC(3),DC(6),DC(9),DC(14)
197         706 FORMAT(' IVES ',F9.4,9X,3(F9.4))
198             WRITE(6,707) F(7),F(7),CPB,CPT,C(12),CPB,CPT
199         707 FORMAT(' PCO2 ',7(F9.4))
200             WRITE(6,708) F(1),F(1),F(17),PTO2,C(13),F(17),PTO2
201         708 FORMAT('  PO2 ',7(F9.4))
202             WRITE(6,709) PAN2,PAN2,F(18),PTN2,C(14),F(18),PTN2
203         709 FORMAT('  PN2 ',7(F9.4))
204             WRITE(6,710) (CH(I),I=1,4),HVB,HVT
205         710 FORMAT(' (H+) ',9X,6(F9.4))
206             WRITE(6,711) (CPH(I),I=1,3),PHCSF,PHVB,PHVT
207         711 FORMAT('   PH ',9X,6(F9.4))
208             WRITE(6,712) (CHB(I),I=1,3)
209         712 FORMAT(' HBO2 ',9X,F9.4,27X,2(F9.4))
210       C  PRINTOUT TRANSPORT TIMES.
211             WRITE(6,713) (TAU(I),I=1,5),VI
212         713 FORMAT(' TRANSPORT TIMES'/
213            1 ' ',12X,'AB',7X,'VB',7X,'VT',7X,'AT',7X,'AC',7X,'VI'/
214            2 ' ',5X,6(F9.4))
215             WRITE(6,714) VE,C(10),C(11),DC(10),DC(11)
216         714 FORMAT(' ',12X,'VE',8X,'Q',7X,'FB',4X,'DERIVATIVES'/
217            1 ' ',5X,5(F9.4))
218             WRITE(6,715) FREQ,TVNT,DEADVT,HRATE,AVO2DF,DSVOL
219         715 FORMAT(' ',5X,'RESP FREQ  MIN VOL D.S.VENT  HEART R   AVO2DF  '
220            1 ,'  DSVOL'/ 6X,6(F9.4))
221       C
222             RETURN
223         610 IF (N .NE. 4)      GO TO 1220
224             N = 0
225             WRITE (6,1805)
226        1220 N = N + 1
227       C
```

```
      WRITE (6,1810) CXT, RQ, QF(5)
C
      WRITE (6,1815)   (C(I), I = 1,3), (DC(I), I = 1,3), F(7), F(1),
     1       PAN2
      WRITE (6,1820)   CC(1), F(9), F(10), F(7), F(1), PAN2, CH(1),
     1       CPH(1), CHB(1)
      WRITE (6,1825)   (C(I), I = 4,6), (DC(I), I = 4,6), CPB, F(17),
     1       F(18), CH(2), CPH(2)
      WRITE (6,1830)   (C(I), I = 7,9), (DC(I), I = 7,9), CPT, PTO2,
     1       PTN2, CH(3), CPH(3)
      WRITE (6,1835)   (DC(I), I = 12,14), (C(I), I = 12,14), CH(4),
     1       PHCSF
      WRITE (6,1840)   CC(2), F(12), C(6), CPB, F(17), F(18), HVB,
     1       PHVB, CHB(2)
      WRITE (6,1845)   CC(3), F(13), C(9), CPT, PTO2, PTN2, HVT,
     1       PHVT, CHB(3)
      WRITE (6,1850)   (TAU(I), I = 1,5), VI, VE, C(10), C(11), DC(10),
     1       DC(11)
      WRITE (6,1855) FREQ,TVNT,DEADVT,HRATE,AVO2DF,DSVOL
 1230 RETURN
 1290 FORMAT (5H XXXX5X7F10.4)
 1292 FORMAT (8F10.4)
 1805 FORMAT (1H1)
 1810 FORMAT (1H06X4HTIMEF10.4,74X6HALV RQF10.4,3X7HRQ DIFF,F8.4/
     1       16X3HCO28X2HO28X2HN27X21HD E R I V A T I V E S9X4HPCO26X
     2       3HPO27X3HPN27X4H(H+)7X2HPH5X4HHBO2)
 1815 FORMAT (3X8HALVEOLAR9F10.4)
 1820 FORMAT (3X8HARTERIAL3F10.4,30X,5F10.4,F8.4)
 1825 FORMAT (6X5HBRAIN11F10.4)
 1830 FORMAT (5X6HTISSUE11F10.4)
 1835 FORMAT (8X3HCSF30X8F10.4)
 1840 FORMAT (4X7HV BRAIN3F10.4,30X,5F10.4,F8.4)
 1845 FORMAT (3X8HV TISSUE3F10.4,30X,5F10.4,F8.4)
 1850 FORMAT (5X18HTRANSPORT TIMES --4X2HAB8X2HVB8X2HVT8X2HAT8X2HAC2X
     1   2H**4X2HV18X2HVE8X1HQ9X2HFB7X1)HDERIVATIVES/21X,10F10.4,F8.4)
 1855 FORMAT(3X,9HRESP FREQ,F8.4,2X,13HMINUTE VOLUME,F8.4,
     1   2X,8HD S VENT,F8.4,2X,10HHEART RATE,F8.4,
     2   2X,7HAVO2DF,F8.4,2X,5HDSVOL,F8.4)
C    BATCH MODE WORK CARD READ...
C
C      WILL USE WORK CARD WITH TIME=0 AS INDICATION
C      OF END OF RUN BECAUSE 1106 HAS PROBLEM
C      WITH END= ON READ.
  500 READ(5,300,END=2) WORK2,DURAT
  300 FORMAT(F6.2,3X,F6.2)
C
      IF(DURAT .GT. 0.) GO TO 606
C  HERE IF READ INDICATION OF END OF RUN IN BATCH MODE.
      C(15) = 0.
      GO TO 1210
C
  606 IF (KPLT.GT.0) GO TO 607
      WRITE (6,305) WORK2,DURAT,CXT
  305 FORMAT('0',43('*')/
     1  ' WORK LOAD CHG.(',F6.2,'WATTS FOR',
     2  F8.2,'MINS) AT',F9.4,'MINS')
  607 TIMEOF=DURAT+CXT
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285              TIMEON=CXT
286        C  SYSTEM RESPONSES: TIME CONSTANTS FOR WORK LOADS AND TISSUE O2
287        C  METABOLIC RATE.
288              IF(WORK2.GE.WORK)RMTB2=RMT(2)
289        C  DECREASING WORK LOADS.
290              IF(WORK2.LT.WORK) RMTM=RMT(2)
291              IF(WORK2.LT.WORK)RMTB=SSO2W(WORK2)
292              IF((WORK2.LT.WORK).AND.(WORK.GE.50.))    TCT=2.3/(2.*WORK/200.)
293              IF((WORK2.LT.WORK).AND.(WORK.LT.50.))TCT=4.6
294              IF(WORK2.GE.WORK) GOTO1
295            101 WORK=WORK2
296              MARKER=0
297        C  TISSUE O2 METABOLIC RATE.
298              RMT(2)=RMTB-(RMTB-RMTM)*EXP(-TCT*(CXT-TIMEON)*.50)
299              VTIME=1.1-1.1*EXP(-TCT*(CXT-TIMEON)/3.84)
300        C  TERM USED IN VI THAT IS A COMPONENT OF TRANSIENT RESPONSE RELATED
301        C  TO WORK LOAD.
302              RMLIN =RMTB-(RMTB-RMTM)*(1.-VTIME)
303              IF(VTIME.GE.1.) RMLIN=RMTB
304        C  TISSUE CO2 METABOLIC RATE.
305              RMT(1)=.88*RMT(2)
306              IF(TVNT.GT.37.) RMT(1)=(TVNT+40.77)*RMT(2)/88.5
307              IF(C(35).LT.C(40)) GOTO2
308              IF (KPLT.GT.0) GO TO 2
309              WRITE (6,333) RMT(1),RMT(2)
310              GOTO2
311              END
```

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:PRT,S RC13
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```
)B6-G03432*TPFS.RC13
      1              SUBROUTINE RC13
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1           SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3           DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C6969                FORMAT(1H 8HSUB RC13)
     10        C    SOLVES M DIFFERENTIAL EQUATIONS BY FOURTH-ORDER RUNGE-KUTTA AND
     11        C    ADAMS-MOULTON PREDICTOR-CORRECTOR METHODS
     12        C    NAMELIST/DBG/C,DC,SC
     13             IF (IRK - 4)      1304, 1356, 1356
     14         1304 DO 1352 INDEX = 1,4
     15              DO 1308 I = 1,M
     16              RK(I,INDEX) = DC(I)
     17         1308 CONTINUE
     18              GO TO (1312, 1320, 1328, 1340), INDEX
     19         1312 DO 1316 I = 1,M
     20              SC(I,IRK+1) = C(I)
     21              SC(I,IRK) = DC(I)
     22         1316 CONTINUE
     23              TI = C(35)
     24         1320 C(35) = TI + C(36)/2.0
     25              DO 1324 I = 1,M
     26              C(I) = SC(I,IRK+1) + C(36)*RK(I,INDEX)/2.0
     27         1324 CONTINUE
     28              GO TO 1336
     29         1328 C(35) = TI + C(36)
     30              DO 1332 I = 1,M
     31              C(I) = SC(I,IRK+1) + C(36)*RK(I,INDEX)
     32         1332 CONTINUE
     33         1336 CALL RC14
     34              GO TO 1352
     35         1340 DO 1344 I = 1,M
     36              C(I) = SC(I,IRK+1) + C(36)*(RK(I,1) + 2.0*RK(I,2) + 2.0*RK(I,3)
     37             1        + RK(I,4))/6.0
     38         1344 CONTINUE
     39              IRK = IRK + 1
     40         1352 CONTINUE
     41              RETURN
     42         1356 DO 1360 I = 1,M
     43              SC(I,5) = C(I)
     44              SC(I,4) = DC(I)
     45              C(I) = SC(I,5) + C(36)*(55.0*SC(I,4) - 59.0*SC(I,3) + 37.0*SC(I,2)
     46             1        - 9.0*SC(I,1))/24.0
     47         1360 CONTINUE
     48              C(35) = C(35) + C(36)
     49              NC35=C(35)/C(36) + .1
     50              C(35)=C(36)*NC35
     51         1364 CALL RC14
     52              DO 1368 I = 1,M
     53              SC(I,1) = C(I)
     54              C(I) = SC(I,5) + C(36)*(9.0*DC(I) + 19.0*SC(I,4) - 5.0*SC(I,3)
     55             1        + SC(I,2))/24.0
     56         1368 CONTINUE
```

```
      DO 1372 I = 1,M
      IF  (ABS  (C(I) - SC(I,1)) - 1.0E-3)  1372, 1372, 1364
 1372 CONTINUE
      DO 1376 I = 1,M
      DO 1376 J = 1,3
      SC(I,J) = SC(I,J+1)
 1376 CONTINUE
      RETURN
      END
```

```
.PRT,S RC14
```

```
)B6-GD3432*TPF$.RC14
    1              SUBROUTINE RC14
    2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
    3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
    4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
    5             3          DQ(4)
    6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
    7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
    8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
    9       C      CALLS OTHER SUBROUTINES IN A BLOCK
   10       C6969                FORMAT(1H 8HSUB RC14)
   11              CALL RC3
   12              CALL RC8
   13              CALL RC9
   14              CALL RC4
   15              CALL RC5 (CPB, F(4), C(4), BC(2))
   16              CALL RC21 (CHB(2), F(3), F(4), C(4), CH(2), CPH(2))
   17              CALL RC19 (CPB, CHB(2), CC(2), BC(1), F(4))
   18              CALL RC5 (CPT, F(6), C(7), BC(3))
   19              CALL RC21 (CHB(3), F(5), F(6), C(7), CH(3), CPH(3))
   20              CALL RC19 (CPT, CHB(3), CC(3), BC(1), F(6))
   21              CALL RC10
   22              CALL RC20
   23              CALL RC11
   24              RETURN
   25              END

)PRT,S RC15
```

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```
)86-G03432*TPF$*RC15
      1              SUBROUTINE RC15
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9       C6969                FORMAT(1H 8HSUB RC15)
     10       C      NAMELIST/SCH/SV
     11       C      SHIFTS VALUES IN SV ARRAY
     12              DO 1530 I = 1,18
     13              DO 1520 J = 1,49
     14              JM = 51 - J
     15              JMM = JM - 1
     16              SV(I,JM) = SV(I,JMM)
     17        1520  CONTINUE
     18        1530  CONTINUE
     19              RETURN
     20              END
```

```
)PRT,S RC16
```

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```
)B6=G03432*TPFS*RC16
      SUBROUTINE RC16
      DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     3          DQ(4)
      COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     1       TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
     2       IRK, LOC, ITERX, INDEX, I, J, M, N
      COMMON/R/ XDS,XMH,CXT,WORK,DUM1,DUM2,DUM3,WORK2,RMTB,RMTB2,TIMEOF
     1  ,RMLIN
C6969                 FORMAT(1H 8HSUB RC16)
C     SETS VALUES FOR SV ARRAY
C  ARTERIAL CO2 CONCENTRATION.
      SV(1,1) = CC(1)
C  ARTERIAL O2 CONCENTRATION.
      SV(2,1) = F(9)
C  BRAIN VENOUS CO2 CONCENTRATION.
      SV(4,1) = CC(2)
C  ARTERIAL N2 CONCENTRATION.
      SV(3,1) = F(10)
C  BRAIN VENOUS O2 CONCENTRATION
      SV(5,1) = F(12)
C  BRAIN VENOUS N2 CONCENTRATION.
      SV(6,1) = C(6)
C  TISSUE VENOUS CO2 CONCENTRATION.
      SV(7,1) = CC(3)
C  TISSUE VENOUS O2 CONCENTRATION.
      SV(8,1) = F(13)
C  TISSUE VENOUS N2 CONCENTRATION.
      SV(9,1) = C(9)
C  CARDIAC OUTPUT.
      SV(10,1) = C(10)
C  CEREBRAL BLOOD FLOW.
      SV(11,1) = C(11)
C  TISSUE BLOOD FLOW.
      SV(12,1) = QF(1)
C  ARTERIAL H+ CONCENTRATION.
      SV(13,1) = CH(1)
C  ARTERIAL O2 TENSION.
      SV(14,1) = F(1)
C  INITIAL TIME.
      SV(15,1) = 0.0
C  TOTAL GAS CONCENTRATIONS AT BRAIN EXIT.
      SV(16,1) = SV(4,1) + SV(5,1) + SV(6,1)
C  TOTAL GAS CONCENTRATIONS AT TISSUE EXIT.
      SV(17,1) = SV(7,1) + SV(8,1) + SV(9,1)
C  SIMULATED TIME.
      SV(18,1) = C(35)
      RETURN
      END
)PRT*S RC17
```

```
)B6-G03432*TPF5.RC17
      1              SUBROUTINE RC17
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1       TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2       IRK, LOC, ITERX, INDEX, I, J, M, N
      9              COMMON/R/ XDS,XMH,CXT,WORK,DUM1,DUM2,DUM3,WORK2,RMTB,RMTB2,TIMEOF
     10             1  ,RMLIN
     11       C      NAMELIST/BAD/CH(4),CADK,D(11),C(12),BC(4),C(37),C(38),VTRAN(14),
     12       C     ITERM,VI,C(20),C(16),VTRAN(15),C(21),VTRAN(13),C(37),D(9),C(11),
     13       C     2VTRAN(16),QF(1),VTRAN(17),C(10),F(11),
     14       C6969                  FORMAT(1H 8HSUB RC17)
     15       C      CALCULATES VENTILATION
     16       C  CFS H+ CONCENTRATION , EQUATION 6.1 .
     17              CH(4)  = CADK*D(11)*C(12)/BC(4)
     18              IF (C(37) .GT. 1.0E-5)       GO TO 1708
     19        1704 VI = C(38)
     20              GO TO 1730
     21        1708 TERM = 0.0
     22       C  DECISION ON ARTERIAL O2 TENSION AT CAROTID BODIES*SITE.
     23              IF (VTRAN(14) - 104.0)       1710, 1720, 1720
     24        1710 TERM = (23.6E-9)*((104.0 - VTRAN(14))**4.9)
     25       C  CONTROLLER EQUATION AS A FUNCTION OF HUMORAL TERMS.
     26        1720 VI = C(20)*(C(16)*VTRAN(15) + (1.0 - C(16))*CH(4))
     27             1       + C(21)*VTRAN(13) + TERM - C(37)
     28       C  INCLUSION OF NEURAL COMPONENT AS A FUNCTION OF WORK LOAD.
     29              SVNT2=SSVENT(SSO2W(WORK))  -VI
     30              IF((SVNT2.GT.0.).AND.(SVNT2.LE.15.))   VI=VI+SVNT2
     31              IF(SVNT2.GT.15.)  VI=VI+15.
     32       C
     33       C  DESCRIPTION OF TRANSIENT VENTILATION RESPONSE.
     34              SVNT =SSVENT(RMLIN ) -VI
     35              IF(SVNT.GT.0.5)   VI=VI+0.75*SVNT
     36       C
     37       C  EXPIRED VENTILATION RATE, EQUATION 11.1 .
     38        1730 VE = VI + D(9)*(C(11)*VTRAN(16) + QF(1)*VTRAN(17) - C(10)*F(11))
     39              IF (VI .LT. 0.0 .OR. VE .LT. 0.0)      GO TO 1740
     40              RETURN
     41        1740 VI = 0.0
     42              VE = 0.0
     43              RETURN
     44              END

:PRT.S RC19
```

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```
)B6-G03432*TPFS*RC19
      1              SUBROUTINE RC19 (CPA, CVHBA, CVC, BHCA, FC)
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1       TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2       IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C     NAMELIST/DM2/CPA,CVHBA,CVC,BHCA,FC
     10        C6969              FORMAT(1H BHSUB RC19)
     11        C     ITERATES FOR VENOUS BRAIN AND VENOUS TISSUE CO2 CONCENTRATION
     12        C  TERM USED IN EQUATION 4.2 .
     13         1910 X = (CVC - FC)/(0.01*CPA)
     14        C  LOGARITHM SUBROUTINE.
     15              X = RCF1(X)
     16        C  EQUATION 4.2 .
     17              X = BHCA + 0.375*(C(17) - CVHBA) - D(8)*(X - 0.14) + FC
     18              CALL RC6 (CVC)
     19              CVC = CVC + 2.0*(X - CVC)/3.0
     20              IF (ITERX)          1920, 1910, 1920
     21         1920 CONTINUE
     22              RETURN
     23              END

)PRT,S RC20
```

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```
)B6-G03432*TPFS.RC20
      1              SUBROUTINE RC20
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9       C      NAMELIST/NMF/F
     10       C6969                  FORMAT(1H 8HSUB RC20)
     11       C      SETS TIME DEPENDENT EXPRESSIONS
     12       C   ARTERIAL OXYGEN CONCENTRATION INCLUDING EFFECTS OF HEMOGLOBIN.
     13              F(9) = D(6)*C(2) + CHB(1)
     14       C   ARTERIAL NITROGEN CONCENTRATION.
     15              F(10) = D(7)*C(3)
     16       C   TOTAL ARTERIAL GAS CONCENTRATION AT LUNG EXIT.
     17              F(11) = CC(1) + F(9) + F(10)
     18       C   VENOUS BRAIN OXYGEN CONCENTRATION INCLUDING EFFECTS OF HEMOGLOBIN.
     19              F(12) = C(5) + CHB(2)
     20       C   VENOUS TISSUE OXYGEN CONCENTRATION INCLUDING EFFECTS OF HEMOGLOBIN.
     21              F(13) = C(8) + CHB(3)
     22       C   OXYGEN TENSION IN BRAIN.
     23              F(17) = C(5)/D(3)
     24       C   NITROGEN TENSION IN BRAIN.
     25              F(18) = C(6)/D(4)
     26       C   PRODUCT OF DIFFUSION COEFFS.AND DIFFERENTIAL BRAIN - CSF GAS TENSIONS
     27              F(14) = C(27)*(CPB - C(12))
     28              F(15) = C(28)*(F(17) - C(13))
     29              F(16) = C(29)*(F(18) - C(14))
     30       C
     31              RETURN
     32              END

)PRT,S RC21
```

```
)B6-G03432*TPFS.RC21
      1              SUBROUTINE RC21 (CHBA, FA, FD, CCA, CHA, CPHA)
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C6969                FORMAT(1H 8HSUB RC21)
     10        C     NAMELIST/PB/CHBA,FA,FD,CCA,CHA,CPHA
     11        C     COMPUTES H+ ION, PH, AND OXYHEMOGLOBIN
     12        C  ARTERIAL H+ CONCENTRATION.
     13              CHA = CADK*FD/(CCA - FD)
     14        C  ARTERIAL PH.
     15              CPHA = 9.0 - RCF1(CHA)
     16        C  DEVELOPMENT OF EXPRESSION USED IN CALCULATION OF ARTERIAL
     17        C  OXYHEMOGLOBIN SATURATION.
     18              X = RCF2(CPHA)
     19              X = -X * FA
     20              X = (1.0 - EXP (X))**2
     21              X=ABS(X)
     22        C
     23        C  ARTERIAL OXYHEMOGLOBIN CONCENTRATION.
     24              CHBA = X*C(17)
     25              RETURN
     26              END
```

```
)PRT,S RCF1
```

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```
)B6=GD3432*TPFS*RCF1
     1              FUNCTION RCF1(W)
     2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
     3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
     4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
     5             3          DQ(4)
     6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
     7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
     8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
     9       C      LOGARITHM TO BASE 10
    10              RCF1    = 0.43429448 * ALOG(W)
    11              RETURN
    12              END

)PRT,S RCF2
```

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```
)B6=G03432*TPF$*RCF2
      1              FUNCTION RCF2(Z)
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1       TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2       IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C     OXYHEMOGLOBIN = PH EMPIRICAL FUNCTION
     10        C       EQUATION 3,4 .
     11              RCF2     = (((0.0066815*Z) - 0.10C98)*Z + 0.44921)*Z - 0.454
     12              RETURN
     13              END

)PRT,S RCF3
```

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```
)B6-GD3432*TPFS,RCF3
      1              FUNCTION RCF3(KK)
      2              DIMENSION C(40), XN(40,2), SV(18,50), VTRAN(18), RK(14,4),
      3             1          SC(14,5), DC(14), A(6), D(15), F(20), VOL(10), RMT(2),
      4             2          BC(4), QF(6), TAU(5), CC(3), CHB(3), CH(4), CPH(3),
      5             3          DQ(4)
      6              COMMON/Z/ C, XN, SV, VTRAN, RK, SC, DC, A, D, F, VOL, RMT, BC, QF,
      7             1        TAU, CC, CHB, CH, CPH, DQ, VE, VI, CPB, CPT, CADK, X, DT,
      8             2        IRK, LOC, ITERX, INDEX, I, J, M, N
      9        C     VTRAN FUNCTION
     10        C  VARIABLES WITH TIME DELAYS USED IN EQUATIONS 8.1-8.1 .
     11              RCF3 = SV(KK,LOC) + (SV(KK,LOC + 1) - SV(KK,LOC))*DT/D(14)
     12              RETURN
     13              END

)PRT,S SS02%
```

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```
)B6-G03432*TPFS.SSO2W
      1              FUNCTION SSO2W(X)
      2        C  CALCULATION OF STEADY-STATE OXYGEN REQUIREMENTS FOR VARIOUS LEVELS
      3        C  OF WORK LOAD (X=WATTS).
      4              IF(X.GT.250.)GOTO1
      5              IF( X.LT.75.)GOTO2
      6              SSO2W=-.072+(X/70.)
      7              RETURN
      8        1     SSO2W=3.5
      9              RETURN
     10        2     SSO2W=(X/75.)+.215*(75.-X)/75.
     11        C
     12              RETURN
     13              END

)PRT.S SSVENT
```

```
)B6-G03432*TPF$.SSVENT
      1              FUNCTION  SSVENT(X)
      2        C  CALCULATION OF STEADY-STATE VENTILATION RATE AS A FUNCTION OF TISSUE
      3        C  OXYGEN METABOLIC RATE.
      4              IF(X.LE..215) SSVENT=5.398
      5              IF((X.GT..215).AND.(X.LT.2.))SSVENT=25.*X
      6              IF(X.GE.2.)SSVENT=50.+50.*(X-2.)
      7        C
      8              RETURN
      9              END

)PRT,S PLOT
```

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```
)B6-G03432*TPFS*PLOT
      1            SUBROUTINE PLOT
      2            COMMON/PLTBUF/IPLTPT,TLOTBF(181),PLOTBF(181,8),ALPHA(8),KSTOPP
      3           &  ,TMAX,KPLT
      4            DIMENSION HEAD(6)
      5            DATA HEAD/'GRODINS RESPIRATORY CONTROL MODEL   '/
      6            DIMENSION TSTEPX(4),TSTALP(4)
      7            DATA TSTEPX/1.,1.,60.,1440./
      8            DATA TSTALP/'MINS','MINS','HOUR','DAYS'/
      9            DIMENSION IIDAS(8,2),PPARS(8,3)
     10            DIMENSION XNO(5)
     11            DATA ISA/'S   '/,IN/'N   '/,IY/'Y   '/,IPLL/'PLOT'/
     12            DATA IFIRST,KSTOPP,NOP/0,0,0/
     13            IF (IFIRST.EQ.0) CALL INITT(300)
     14            K=8
     15            IFIRST=1
     16            IEXECI=IPLL
     17            IS = IPLTPT - 1
     18            IF(IPLTPT .LE. 1) GO TO 1
     19            IF(IEXECI .EQ. IPLL .AND. KSTOPP .EQ. 0)
     20           1  GO TO 28
     21            IF(IEXECI .EQ. IPLL .AND. KSTOPP .GE. 1)
     22           1  GO TO 120
     23          1 IS = 1
     24         11 WRITE(6,2)
     25          2 FORMAT(9X,' GRAPHIC OUTPUT(Y,N,S),TIME INTERVALS,STARTX,'
     26           &  ,'STOPX,(A2,3F5.0)..')
     27          4 READ(5,3,ERR=4) I,TSPLIT,STARTX,STOPX
     28          3 FORMAT(A2,3F5.0)
     29            IF(I .EQ. IN) RETURN
     30            IF(I .EQ. ISA) GO TO 10
     31            IF (STOPX.LT.1.) STOPX=TMAX
     32            IF (STARTX.LT.1.) STARTX=TLOTBF(1)
     33            RUNSTP=STOPX-STARTX
     34            TTSPT = TSPLIT
     35            IF(I .NE. IY) GO TO 11
     36            IF(TSPLIT .LT. 3. .OR. TSPLIT .GT. 5.) GO TO 11
     37        C   HERE TO BUILD PLOT PARAMETERS.
     38            NOP = 0
     39            DO 20 I = 1,K
     40         17 WRITE(6,5) ALPHA(I)
     41          5 FORMAT(' ',A6,13X,'Y SCALE   (A4,8X,F4.0,2F6.0)'/
     42           1 ' PLOT(Y,N,S) LOC HIGH  LOW    ..')
     43          7 READ(5,6,ERR=7) I1,XP1,XP2,XP3
     44          6 FORMAT(A4,8X,F4.0,2F6.0)
     45            IF(I1 .EQ. IY) GO TO 18
     46            IF(I1 .EQ. ISA) GO TO 19
     47            IF(I1 .NE. IN) GO TO 17
     48            PPARS(I,1) = 0.
     49            GO TO 20
     50         18 IF(XP1 .LE. 0.) GO TO 17
     51            IF(IFIX(XP1) .GT. 8) GO TO 17
     52            IF(XP3 .GE. XP2) GO TO 17
     53            PPARS(I,1) = XP1
     54            PPARS(I,2) = XP2
     55            PPARS(I,3) = XP3
     56         19 IF(IFIX(PPARS(I,1)) .GT. NOP) NOP = PPARS(I,1)
```

```
      IF(PPARS(I,I) .LT. 1.) GO TO 17
   20 CONTINUE
C     BUILD WHOLE PAGE GRAPH.
   10 CALL NEWPAG
      CALL MOVABS(300,775)
      CALL DMPBUF
      WRITE (6,21) HEAD
   21 FORMAT(25X,6A6)
      CALL MOVABS(3,100)
      CALL DRWABS(1000,100)
      CALL DRWABS(1000,750)
      CALL DRWABS(3,750)
      CALL DRWABS(3,100)
      CALL MOVABS(300,750)
      CALL DRWABS(300,100)
      CALL DMPBUF
      I1 = TTSPT - 1.
      I2 = 300
      I3 = 700 / (I1 + 1)
      DO 25 I = 1,I1
      I2 = I2 + I3
      CALL MOVABS(I2,100)
      CALL DRWABS(I2,750)
   25 CONTINUE
      CALL DMPBUF
C  DRAW DIVISIONS FOR DIFFERENT GRAPHS.
      I3Y = 650 / NOP
      I4Y = I3Y / 2
      I1 = NOP - 1
      I2 = 100
      IF(I1 .LT. 1) GO TO 280
      DO 26 I = 1,I1
      I4 = I2 + I4Y
      CALL MOVABS(300,I4)
      CALL DRWABS(305,I4)
      CALL MOVABS(995,I4)
      CALL DRWABS(1000,I4)
      I2 = I2 + I3Y
      CALL MOVABS(3,I2)
      CALL DRWABS(1000,I2)
      CALL DMPBUF
   26 CONTINUE
  280 I4 = I2 + I4Y
      CALL MOVABS(300,I4)
      CALL DRWABS(305,I4)
      CALL MOVABS(995,I4)
      CALL DRWABS(1000,I4)
      CALL DMPBUF
C  ADD ALPHA
      I1 = 750
      IDUP = 1
      CALL VWINDO(0.,1023.,0.,780.)
      CALL SWINDO(0,1023,0,780)
      DO 70 I = 1,NOP
      III = I1
      I22 = I1 - I3Y + 30
      ID = 0
```

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```
      DO 60 J = 1,K
      IF(IFIX(PPARS(J,1)) .NE. I) GO TO 60
      CALL MOVABS(0,I11)
      CALL ANMODE
      CALL DMPBUF
      WRITE(6,55) ALPHA(J),PPARS(J,2)
   55 FORMAT(' ',6X,A6,F8.2)
      Y1 = I11 - 11.
      CALL MOVEA(10.,Y1)
      IF(ID .EQ. 0) GO TO 410
      ID1 = 0
      ID2 = 0
      CALL DSHARC(104.,Y1,ID,ID1,ID2,IDUP)
      GO TO 411
  410 CALL DRAWA(104.,Y1)
  411 CALL MOVABS(0,I22)
      CALL ANMODE
      CALL DMPBUF
      WRITE(6,55) ALPHA(J),PPARS(J,3)
      Y1 = I22 - 13.
      CALL MOVEA(10.,Y1)
      IF(ID .EQ. 0) GO TO 413
      ID1 = 0
      ID2 = 0
      CALL DSHARC(104.,Y1,ID,ID1,ID2,IDUP)
      GO TO 415
  413 CALL DRAWA(104.,Y1)
  415 ID = ID + 1
      I11 = I11 - 21
      I22 = I22 + 21
   60 CONTINUE
      I1 = I1 - 13Y
   70 CONTINUE
      X = (RUNSTP/TTSPT) + .000001
      I = 1
C      IF(X .LT. 1.) I = 1
C      IF(X .GE. 60.) I = 3
C      IF(X .GE. 1440.) I = 4
      X = X Y TSTEPX(I)
      IF (STARTX.LT.1.) STARTX=TLOTBF(I)
      X2 = STARTX / TSTEPX(I)
      X1 = X2 + X
      I1 = TTSPT
      DO 75 J = 1,I1
      XNO(J) = X1
      X1 = X1 + X
   75 CONTINUE
      CALL MOVABS(0,100)
      CALL ANMODE
      CALL DMPBUF
      IF(TTSPT .GT. 4.) GO TO 80
      IF(TTSPT .GT. 3.) GO TO 79
      WRITE(6,93) X2,(XNO(J),J=1,3)
   93 FORMAT(' ',15X,F6.1,11X,F6.1,11X,F6.1,10X,F6.1)
      GO TO 85
   79 WRITE(6,77) X2,(XNO(J),J=1,4)
   77 FORMAT(' ',15X,F6.1,6X,F6.1,7X,F6.1,6X,F6.1,7X,F6.1)
```

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```
171            GO TO 85
172         80 WRITE(6,81) X2,(XNO(J),J=1,5)
173         81 FORMAT(' ',11X,6(4X,F6.1))
174         85 WRITE(6,86) TSTALP(I)
175         86 FORMAT(' ',30X,'TIME (',A4,')')
176       C  INITIALIZE DASH INFORMATION.
177            DO 90 J = 1,6
178            IIDAS(J,1) = 0
179         90 CONTINUE
180       C       IF(IEXECI .EQ. IPLL) RETURN
181       C  PLOT VARIABLES...
182            28 IL = 750
183               IS2 = IS
184               I2 = IPLTPT
185               DO 40 I = 1,NOP
186               IL = IL - I3Y
187               IDAS = -1
188               IDUP = 1
189               DO 30 II = 1,K
190               IF(IFIX(PPARS(II,1)) .NE. I) GO TO 30
191               IDAS = IDAS + 1
192               X = TLOTBF(I)
193               IF (STARTX.GT.0.1) X=STARTX
194               XL = RUNSTP
195               Y = PPARS(II,3)
196               YL = PPARS(II,2) - Y
197               CALL VWINDO(X,XL,Y,YL)
198               CALL SWINDO(300,700,IL,I3Y)
199               X = TLOTBF(IS)
200              -Y = PLOTBF(IS,II)
201               IF(IEXECI .NE. IPLL) GO TO 97
202               IF(Y .LE. PPARS(II,2)) GO TO 105
203               IF(PLOTBF(IS2,II) .GE. PPARS(II,2)) GO TO 30
204               IF (TLOTBF(II).GT.STOPX) GO TO 30
205               YY = PPARS(II,2)
206               GO TO 96
207        105    IF(Y .GE. PPARS(II,3)) GO TO 97
208               IF(PLOTBF(IS2,II) .LT. PPARS(II,3)) GO TO 30
209               YY = PPARS(II,3)
210         96    CALL MOVEA(X,YY)
211               IDUP = IDUP + 1
212         97    IDUP = IDUP + 1
213               CALL MOVEA(X,Y)
214               DO 35 III = IS2,I2
215               X = TLOTBF(III)
216               Y = PLOTBF(III,II)
217               IF(IDAS .GT. 0) GO TO 33
218               IDUP = IDUP + 1
219               CALL DRAWA(X,Y)
220               GO TO 34
221         33    L = IIDAS(II,1)
222               N = IIDAS(II,2)
223               CALL DSHARC(X,Y,IDAS,L,N,IDUP)
224               IIDAS(II,1) = L
225               IIDAS(II,2) = N
226         34    IF(IDUP .LT. 13 ) GO TO 35
227               CALL DMPBUF
```

```
228              IDUP = 1
229           35 CONTINUE
230           30 CONTINUE
231           40 CALL DMPBUF
232              IF(IDUP .GT. 1) CALL DMPBUF
233              IF (KSTOPP.NE.1) RETURN
234          120 CALL PAGE3
235              IEXECI = 0
236              IF (KSTOPP.GT.1) IEXECI=IPLL
237              GO TO 1
238              END
```

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```
$PRT.S GRODAT
```

```
)B6-G03432*TPFS.GRODAT
      1
      2                    .17827
      3                    .53459
      4                    .28714
      5                    .64121
      6                    .00116
      7                    .00105
      8                    .61553
      9                    .00147
     10                    .00105
     11                    6.0
     12                    .74913
     13                    48.17427
     14                    36.69498
     15                    61.17176
     16                    40.0          TMAX
     17                    0.0           CENT SENS PT
     18                    0.2           HB
     19                    0.1           R1
     20                    0.1           R2
     21                    1.138         CNT SENS COF
     22                    1.154         CRTD BDY SCF
     23                    3.0           KL
     24                    1.0           KB
     25                    39.0          KT
     26                    0.05          MRB(CO2)
     27                    0.05          MRB(02)
     28                    81.99         D(CO2)
     29                    4.361         D(02)
     30                    2.524         D(N2)
     31                    260.0         B
     32                    .0192         FI(CO2)
     33                    .70           FI(02)
     34                    .2808         FI(N2)
     35                    .1            KCSF
     36                    0.            T
     37                .0078125          H
     38                    87.55         VI(N)
     39                    5.39          VI(SS)
     40                    .25           PRINT ALL TIM
     41                    000.          UNKNOWN
     42                    .547          BHCO3 BLOOD
     43                    .585          BHCO3 BRAIN
     44                    .585          BHCO3TISSUE
     45                    .585          BHCO3 CSF
     46                    .182          RMT(CO2)
     47                    .215          RMT(02)
     48                    0.0           DJ1
     49                    0.0           DJ2
     50        0.          .5
     51        40.         .25
     52        100.        .25
     53
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
)B6-G03432*TPFS*GRODATT
      1        TTY
      2                        .17827
      3                        .53459
      4                        .28714
      5                        .64121
      6                        .00116
      7                        .00105
      8                        .61553
      9                        .00147
     10                        .00105
     11                        6.0
     12                        .74913
     13                        48.17427
     14                        36.69498
     15                        61.17176
     16                        40.0          TMAX
     17                        0.0           CENT SENS PT
     18                        0.2           HB
     19                        0.1           R1
     20                        0.1           R2
     21                        1.138         CNT SENS COF
     22                        1.154         CRTD BDY SCF
     23                        3.0           KL
     24                        1.0           KB
     25                        39.0          KT
     26                        0.05          MRB(CO2)
     27                        0.05          MRB(O2)
     28                        81.99         D(CO2)
     29                        4.361         D(O2)
     30                        2.524         D(N2)
     31                        260.0         B
     32                        .0192         FI(CO2)
     33                        .70           FI(O2)
     34                        .2808         FI(N2)
     35                        .1            KCSF
     36                        0.            T
     37                    .0078125          h
     38                        87.55         VI(N)
     39                        5.39          VI(SS)
     40                        .25           PRINT ALL TIM
     41                        000.          UNKNOWN
     42                        .547          BHCO3 BLOOD
     43                        .585          BHCO3 BRAIN
     44                        .585          BHCO3TISSUE
     45                        .585          BHCO3 CSF
     46                        .182          RMT(CO2)
     47                        .215          RMT(O2)
     48                        0.0           DJ1
     49                        0.0           DJ2

@PRT*S SEADAT
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
)B6-G03432*TPFS.SEADAT
      1      TTY
      2                  .05269
      3                  .15144
      4                  .79587
      5                  .63977
      6                  .00114
      7                  .00974
      8                  .61323
      9                  .00145
     10                  .00974
     11                 6.00000
     12                  .73723
     13                47.85777
     14                36.01092
     15               567.44715
     16                  40.0        TMAX
     17                  0.0         CENT SENS PT
     18                  0.2         HB
     19                  0.1         K1
     20                  0.1         K2
     21                  1.138       CNT SENS COF
     22                  1.154       CRTD BDY SCF
     23                  3.0         KL
     24                  1.0         KB
     25                  39.0        KT
     26                  0.05        MRB(CO2)
     27                  0.05        MRB(O2)
     28                  81.99       D(CO2)
     29                  4.361       D(O2)
     30                  2.524       D(N2)
     31                  760.0       B
     32                  .0004       FI(CO2)
     33                  .2096       FI(O2)
     34                  .7900       FI(N2)
     35                  .1          KCSF
     36                  0.          T
     37              .0078125        H
     38                  87.55       VI(N)
     39                  5.39        VI(SS)
     40                  .25          PRINT ALL TIM
     41                  000.        UNKNOWN
     42                  .547        BHCO3 BLOOD
     43                  .585        BHCO3 BRAIN
     44                  .585        BHCO3TISSUE
     45                  .585        BHCO3 CSF
     46                  .182        RMT(CO2)
     47                  .215        RMT(O2)
     48                  0.0         DJ1
     49                  0.0         DJ2

)PRT,S CO2DAT
```

ORIGINAL PAGE IS
OF POOR QUALITY

```
)B6-G03432*TPFS*C02DAT
      1       TTY
      2                    .05269
      3                    .15144
      4                    .79587
      5                    .63977
      6                    .00114
      7                    .00974
      8                    .61323
      9                    .00145
     10                    .00974
     11                   6.00000
     12                    .73723
     13                  47.85777
     14                  36.01092
     15                 567.44715
     16                    40.0          TMAX
     17                    0.0           CENT SENS PT
     18                    0.2           HB
     19                    0.1           R1
     20                    0.1           R2
     21                    1.138         CNT SENS COF
     22                    1.154         CRTD BDY SCF
     23                    3.0           KL
     24                    1.0           KB
     25                    39.0          KT
     26                    0.05          MRB(CO2)
     27                    0.05          MRB(O2)
     28                    81.99         D(CO2)
     29                    4.361         D(O2)
     30                    2.529         D(N2)
     31                    760.0         B
     32                    .0700         FI(CO2)
     33                    .2096         FI(O2)
     34                    .7204         FI(N2)
     35                    .1            KCSF
     36                    0.            T
     37                 .0078125         H
     38                    87.55         VI(N)
     39                    5.39          VI(SS)
     40                    .25            PRINT ALL TIM
     41                    000.          UNKNOWN
     42                    .547          BHCO3 BLOOD
     43                    .585          BHCO3 BRAIN
     44                    .585          BHCO3TISSUE
     45                    .585          BHCO3 CSF
     46                    .182          RMT(CO2)
     47                    .215          RMT(O2)
     48                    0.0           DJ1
     49                    0.0           DJ2

)PRT*S RUNB
```

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