



DECUS

PROGRAM LIBRARY

DECUS NO.	FOCAL8-119
TITLE	CHEM LAB 5
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DATE	October 30, 1970
SOURCE LANGUAGE	FOCAL 5/69

BACKGROUND:

AMONG THE "NEW BREED" CHEMISTRY COURSES DESIGNED FOR SECONDARY APPLICATION, THE 'CHEMICAL MATERIALS STUDY' (CHEMS) IS A FAVORITE WHICH CONTINUES TO BE ADOPTED, ADAPTED, REVISED, AND REWRITTEN. CHEMS LAB 5 IS DESIGNED TO CONTRAST THE ENERGY INVOLVED IN A PHASE CHANGE WITH THAT OF A CHEMICAL CHANGE USING VERY SIMPLE MATERIALS AND EQUIPMENT. IT ALSO PROVIDES EARLY EXPERIENCE IN QUANTITATIVE INVESTIGATION BY DEALING WITH THE UNCERTAINTY OF MEASUREMENT, AND THE IDEAS OF ACCURACY AND PRECISION.

IT IS IMPORTANT THAT THE STUDENT REALIZE WHY WE DIFFERENTIATE CHEMICAL AND PHASE CHANGES: BECAUSE THE ENERGY EFFECTS ARE EXTREMELY DIFFERENT (BETTER THAN TWO ORDERS OF MAGNITUDE).

THE INVESTIGATION:

A SIMPLE WATER BATH IS USED TO HEAT-SINK A BURNING CANDLE, AND ALSO SOME MELTED WAX. CALCULATIONS ARE MADE ON THE DATA, INCLUDING THE POSSIBLE EXTREMES CAUSED BY THE UNCERTAINTY OF THE MEASUREMENTS.

THE FOCAL PROGRAM:

THIS PROGRAM IS INTENDED AS THE MINI-NUMBER-CRUNCHER FOR THIS INVESTIGATION. WHILE THE CALCULATIONS ARE ELEMENTARY AND EASILY VISUALIZED WITH TEACHER GUIDANCE, IT IS PERHAPS EASIER TO CONCENTRATE ON THE CENTRAL FINDINGS IF THE EXTREMES AND AVERAGE VALUES ARE CALCULATED FOR A CLASS-SIZE COLLECTION OF INPUT DATA IN A SHORT PERIOD OF TIME. THE CENTRAL THEME IS TOO BEAUTIFULLY SIMPLE TO LOOSE IT IN PAGES OF HAND CALCULATION BY THE STUDENTS.

THE PROGRAM IS DESIGNED TO ACCEPT THE PRESCRIBED INPUT DATA FOR EITHER PART ONE OR PART TWO WITHOUT CORRECTING THE FORMAT ACCORDING TO THE PHYSICAL SIGNIFICANCE OF THE DIGITS OUTPUT. IN THIS WAY, THE MATHEMATICAL LANGUAGE IS SERVICED BY THE COMPUTER LEAVING THE STUDENT FREE TO DO THE CHEMISTRY.

RESTRICTIONS:

THE PROGRAM IS DESIGNED TO USE "FOCAL, 5/69" [DECUS FOCAL8-52]

01.05 O X;S 160;A!"CHEMS LAB 5!"DID YOU DO 1 OR 2 ? "A,"NOW FILL IN
 01.12 T %6.1," THE DATA AS OUTLINED IN MANUAL.";I(A-2)2.08;
 01.14 D 8;A"TEST TUBE AND WAX? "A;D 6;A B," G.
 01.16 D 8;A"EMPTY TEST TUBE? "C;D 6;A D," G.";S A=A-C;S B=B+D
 01.18 D 8;A"BEAKER PLUS WATER? "G;D 6;A H," G.
 01.20 D 8;A"EMPTY BEAKER? "I;D 6;A J," G.";S K=G-I;S L=H+J;S C=K+L
 01.22 S D=K-L;D 9;A"WATER BEFORE? "G;D 6;A H," DEG.C.
 01.24 D 9;A"WATER AFTER? "I;D 6;A J," DEG.C.";S G=I-G;S H=H+J
 01.26 S I=G+H;S G=G-H;S C=C*I;S D=D*G;S C=(C-D)/2;S D=C+D
 01.30 S H=(C+D)/(A-B);S I=(D-C)/(A+B);S H=(H-I)/2;S I=I+H;D 7
 01.32 D 8;T"WAX"A;D 6;T B," G.";D 8;T"WATER"K;D 6;T L," G.
 01.34 T!"TEMP. CHANGE OF WATER"G;D 6;T H," DEG.C."!!"QUANTITY OF
 01.36 T"HEAT"D;D 6;T C," CAL."!!"HEAT OF SOLIDIFICATION OF WAX"I
 01.38 D 6;T H," CAL./G.";D 7;Q

02.08 D 8;A"CANDLE BEFORE BURNING? "A;D 6;A B," G.
 02.10 D 8;A"CANDLE AFTER BURNING? "C;D 6;A D," G.";S A=A-C;S B=B+D
 02.12 D 8;A"CAN AND WATER? "G;D 6;A H," G.
 02.14 D 8;A"EMPTY CAN? "I;D 6;A J," G.";S C=G-I;S D=H+J
 02.16 D 9;A"WATER BEFORE HEATING? "G;D 6;A H," DEG.C.
 02.18 D 9;A"WATER AFTER HEATING? "I;D 6;A J," DEG.C.";S G=I-G;S H=J+H
 02.22 S I=(C+D)*(G+H);S J=(C-D)*(G-H);S K=(I-J)/2;S L=J+K;S I=I/(A-B)
 02.28 S J=J/(A+B);S I=(I-J)/2;S J=J+I;D 7;D 8;T"CANDLE BURNED"A;D 6
 02.30 T B," G.";D 8;T"WATER HEATED"C;D 6;T D," G."!!"TEMP. CHANGE OF
 02.34 T"WATER"G;D 6;T H," DEG.C."!!"QUANTITY OF HEAT TO WARM WATER"L
 02.36 D 6;T K," CAL."!!"HEAT OF COMBUSTION OF CANDLE WAX"J;D 6;T I
 02.38 T" CAL./G.";D 7;Q

06.05 T " PLUS OR MINUS "

07.05 T!!;F M=1,4;T" << TEAR OFF >> "

08.05 T!"MASS OF "

09.05 T!"TEMP. OF "

G

CHEMS LAB 5

DID YOU DO 1 OR 2 ? 1 NOW FILL IN THE DATA AS OUTLINED IN MANUAL.

MASS OF CANDLE BEFORE BURNING? 32.48 PLUS OR MINUS .01 G.

MASS OF CANDLE AFTER BURNING? 31.23 PLUS OR MINUS .01 G.

MASS OF CAN AND WATER? 401 PLUS OR MINUS 1 G.

MASS OF EMPTY CAN? 80 PLUS OR MINUS 1 G.

TEMP. OF WATER BEFORE HEATING? 10.2 PLUS OR MINUS .2 DEG.C.

TEMP. OF WATER AFTER HEATING? 40.2 PLUS OR MINUS .2 DEG.C.

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MASS OF CANDLE BURNED 1.2 PLUS OR MINUS 0.0 G.

MASS OF WATER HEATED 321.0 PLUS OR MINUS 2.0 G.

TEMP. CHANGE OF WATER 30.0 PLUS OR MINUS 0.4 DEG.C.

QUANTITY OF HEAT TO WARM WATER 9630.8 PLUS OR MINUS 188.4 CAL.

HEAT OF COMBUSTION OF CANDLE WAX 7709.0 PLUS OR MINUS 274.1 CAL./G.

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CHEMS LAB 5

DID YOU DO 1 OR 2 ? 2 NOW FILL IN THE DATA AS OUTLINED IN MANUAL.

MASS OF TEST TUBE AND WAX? 28.6 PLUS OR MINUS .1 G.

MASS OF EMPTY TEST TUBE? 18.5 PLUS OR MINUS .1 G.

MASS OF BEAKER PLUS WATER? 247 PLUS OR MINUS 1 G.

MASS OF EMPTY BEAKER? 89 PLUS OR MINUS 1 G.

TEMP. OF WATER BEFORE? 22 PLUS OR MINUS .2 DEG.C.

TEMP. OF WATER AFTER? 24.6 PLUS OR MINUS .2 DEG.C.

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MASS OF WAX 10.1 PLUS OR MINUS 0.2 G.

MASS OF WATER 158.0 PLUS OR MINUS 2.0 G.

TEMP. CHANGE OF WATER 2.2 PLUS OR MINUS 7.6 DEG.C.

QUANTITY OF HEAT 411.6 PLUS OR MINUS 68.4 CAL.

HEAT OF SOLIDIFICATION OF WAX 40.9 PLUS OR MINUS 7.6 CAL./G.

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