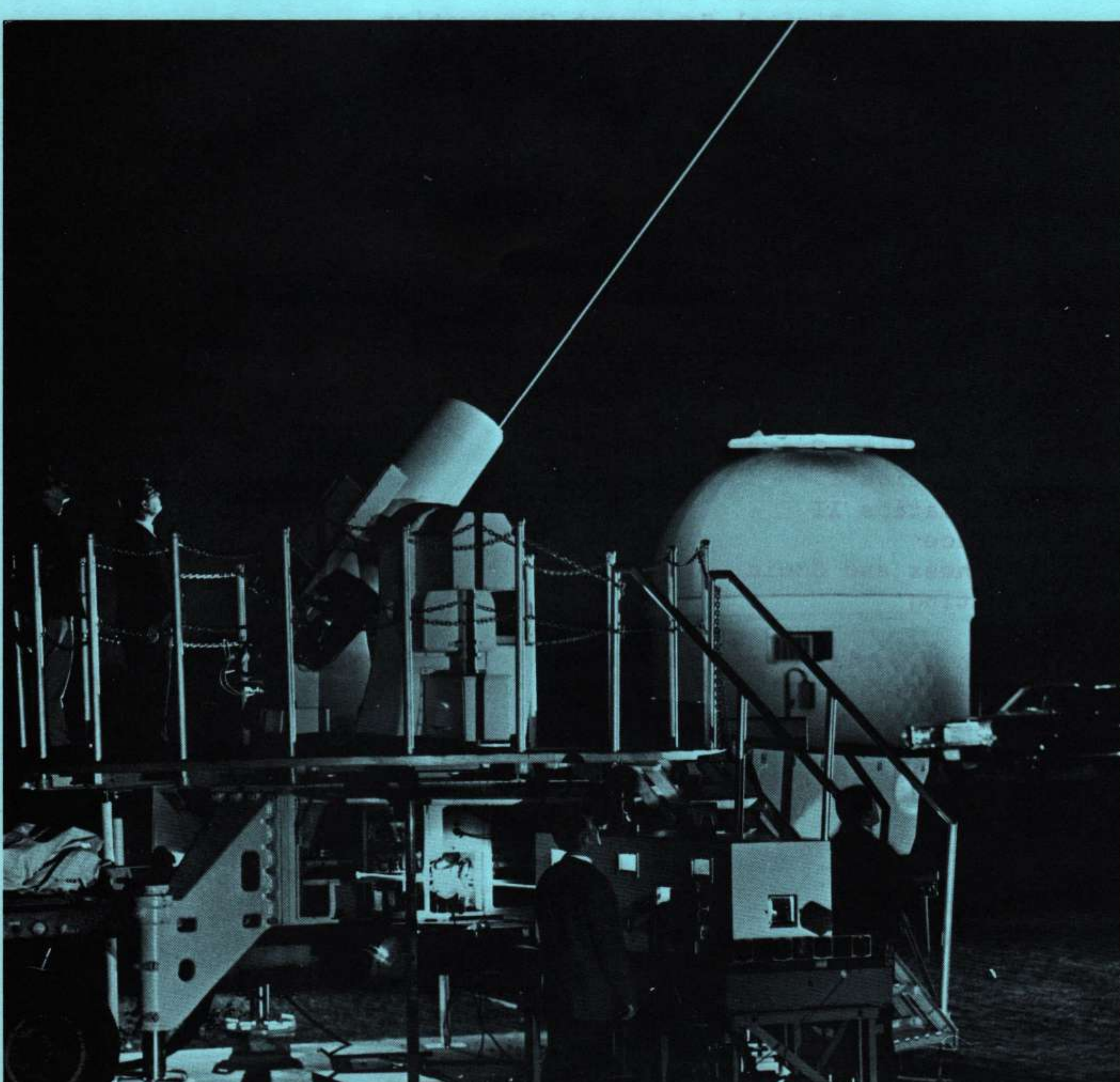
DIGITAL EQUIPMENT CORPORATION

Student Workbook $.30

education

HUNTINGTON II Simulation Program—SLITS



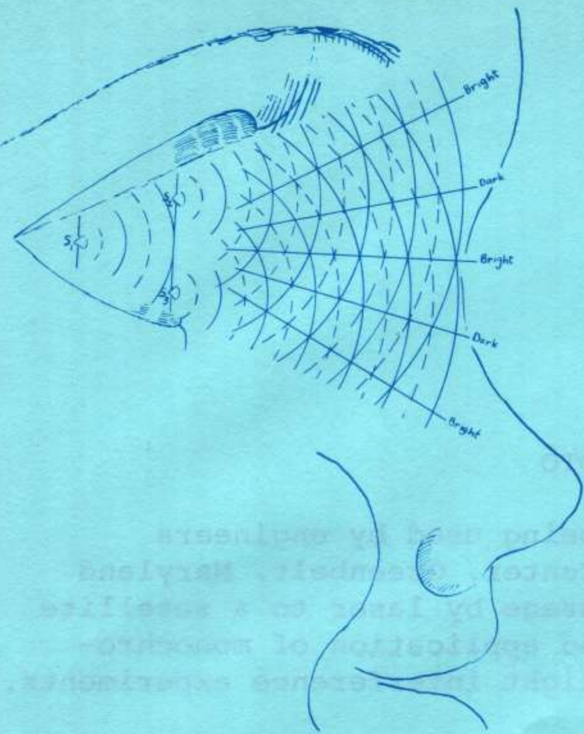
DIGITAL EQUIPMENT CORPORATION
EDUCATIONAL PUBLICATIONS

A partial list of the publications in the continuing series of curriculum material published by Digital for use with EduSystems and RSTS are listed below. Please inquire directly for prices on classroom quantities.

Additional publications may be obtained from:

Software Distribution Center
Digital Equipment Corporation
Maynard, Massachusetts 01754

Populution: Self teaching BASIC Workbook	$2.00
BASIC Matrix Operations, Project Solo	$1.00
Problems for Computer Mathematics	$1.25
Advanced Problems for Computer Mathematics	2.00
BASIC Application Programs	
Mathematics I	$1.00
Mathematics II	1.00
Science	1.00
Business and Social Studies	1.00
Plotting	1.00
Huntington I Application Programs	
MATHEMATICS	$2.00
TEACHER ASSISTANCE	1.00
Huntington I Simulation Programs	
BIOLOGY	$1.00
CHEMISTRY	2.00
EARTH SCIENCE	1.00
PHYSICS	2.00
SOCIAL STUDIES	1.00
Huntington II Simulation Modules	
Student Workbook	$0.30
Teacher's Guide	.30
Resource Handbook	.50
Program Paper Tape	1.00



SLITS

A COMPUTER SIMULATION of YOUNG'S DOUBLE-SLIT EXPERIMENT

STUDENT WORKBOOK

Devloped and programmed by:

Anthony Caggiano
Patchogue High School
Patchogue, New York

Teacher support material written by:

Elizabeth A. Williamson
Northwest Regional Educational Laboratory
Portland, Oregon

HUNTINGTON TWO COMPUTER PROJECT

15 January 1971

The work of the Huntington Two Computer Project is partially support by the National Science Foundation, Grant GW-5883.

COVER PHOTO

A continuous argon laser is being used by engineers of the Goodard Space Flight Center, Greenbelt, Maryland in experiements to send a message by laser to a satellite in orbit. This is an advanced application of monochromatic light used in young's light interference experiments. Photo courtesy of NASA.

NAME ______________________________

SECTION/CLASS ______________________

DATE ______________________________

COMPUTER LABORATORY GUIDE FOR YOUNG'S DOUBLE-SLIT EXPERIMENT

This unit will help you use a computer simulation of Young's double-slit experiment. You will be able to obtain more data than you could in the actual lab experiment and should be able to use it to discover the relationships among the variables in the experiment.

In this computer-lab guide and in the program SLITS, the following variables are used:

Y = relative light intensity

X = distance (in centimeters) from the center of the viewing screen to the point at which light intensity is measured

D = distance (in millimeters) between the slits

W = wavelength (in angstroms) of light source

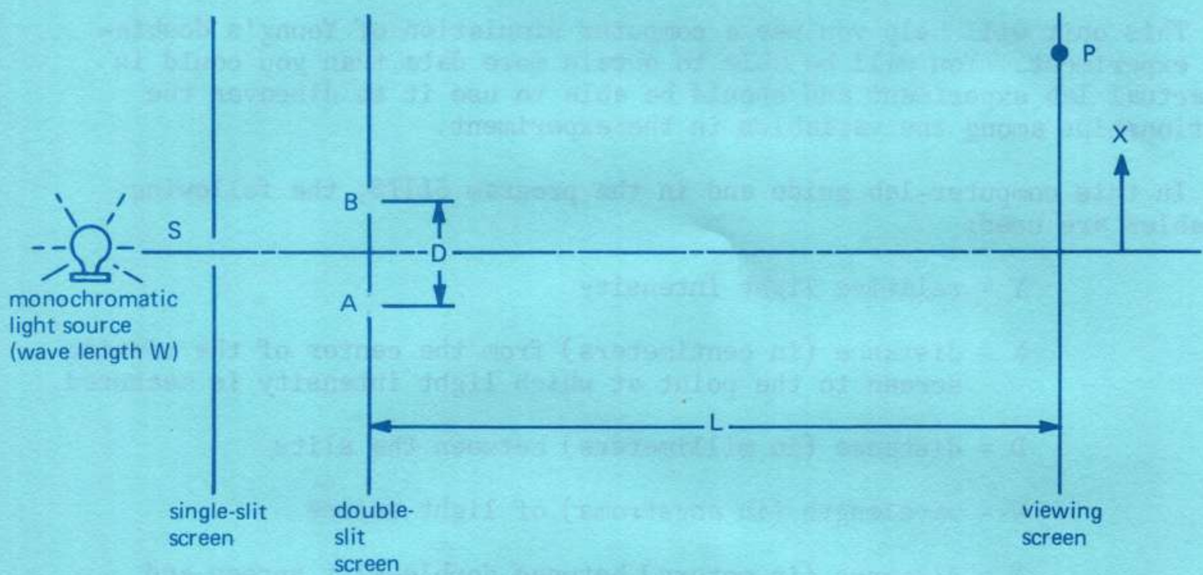
L = distance (in meters) between double-slit screen and viewing screen

Z = distance (in centimeters) between bright bands

These variables are indicated in the diagram on the following page.

1. If you are using the actual apparatus for the experiment before you use the SLITS program, you can record the lab data you obtain in the following format:

W (ang)	L (meters)	D (mm.)	Z (cm.)


P
X
B
S
D
A
monochromatic
light source
(wave length W)
L
single-slit
screen
double-
slit
screen
viewing
screen

NAME________________________________

2. When you use the SLITS program, the quantity Z, distance between bright bands on the screen, will not be measured as such. Instead, the computer will accept values for D, L, and W, and plot a graph of relative light intensity versus distance from the center of the screen. It may help if you interpret distance between bright bands as distance between intensity peaks on the computer's graph.

The program will allow you to fix values for any two of D, L, and W, and vary the third until you have determined how it affects the relative intensity pattern. After you have determined the effect of one variable, use the same procedure to determine the influence of the other two.

Each time a run is made, record the values for D, L, and W in the appropriate spaces, and plot the intensity pattern on the axes provided, which are duplicates of the axes on the computer's graph.

If any questions occur to you, or if you have any hunches during the simulation, write them down.

NAME ____________________

RUN #________

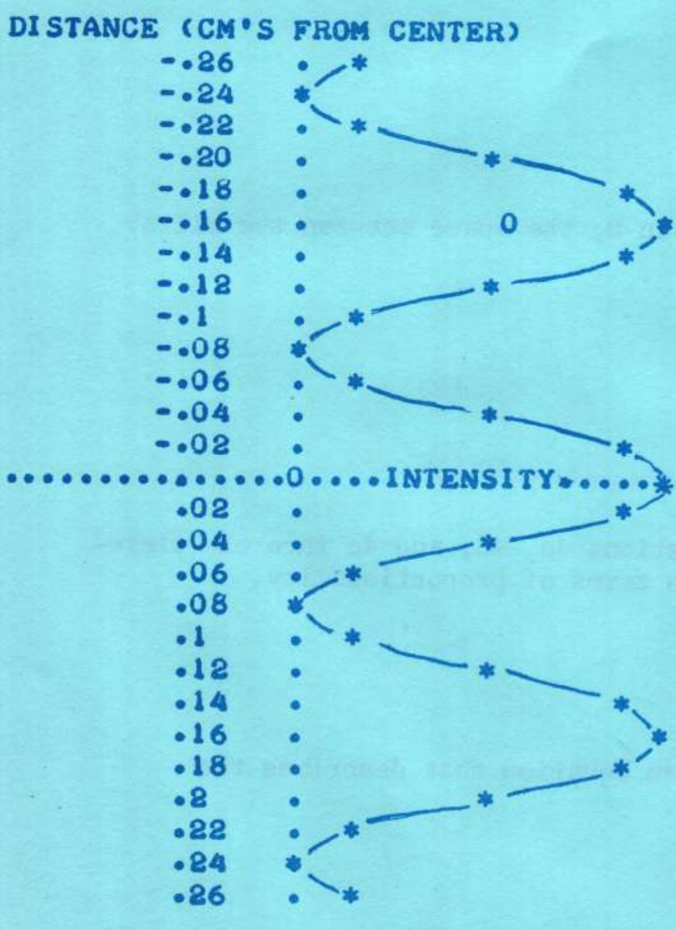
```
L = -----------   W = -------------   D = ------------

DISTANCE (CM'S FROM CENTER)
          -.26   .
          -.24   .
          -.22   .
          -.2    .
          -.18   .
          -.16   .
          -.14   .
          -.12   .
          -.1    *
          -.08   .
          -.06   .
          -.04   .
          -.02   .
.................0....INTENSITY......*
           .02   .
           .04   .
           .06   .
           .08   .
           .1    *
           .12   .
           .14   .
           .16   .
           .18   .
           .2    .
           .22   .
           .24   .
           .26   .
```

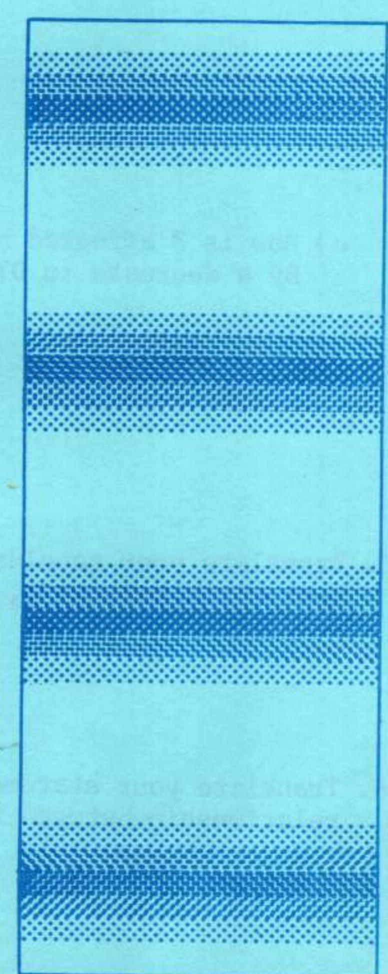
```
RUN #-------

L = -----------   W =------------   D = -------------

DISTANCE (CM'S FROM CENTER)
          -.26   .
          -.24   .
          -.22   .
          -.2    .
          -.18   *
          -.16   .
          -.14   .
          -.12   .
          -.1    .
          -.08   .
          -.06   .
          -.04   .
          -.02   .
.................0....INTENSITY......*
           .02   .
           .04   .
           .06   .
           .08   .
           .1    .
           .12   .
           .14   .
           .16   .
           .18   *
           .2    .
           .22   .
           .24   .
           .26   .
```

Use the following questions to help you analyze the computer data and formalize the relationships you have observed.

3. The graphs generated by the computer can be very easily translated into "pictures" of the viewing screen during an actual experiment in which those specific parameter values were used. The scale, of course, will be changed, but the relative pattern will be the same. The procedure for doing this is described below.

   Suppose the computer graph looked like the one below. In this case, W = 4000, L = 2, and D = .5. You know that the highest points on the graph (points of highest intensity) correspond to bright bands, and that the lowest points on the graph (points of highest intensity) dark bands. Thus you can roughly sketch the pattern that would appear on the viewing screen as is done at the right below.





Go back and sketch the viewing screen patterns for each computer graph in your data.

4. Examine the data carefully, and answer the following questions. In each question, let Z be the <u>distance</u> between peaks of intensity (bright bands).

   a) How is Z affected by an increase in W, the wavelength of the light source? How is it affected by a decrease in the wavelength?

   b) How is Z affected by an increase in L, the distance between the slit screen and the viewing screen? How is is affected by a decrease in L?

   c) How is Z affected by an increase in D, the space between the slits? By a decrease in D?

5. Translate your conclusions from questions 4a, 4b, and 4c into one statement which relates Z, W, L, and D in terms of proportionality.

6. Translate your statement in 5 into an equation that describes the relationship between Z, W, L, and D.

7. Determine the values for any constant(s) which appear in your equation for 6 by substituting known values of Run #1 for the variables Z, W, D, and L. (How will you find the value of Z?)

8. Would you expect the values of Z, W, D, and L from Run #2 to lead to the same or a different constant? Try it.

9. The computer simulation allowed you to examine an additional variable in this experiment, namely the relative intensity of the bands on the viewing screen. You may have had a feeling that the graphs typed by the computer looked strangely familiar, and that despite their different appearance, they shared some common traits.

   a) Assign a y-value of 0 to the lowest intensity points plotted on the graphs, and assign a y-value of 1 to the highest points plotted. Then examine the graphs, and write down any characteristics you notice that are common to all intensity graphs.

b) To jog your memory a bit, sketch a graph for each of the following trigonometric functions. (next page)

c) Which of the above equations describes a graph which is most like the general pattern of the intensity graphs?

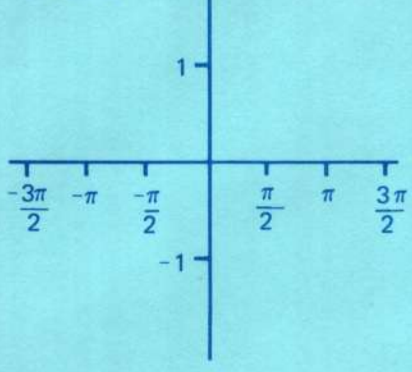
d) For the equation you have chosen in part c what is the value of X that makes Y have its largest value?

e) The fact that the computer graphs, in effect, stretch and shrink lengthwise implies that some variable must be included in the equation which would control the period of the curve. Where in the equation you selected above would this variable fit? Write the general form of the equations that describes the intensity graph.

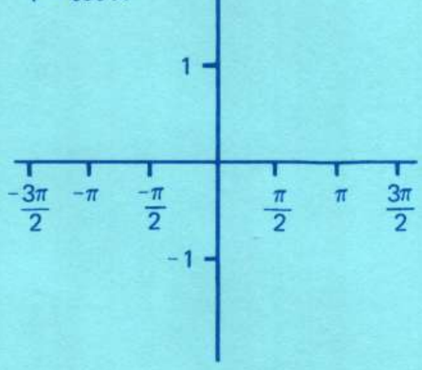
f) Can you combine the equation e) with what you learned in questions 7 and 8 to write the actual relationship between the relative intensity on the screen and W, X, L, and D for the Young's double-slit experiment? (Hard thinking!)

NAME: ______________________

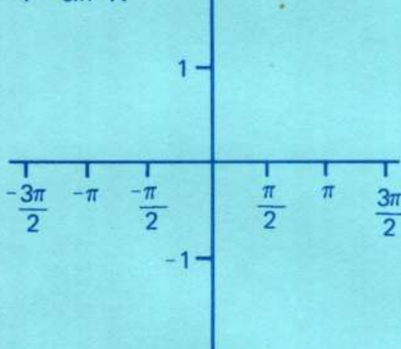
$Y = \sin X$



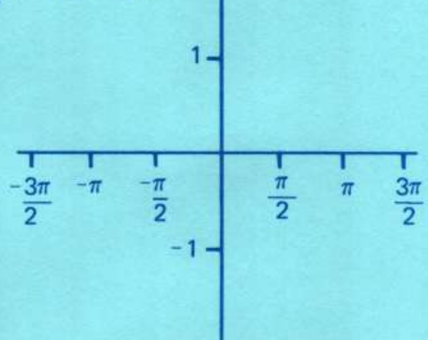
$Y = \cos X$



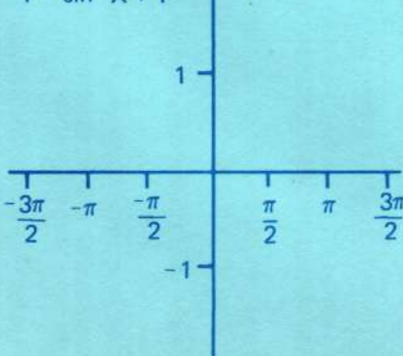
$Y = \sin^2 X$



$\frac{1}{2}(1 + \cos X)$



$Y = \sin^2 X + 1$



$Y = \cos^2 X + 1$