

WORKBOOK TO DEVELOP VISUALIZATION

A special project report

by

B. K. Chakravarthi

guide

Prof. U. A. Athavankar

Industrial Design Center

Indian Institute Of Technology

Powai Bombay 400 076

March 1988

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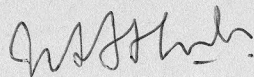
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APPROVAL SHEET

The special project titled "WORKBOOK TO DEVELOP VISUALIZATION " by B. K. Chakravarthy is approved in partial fulfilment of the requirement for M.Des degree in Industrial design.

Signature



Date

Guide:

ACKNOWLEDGEMENT

I, sincerely thank prof U. A. Athavankar for his valuable guidance and encouragement throughout this project

I, also, sincerely thank all concerned faculty, staff and my fellow class mates for their kind help extended for this project

B . K . CHAKRAVARTHY

CONTENTS

1. INTRODUCTION

2. METHODOLOGY

3. BIBLIOGRAPHY

4. ANNEXURE

*Roger N. Shepard, Professor of
Psychology at Stanford University,
recently described his personal mode of
creative thought during which research
ideas emerged in his mind as
unverbalized, essentially complete,
long-sought solutions to problems.*

*"That in all of these sudden
illuminations my ideas took shape in a
primarily visual-spatial form without, so
far as I can introspect, any verbal
intervention is in accordance with what
has always been my preferred mode of
thinking Many of my happiest hours
have since childhood been spent absorbed in
drawing, in tinkering, or in exercises of
purely mental visualization."*

-- Roger N. Shepard

*Visual learning, thinking, and
communication*

INTRODUCTION

INTRODUCTION

Although visual abilities are not democratically endowed, differences in inherited aptitude do not afford a rationale to deny visual education. What ever the inheritance, the unrealized potential for visual development is great. Even the visually apt have room for improvement; writes psychologist MacFarlane Smith, "Our current system of education actively discriminates against the student who is competent in spatial ability." Given a one sided education in the 3R's (Arithmetic, Reading & Writing), most people possess a large unrealized potential for visualization. Almost everyone can learn to see more fully, to imagine more productively, and to express their visual ideas by drawing.

Visualization pervades all human activity, from abstract

to theoretical to the down-to-earth and every day. An astronomer ponders over a mysterious cosmic event, a foot ball coach considers a new strategy; a motorist maneuvers his car along a unfamiliar pathway: all are thinking visually. You are in the midst of a dream; you are making order out of disarray on your desk: you are thinking visually. Surgeons think visually to perform an operation chemists to construct molecular models; engineers to design circuits, structures, and mechanisms; businessmen to organize and schedule work; architects to coordinate function with beauty; carpenters and mechanics to translate plans in to things.

Now let us see what the dictionary meaning for visualize is, it says "To make perceptible to the mind or imagination, To form a mental image of, To call up or form mental images. Visual thinking is made up of a series of visualizations which in turn result due to a lot of mental operations.

The upmost advantage of visual thinking is that while we are hearing, smelling, or touching, we are also seeing; and the brain which constantly seeks to simplify information for us, sets up visual clues along with other clues, enabling us to substitute vision for our other senses. The most important function for the brain is to sort or identify quickly our experiences using the most efficient sensory mechanism. Consider this example "Look at the picture of the large, sculptural water fountain in the middle of the park". The reflections of the water as it spills and sprays over the edge of the fountain is our visual picture but at the same time, we experience damp coolness and the pattern of the falling drops. Even if this fountain is only a small part of this picture, our eyes are invariably drawn towards it because it is visually symbolic of all the sensual pleasures. Therefore, visual images are powerful by the way they represent experiences using the other senses.

"A monk asked his teacher, 'What is myself?' The teacher answered, 'There is something deeply hidden within you, and you must become acquainted with its hidden activity.' The monk then asked to be told what this hidden activity was. The teacher just opened and closed his eyes

--- Frederick Franck

The zen of seeing

"To be shaken out of the ruts of ordinary perception, to be shown for a few timeless hours the outer and inner world, not as they are apprehended, directly and unconditionally, by Mind at Large -- this is an experience of inestimable value to everyone."

-- Aldous Huxley

The Doors of Perception

METHODOLOGY

METHODOLOGY

The workbook's main aim is not to test but to develop the ability of visualization.

The exercises were developed considering the basic mental operations of visualization-that is some of the active ways that visual images are formed and manipulated spatially. Psychologists who study and test mental ability have discovered that visual thinking involves a number of visual-spatial operations. L.L. Thurstone ,a pionner in the development of Psychological tests, writes:"As a result of factorial studies during the last two decades, we no longer speak of visualizing as a single trait. We know some seven or eight primary factors that are quite distinct and which are all related to visual thinking."

To understand how good a person was in understanding the third dimention and visualizing the tool used was games. These games which were essentially building blocks type would always activate the right hemisphere of the brain. The right hemisphere of the brain does the work of visual spatial relationships.

The games used were

1. Superfection : In this game there are a number of negative and positive pieces, out of the lot a positive and negative piece has to be selected such that it forms a cuboid.
2. Tangram: In this game there are seven pieces using which different shapes have to be made
3. Metal ring puzzles: In this game there are inter locked metal rings which have to be separated out
4. Game maker: In this game there are fifteen pieces with regular shapes. After selecting one piece the other pieces have to be arranged in such a way that they form triple the size of the selected piece

These games were given to a variety of people all graduates. The problems they faced the way of tackling, the approach etc while playing were observed. After this by brain storming exercises were created, these exercises were separated out into different kinds. The groups were further polished by referring to the book "EXPERIENCES IN VISUAL THINKING " by Mackim

The five kinds of exercises developed take the subject gradually from manipulating in two dimensions to manipulating in three dimensions.

This approach was taken because everybody is confident with two dimensional things on two dimensional surfaces but the problem comes when we have to depict three dimensional things on two dimensional surfaces

The four kinds of exercises are:

1. TWO DIMENSIONAL MANIPULATION:

It involves mainly rotations, pattern seeking, matching etc.

2. ORTHOGRAPHIC IMAGINATION

It involves the building up of three dimensional objects from orthographic views.

3. PERCEPTION OF NEGATIVE SPACES

It involves the matching of spatial relationships.

4. THREE DIMENSIONAL MOTION

Imagery in three dimensional motion is very important for visualizing.

BIBLIOGRAPHY

EXPERIENCES IN VISUAL THINKING

ROBERT.H.McKIM

STANFORD UNIVESITY

DRAWING ON THE RIGHT SIDE OF THE BRAIN

BETTY EDWARDS

FONTANA / COLLINS

FIGURES FOR FUN

YA. PERELMAN

MIR PUBLISHERS

SCIENTIFIC AMERICAN

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WORK BOOK TO DEVELOP THE ABILITIES OF VISUALIZATION

By B. K. Chakravarty (Supplement to
Spl. Project Report)

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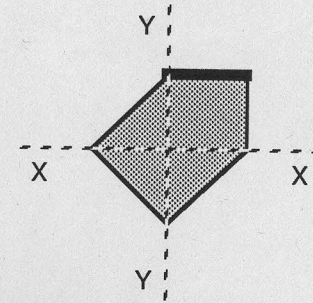
THE KINDS OF EXERCISES

1. TWO DIMENSIONAL MANIPULATION
2. ORTHOGRAPHIC IMAGINATION
3. NEGATIVE SPACE PERCEPTION
4. THREE DIMENSIONAL MOTION

1.TWO DIMENSIONAL MANIPULATION

Here a single sample exercise is given. Further exercises can be developed by increasing the complexity gradually

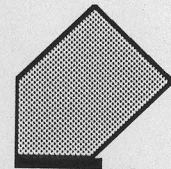
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Study the polygon with the darkened side.
Take the mirror image of the polygon along "yy" axis.
Then rotate the mirror image of the polygon in
anti clockwise direction through 90 degrees.
Choose the resulting polygon from the alternatives,

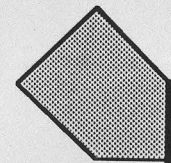
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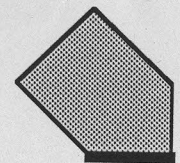
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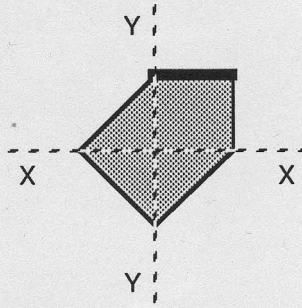


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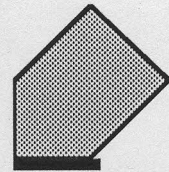
PROBLEM: 1



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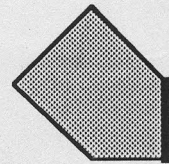
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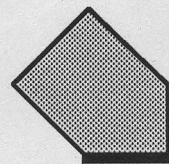
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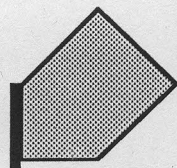
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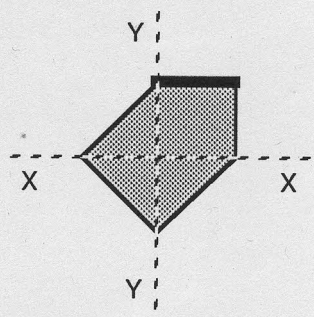


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D



PROBLEM: 1

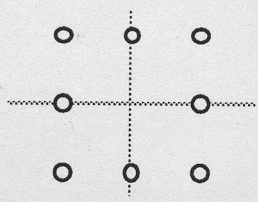


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Then rotate the mirror image of the polygon in
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Choose the resulting polygon from the alternatives,

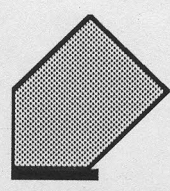
YOU ARE WRONG

In taking the mirror image,
do it by using the grid
and then execute
the rotation

CLUE



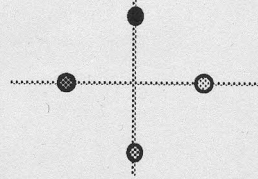
A



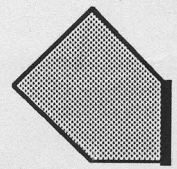
YOU ARE WRONG

Consider the points on the
axis-x & y, rotate these points
and build up the sides

CLUE



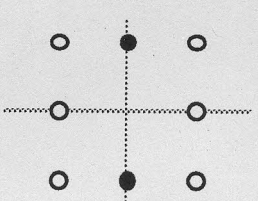
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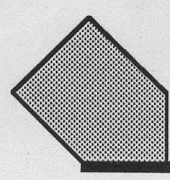
YOU ARE WRONG

Using the grid get the mirror
reflection keeping the points
on 'y' axis same.
Then execute the rotation

CLUE



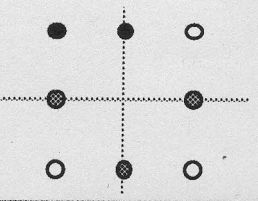
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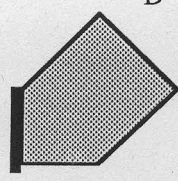
YOU ARE RIGHT

The mirror image along
'y' axis is shown by the
filled dots, the dark dots
depict the dark side

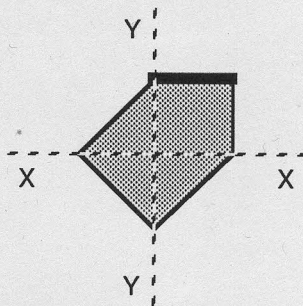
CLUE



D



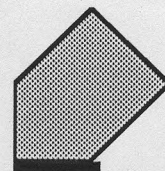
PROBLEM: 1



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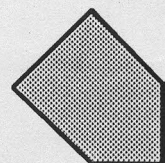
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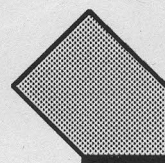
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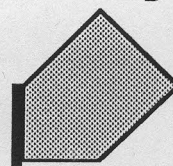
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C



OPEN IF YOU HAVE CHOSEN 'D'

D

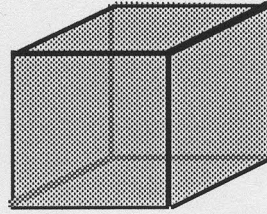


2. ORTHOGRAPHIC IMAGINATION

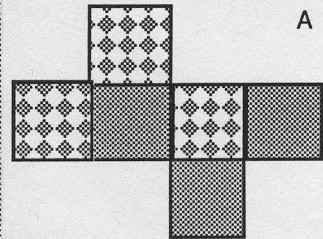
In this kind three sample exercises are given. The exercises show the levels of complexity.

PROBLEM 1

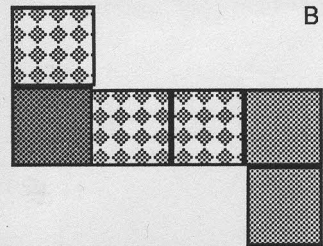
Consider the cube shown in figure
it is such that three sides of the cube
around a vertex have same shading
so there are two types of shadings
From the alternatives find the
correct undeveloped surface



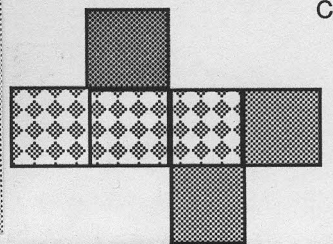
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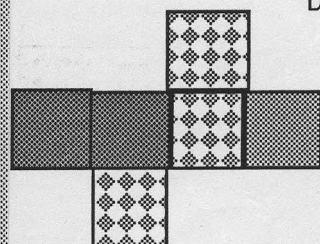
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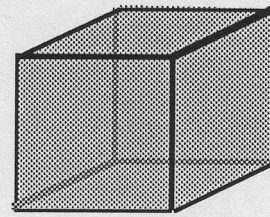


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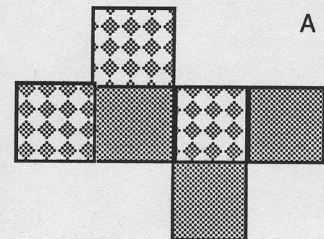
PROBLEM 1

Consider the cube shown in figure
it is such that three sides of the cube
around a vertex have same shading
so there are two types of shadings
From the alternatives find the
correct undeveloped surface



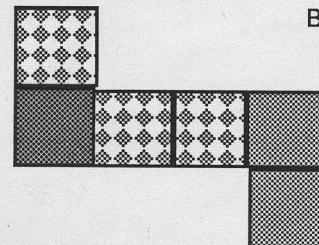
YOU ARE WRONG

TRY TO VISUALIZE A EMPTY
CUBICAL BOX WITH THE
REQUIRED SHADINGS INSIDE THE
BOX. THEN OPEN IT



A

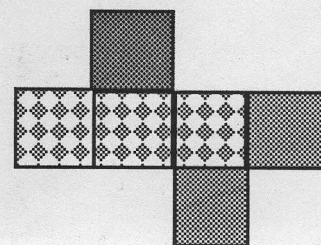
YOU ARE CORRECT



B

YOU ARE WRONG

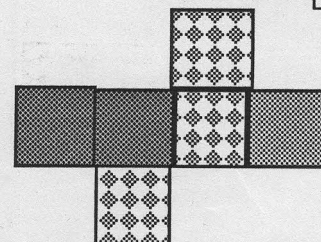
CONSIDER ONLY ONE SHADE
THEN TRY TO FIND OUT
IF THE SIDES DEVELOP
TO HAVE A COMMON VERTEX



C

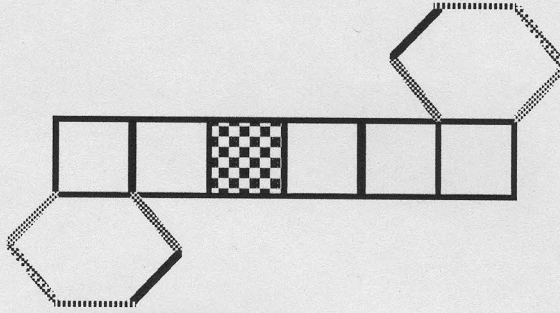
YOU ARE WRONG

IF THE 3 SHADED SIDES ARE IN A ROW
THEN THEY CANNOT SHARE A VERTEX



D

PROBLEM 2



The development of a hexagonal prism is shown in the figure. The sides of the top and bottom hexagon are marked. Find out which sides of the top and bottom hexagon does the shaded square match with on development.

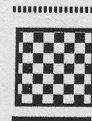
OPEN IF YOU HAVE CHOSEN 'A'

A



OPEN IF YOU HAVE CHOSEN 'B'

B



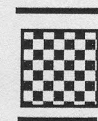
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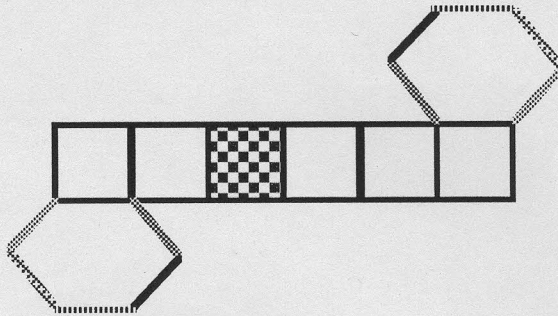


OPEN IF YOU HAVE CHOSEN 'D'

D



PROBLEM 2



The development of a hexagonal prism is shown in the figure. The sides of the top and bottom hexagon are marked. Find out which sides of the top and bottom hexagon does the shaded square match with on development.

YOUR ANSWER IS WRONG

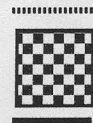
Try to visualize a simple development such as that for a cube. Take notice of the vertices and solve the problem.



A

YOUR ANSWER IS RIGHT

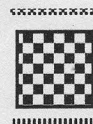
The development becomes very easy when you consider the shaded side as your front side and start



B

YOUR ANSWER IS WRONG

Take the bottom hexagon and then start the development.



C

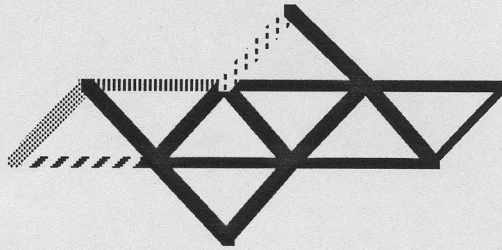
YOUR ANSWER IS WRONG

Try to roll the hexagons on the sides what do you achieve



D

PROBLEM 3



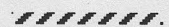
The above figure shows the eight sides of a octahedron. Find out from the alternatives which of the shaded sides does the thin side meet.

A



OPEN IF YOU HAVE CHOSEN 'A'

B



OPEN IF YOU HAVE CHOSEN 'B'

C



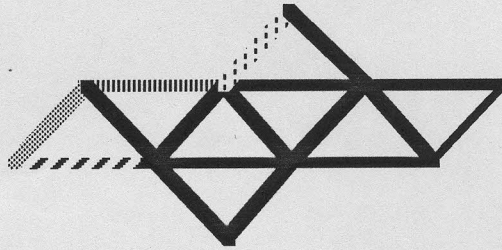
OPEN IF YOU HAVE CHOSEN 'C'

D



OPEN IF YOU HAVE CHOSEN 'D'

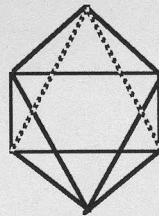
PROBLEM 3



The above figure shows the eight sides of a octahedron. Find out from the alternatives which of the shaded sides does the thin side meet.

YOU ARE CORRECT

On development the octahedron will look like

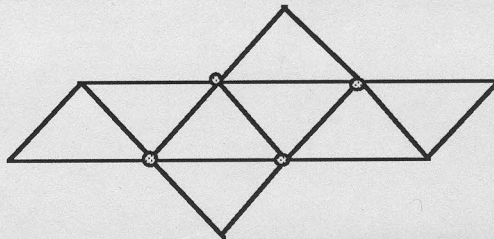


A



YOU ARE WRONG

Consider these points for executing the development



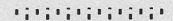
B



YOU ARE WRONG

Try to build the octahedron by considering the centre triangles to reced such that the other triangles wrap round

C



YOU ARE WRONG

What will happen to the sides with out the vertex point

D



