Structure and Working of Science Models

37 TH JAWAHARLAL NEHRU NATIONAL SCIENCE EXHIBITION FOR CHILDREN

Jaipur, Rajasthan

2010

The Spirit of Science

Most countries normally do not like to change. The human being is essentially a conservative animal. He is used to certain ways of life and any one trying to change them meets with this disapproval. Nevertheless, change comes and people have to adapt themselves to it. They have done so in the past.

– Jawaharlal Nehru

Structure and Working of Science Models 2010

विद्ययाऽमृतमश्नुते
एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

November 2010
Kartika 1932

PD 7T OP

Publication Team

Editorial : Om Prakash

Production : _____

Cover : Amit Srivastava

Published at the Publication Department by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016 and printed at Gita Offset Printer, C-90, Okhla Indl. Area, Phase-I, New Delhi - 20

Preface

The learning of Science is instrumental in developing well-defined abilities and skills such as spirit of enquiry, creativity, objectivity and aesthetic sensibilities among children. They learn through interactions with the environment around, nature, thing and people. The structuring of ideas is one of the essential features as children progress in learning. They actively engage with the world around them in exploring, responding, inventing, working things out and interpreting. Science Exhibitions offer an opportunity to the students to express and exchange their creative ideas with joy of scientific investigation. It helps them to learn the methods of science, provide them with opportunity to develop their problem-solving skills and creative abilities.

The National Council of Educational Research and Training (NCERT) organises the Jawaharlal Nehru National Science Exhibition for Children (JNNSEC) as an annual event in collaboration with a State or Union Territory. The JNNSEC is the culminating activity of a series of exhibitions organised at school, zonal, district, regional and state levels. A large number of students and teachers participate in such events.

The present publication i.e., "Structure and Working of Science Models" includes write-ups of a few exhibits selected for display in the 37th JNNSEC being organised in Jaipur, Rajasthan. Other materials like List of Exhibits which contains the titles and synopsis of almost all the exhibits selected for JNNSEC 2010 along with an information brochure stating objectives and other details of exhibition have also been published. It is expected that these publications will motivate and help children to participate in future Science Exhibitions.

The write-ups included in this publication were selected out of the entries received from all the state/UT's agencies. These were reviewed and edited by Professor R.S. Sindhu, Professor V.P. Srivastava, Dr V.P. Singh, Dr Dinesh Kumar, Dr Gagan Gupta, Dr A. K. Wazalwar, Dr R. K. Parashar, Dr Anjani Koul,

Dr P.K. Chaurasia, Dr C.V. Shimray and Ms Sunita Varte of the Department of Education in Science and Mathematics (DESM) of NCERT. I appreciate their sincere efforts. I also thank Professor B. K. Tripathi, who initiated the work of the Exhibition this year.

I appreciate and specially thank Dr Dinesh Kumar for Coordinating the 37th JNNSEC - 2010 and seeing this manuscript through the press. I also thank the Publication Department, NCERT for the cooperation in bringing out this publication.

HUKUM SINGH
Professor and Head
DESM
National Council of Educational
Research and Training

New Delhi
November 2010

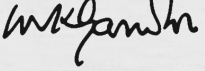
CONTENTS

Gandhiji's Talisman

I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test:

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to Swaraj for the hungry and spiritually starving millions?

Then you will find your doubts and your self melting away.



7

THE WORKING MODEL OF ROOTS OF QUADRATIC EQUATION

STUDENTS
Shah Charmi K.
Pancholi Bhargavi B.

L. H. H. & J. M. T. Sarvajanik
Kanya Vidyalaya
Sankheda
Baroda

TEACHER
Mrs Anuradha

INTRODUCTION

The general form of a quadratic equation is

$$ax^2 + bx + c = 0 \text{ where } a \neq 0,\ a, b, c \in R.$$

$b^2 - 4ac$ is called discriminant and is represented by 'D'.
If α and β are two roots of this quadratic equation,

then, $\alpha = \dfrac{-b + \sqrt{D}}{2a}$ and $\beta = \dfrac{-b - \sqrt{D}}{2a}$

Or,

$$\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \text{ and } \beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

- If $D > 0$, then the roots of equation will be different and real.
- If $D = 0$, then the roots of equation will be real and equal.
- If $D < 0$, then the roots of equation will not be real numbers.

MATERIALS REQUIRED

Plywood sheet (80 cm 40 cm), three strips of wood, two small wooden strips, copper wire, 9 volt battery, LED lamps and colours.

CONSTRUCTION AND WORKING

First we arrange the three strips of wood on which numbers are indicated in figure 1. On the plywood in horisontal direction, upper

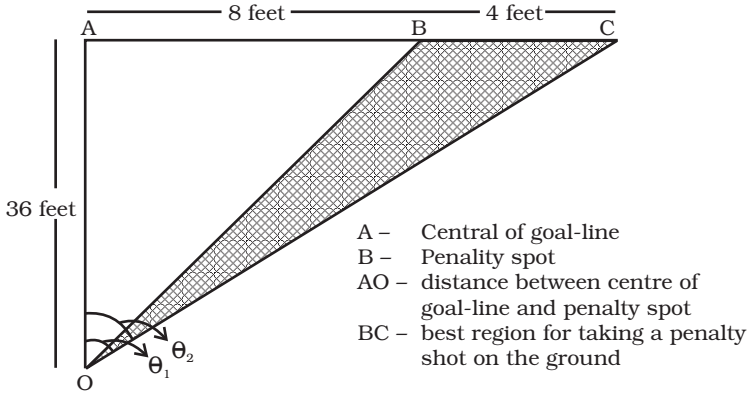


Fig 2

In ΔAOB right angled at A,

$$\text{Tan}\,\theta_1 = \frac{AB}{AO} = \frac{8}{36} = 0.222$$

This gives

$$\theta_1 = 12.5^0$$

Also, in ΔAOC right angled at A,

$$\text{Tan}\,\theta_1 = \frac{AC}{AO} = \frac{12}{36} = 0.333 \text{ or, } \theta_1 = 18.4$$

Hence, we find that if a player wants to take a penalty kick in such a way that the ball goes within the best region, he should shoot the ball in such a way that it is more than 12.5 and less than 18.4 . This will ensure the ball entering the goal with a high success rate of beating the outstretched hands of the goalkeeper.

Figure 3 depicts the value of the angle for which the ball taken by a player during a penalty kick on the ground goes exactly at a distance of 1 feet away from the goal post.

Taking into account that a fully stretched goalkeeper of 6.5 feet height is 8 feet, a semi-circle of this radius with the centre of the goal-line as the centre is drawn and is represented by the shaded region as can be seen from Figure 4. This region indicates the region which is well within the goalkeeper's outstretched hands, thereby making the chance of the ball entering the goal very small, which thus indicates that it is not a good region for taking a penalty kick either on the ground or in the air.

The shot in the air has two components of error—vertical and horizontal components. The vertical component tells us that the height of the ball must be at least greater than 6.5 feet i.e., higher than the tallest goalkeeper (in this case, we have taken 7 feet i.e., 1 foot below the cross-bar). The horizontal component of error is similar to the error for taking penalty on the ground. These two will combine to create a region very difficult if not impossible for a goalkeeper to cover during a penalty shot.

Figure 5 shows the best angle for taking a penalty shot in the air such that the ball is just 1 foot below the cross-bar and 1 foot away from the goal-post.

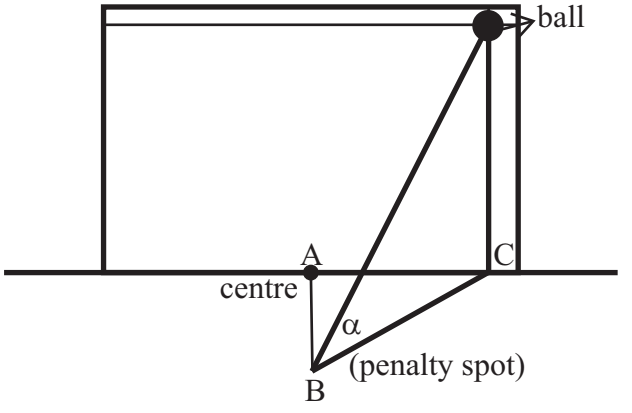


Fig 5
Best angle for taking a penalty kick in the air

From Figure 5, In ΔABC right angled at A,
$BC^2 = AC^2 + AB^2$, BC = 37.6 feet

In ΔBCD right angled at C, $\text{Tan}\,\alpha = \frac{DC}{BC}$, where α is the angle between the point C (1 foot away from the goal post) and the point

It turns out that the angle θ has a special mathematical relationship with sides 'a' and 'b'. Then $\frac{a}{b}$ is equal to the tangent of the angle θ.

Example: Find the height of tower whose angle is 29 and baseline is 575 m.

Solution: Let b and a be the baseline and perpendicular sides height (a) = ?

baseline (b) = 575m

Angle θ = 29

By using equation $\text{Tan}\,\theta = \frac{a}{b}$,

$$\text{Tan } 29 = \frac{a}{575} \Rightarrow a = 319m$$

CONSTRUCTION AND WORKING

By using this device called inclinometer (Fig. 2), we can observe the invisible height of any mountain, tower, building etc. The eye piece is observer and top of tower is the object. The imaginary line (represented as dotted line) is called line of sight and the line from the fort of tower to the eye piece is called baseline (or horizontal).

By using equation $\text{Tan}\,\theta = \frac{a}{b}$ (1)

Where a = height of tower
b = baseline
θ = angle

from (1) reduce as

$$a = b \tan \theta \quad (2)$$

If we know the length of baseline and angle, we can easily find out the height of any tall building, tower, etc. But in calculation some error may be occur but if it is very small in value then neglect the value. Therefore, by using an inclinometer invisible height (or altitude) of any tall building or tower is measurable.

I do believe firmly that the only right approach to the world problems and to our national problems is the approach of science, that is to say, of the spirit of science and method of science...

– Jawaharlal Nehru

विद्ययाऽमृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING