A Problem Play*

A Musical Mathematics Play In One Act and Three Scenes

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Cast of Characters

Alice—A Junior High School child about 12 years old.
Margery—Her friend, same age.
Dorothy—Another school friend.
Tom, Dick, David—Boys in same class.
King Math of Numberland
Guards in the King's palace.
Numbers from 1 to 0.
Plane and Solid Figures—Sq. Rectangle, Parallelogram, Triangle, Hexagon, Circle, Cube, Octagon, Rectangular Prism, Cone, Cylinder.
Dream Fairy

Scenery

The living room scene may be managed by two plain brown screens. In front of these is a table with a chair on each side. The two girls are working with their books and papers piled around. The door at the side may be the right wing of the stage or another screen may form an entrance-exit there.

For the palace in Numberland, plane figures of harmoniously colored cardboard may be attached to a back drop. The throne is a chair set on a small platform and covered with plain cloth on which has been painted in silver tools used in mathematics—compass, protractor, rule, angles, stars made by triangles, circles, etc.

Around the throne are the two screens turned to the opposite side on which have been fastened linen or cardboard hangings painted with geometric designs like mosaics or tiles in a variety of colors.

The piano which helps the chorus sing in tune and dance in rhythm is off stage or down below if in an auditorium.

Costumes

Alice and Friends—Ordinary school dress.
Dream Fairy—Usual fairy's costume.
Guards—Grey material makes a doublet-like jacket with long sleeves; trousers like shorts—on them are painted the four signs of the fundamental operations, $+ - \times \div$. The head piece is a triangular pyramid of cardboard silvered with a visor effect. Silver cardboard sword. Shoes with long points can be made of grey material.
King—Usual costume of royalty, only instead of black ermine tails, have numbers on white "fur" banding.
Numbers—Clown costumes—black and white with numbers forming a design. Stenciled or printed.
Plane Figures:
Square—Silver band around head with a silvered square front and back. Small silvered squares like coat of mail—front and back on grey material basically like the guards' costume.

* This play was the idea of a 7-B Junior High School class of a socialized mathematics lesson. The children suggested the idea, contributed two of the poems and some few lines of the dialogue, chose some of the tunes, and decided on the type of dances. The play was written by the teacher who was a music supervisor before the depression. Now music and mathematics are the subjects taught by her in the Robert E. Lee Junior High School of Baltimore.

The costumes and head dresses were designed by her and executed with the help of the children of the class. The guard costumes were cut out and sewed by a 9-B class under the direction of their sewing teacher in their regular period, material was bought and paid for by each child.

The King and the Dream Fairy provided their own costumes.

Cardboard and screens were furnished by the school.

Ninth grade boys designed and executed the palace background on cardboard and attached the sections to one side of the screens.

The Art, Music and Domestic Science departments in a large Junior High School could make this a correlated project.

Rectangle—Similar—only rectangles in place of squares.

Triangle—Same idea.

Parallelogram—Same idea.

Circle—Head dress same idea as others.

Hexagon—Huge figure—front and back of blouse.

Octagon—Smaller figures on skirt or trouser legs. Shield if desired in respective shape—spear.

Solid Figures:

Cube—Make a cardboard box to fit head—silvered. Same on a spear. Grey blouse and shorts or skirt.

Rectangular Prism—Get a large box. Cover with silver paper or paint. Use small boy. Make holes for eyes and mouth. Paint face. Let boy wear it over his head.

Cone—One with circular base as head dress painted silver. Tin cones sewed on blouse.

Cylinder—Large Quaker Oats box used for display by grocers—silvered or covered with colored paper as desired. Same method as prism.

A PROBLEM PLAY

Act 1

Scene 1

(*Living Room. Alice and Margery are found working at a table with books, papers, and pencils in hand doing homework, especially arithmetic. A chorus is heard off stage singing "I can't do that sum."*)

***** Off stage:

"Once there was a little girl
And her name was Alice.
(*Recitation*) She didn't like arithmetic
So treated it with malice."

Alice: Impossible! This problem is beyond me.

Margery: Oh, the eighth one. Yes, I must confess I can't make heads or tails of it. (*She jumps up.*) I have a book at home which explains every kind of problem. I know just where it is, so I'll run out and get it. (*She leaves.*)

Alice: Oh, dear, I'm tired and sleepy. (*Yawns and puts her head on the table. Dream Spirit appears, dances about the room and beckons. A group of children come in doing a geometric dance. They are the numbers 1 to 0, dressed in clown costumes. The music for this interlude is "I can't do that sum" from "Babes in Toyland." They sing the song and dance out. Alice sits up and begins work again. The door opens and in comes Margery with some boys and girls.*)

Alice: Oh, hello, boys, where did you come from?

Margery: I couldn't find the book anywhere but I thought maybe the boys could help us solve the problem. Come around the table. Alice, you read that problem.

Alice: Did any of you boys get it to come out right? I mean, to prove?

Dick: No, we thought that you could help us because we were stumped.

Alice: All right—here goes. If $\frac{2}{3}$ of a number is 128, what is $\frac{5}{6}$ of the number?

Dot: Oh, I remember. You take $\frac{1}{2}$ of 128 and multiply by 3 and then take $\frac{5}{6}$ of the answer.

David: You're off. What's $\frac{1}{2}$ got to do with $\frac{2}{3}$ and what has 5/to do with 6ths?

Dick: Well, how about $\frac{5}{6}$ of 128?

Tom: Oh, yea! 128 isn't the number. They want to know the real number.

Dot: You're all wrong. It's as plain as A B C. You find the number, then $\frac{5}{6}$ and there you are.

Ken: You're not right.

Dot: I am right. I'll bet on it.

Tom: Well, we can try it. If it proves, it has to be right.

Alice: O.K. Let's see who can get it and prove it first. (*They gather around the table and begin work. A bell is heard outside.*)

Tom: I bet another one of the gang is stuck.

Dick: Guess it must be Arty. (*Alice goes to the door. She returns much excited.*)

ALICE: Oh, the queerest group is outside. I'm afraid to let them in. Oh, here they are. (*Four guards dressed in grey jackets and silver head dresses on which are painted the four signs—addition, subtraction, multiplication and division.*)

CHO. OF CHILDREN: Well, who do you think you are?

GUARDS: We are King Math's men.

CHO.: Ho, ho, ho. Tell us another.

ALICE: Who is King Math?

GUARD: King Math is King of Numberland.

TOM: And where is Numberland? Anywhere near Cumberland?

CHO.: That's a good one!

GUARD: Numberland is a magic land and never on any map. It's in your head —that is, if you are clever enough.

DOT: How do *we* get there as we don't seem to be so clever?

GUARD: We came to take you there to show you how simple and speedy it is.

TOM: Ladies and Gentlemen—get your magic cloaks. You are about to travel. Here we go a-sailing, a-sailing, a-sailing right up to the moon.

GUARD: But you are going. And in a magic balloon. Come. It is getting late. You will have to hurry for King Math is awaiting your arrival. Attention! (*Guards salute, turn and form in line.*) Follow us, boys and girls and watch your step. (*Group look at each other. Suddenly Alice starts after the guards.*)

ALICE: Who's a good sport? I'm ready to go because I want to know how easy that stuff can be. If he says so, it must be so.

CHO.: This way—clear the way—hail, hail, the gang's all here. (*Tune is played and they sing.*)

"Hail, hail, the gang's all here,
We're going to find our numbers!
We're going to find our numbers!
Hail, hail, the gang's all here!
We're going to Numberland!"

SCENE 2

(*Palace of King Math in Numberland. Walls covered with geometric figures, arithmetical signs, tools used in mathematical work. The group of boys and girls rushes in with hair tousled and much out of breath.*)

ALICE: Whew! I never dreamed that we could go so fast. Look at your hair, Dot! It is almost straight up.

DOT: Look at yours—your pigtails are raveling out.

TOM: Say, look at these walls. See anything familiar? There is an oblique parallelogram. Dick, what's the formula?

DICK: Quit that. I can't remember formulas after going through the air 100 miles a minute.

MARGERY: Look at the different kinds of triangles they use here for a decoration. They are certainly smart. Angles, angles, everywhere and not a curve to slide around.

ALICE: Certainly there are curves—look at the circles on the ceiling. As long as it is King Math's palace, he can't omit anything.

DICK: You're right. If they could omit some things maybe we would not be worrying so every night.

GUARD: You'll never worry again. After you see the parade and learn all the history of math, you'll go home rejoicing and be proud of yourselves. (*A trumpet is heard. Guards turn and salute. The King appears. He seats himself upon his throne and motions for the group to come near him. They bow to him, each in turn, and take a place around his throne.*)

KING MATH: Welcome, boys and girls. We have heard about the dreadful time you are having with some of my subjects, so I have decided to find a way out for you. We thought that if you could meet my subjects, things would become more exciting. Now make yourselves comfortable while I have them introduced to you. (*He claps his hands. The music starts—*

"I can't do that sum" and in march in rhythm all the figures—plane and solid—and the numbers from 1 to 0. Each bows to the group and lines up around the stage. If convenient and there is enough time, these may do some sort of dance or form a tableau.)

(Applause by group as each one marches by.)

KING MATH: Now, boys and girls, you see how alive and peppy these subjects of mine are. Not dead nor dull as you sometimes believe them to be. They are right on the job and never fail anyone. If you are accurate they follow your lead, but if you are not sure of yourself, believe me, they certainly get into a mess, and it needs a magician like me to straighten out matters. There is only one way and fortunately that is my way—simple, accurate and speedy. Just to prove how much we need mathematics, some of my subjects will tell you something about its history. Ching come forward and tell us how the Chinese first counted.

CHO.: Honorable soldier, servant of the king,
Stop, we beg of you, and tell us of Ching.

CHING: "Long, long ago
Turtles he had
So he could see;
He said "a lot"
While there were only three.
Years passed by and little Ching
Took his father's place and was crowned king;
Still they counted two, two twos and one—"a lot";
But what we call it—they could not.

New Chings came and old ones went,
Playing in the forest their time was spent;
Counting finally by tens—
Ten and one, ten and two
Up to ten and ten they thought would do;
So their knowledge increased,
Now you see we owe our counting to those deceased.

KING MATH: Good for you, old Ching. We could never have got along without you. Now Bel-Anam, what have you to tell us?

BEL-ANAM: In days gone by when sheep did stray
To drive them home was part of play;
They counted three and then said "many";
Then three and one, two threes, three threes and one,
Two threes and two; oh, there were plenty.
Three threes, three threes and one,
Three threes and two;
But at that time no word said four.
Soon they saw that toes and fingers
Count to ten and ten; so it lingers
To this day; for now as you count,
By tens and twenties you must mount.

(Bel-Anam bows and retires to the side.)

KING MATH: Thank you, Bel-Anam. Now, Ahmes, step forth and tell us how the first book of mathematics was written.

AHMES: Down in the valley of the Nile
Stood a temple, a tremendous pile,
On the walls were curious signs
Which seemed to most just idle lines.
The temple priest one day did tell
The secret that he knew so well;
The number of days in the king's last war
Just so many and never any more.
Now little Ahmes the priest did seek,

And in a voice both low and meek
Begged to learn to read these signs
Which made about the walls such queer lines.

He brought to him a water plant
To cut in strips and lay aslant;
It made an excellent scroll for him
These most curious signs to limn.

As he grew older he did make, for all
Those who came, after Egypt did fall,
A scroll, that told of all he knew—
And thus, the first book of mathematics grew.

(*Bows and goes to side. Applause. Chorus sings the following to the tune of "Santa Lucia."*)

CHO.: Ahmes, oh, great one,
Teacher of math,
Thou hast taught the world
How to subtract;
It shall always be
Told of one who was bold
For thou didst write about
Mathematics which is old;
Ahmes, thou great one
We'll always have faith
In your discovery bold,
For we'll need math
Till we're old.

KING MATH: So, my dear boys and girls, we see that when the world was young it was necessary to learn numbers for they always answered the question "How many" and "How much." Today I heard of a great discussion that you had about a problem.

ALICE: Oh, yes, none of us was sure of the way to find an answer to our problem, so we shall be delighted to have you tell us.

KING MATH: Wouldn't you rather learn how to find the answer yourself? If I show you the HOWS and WHYS maybe you can find out. Would you like that?

GROUP: Oh, yes.

ALICE: I know the problem. If $\frac{2}{3}$ of a number is 128, what is $\frac{5}{6}$ of the number?

KING: All right. Let's get together on this. First we ought to decide WHAT we want to know; after that it will be easy to find out HOW to work it. In this problem, Alice, what is the most important thing?

ALICE: The number.

KING MATH: Exactly. Now let's see HOW we are going to find that number. Do you know anything about it?

ALICE: Yes, I know $\frac{2}{3}$ of it.

KING MATH: Guards, bring forth the cards. (*Guards bring out two cards. On one larger piece which is divided into 2 equal parts is printed 128 in center and $\frac{1}{3}$ at the top of each section. On opposite side 64 in each center. These cards are held by two guards with the fractional side showing.*) How much in each part, Alice?

ALICE: 64.

KING MATH: How did you get this?

ALICE: I divided.

KING: Right. If you have 64 in one part and 64 in another and you must have 3 parts, what number is in the third part?

ALICE: 64.

KING: Turn the cards please. Look, Alice, we have three sections now, therefore what is the whole number?

ALICE: 192. I see. I multiplied this time.

KING: Splendid. You have just told us HOW to do it. Which operations did you use?

ALICE: First I divided to find one part; then I multiplied to find the whole.

KING: Now for the rest of the problem. If you have found the number what is to be done to find the new part of it?

ALICE: $\frac{5}{6}$ means multiplying the number by the new fraction.

GROUP: Hurrah for Alice! Now we know how to do these problems. Divide, then multiply.

KING: And all other problems. Just find

out the HOW and WHAT. Guards, bring forth the guide posts. (*The guards hold out to the view of the group two cards on which we see:*)

WHAT DOES THE PROBLEM ASK?

HOW ARE YOU GOING TO FIND IT?

(*Alice and her friends sing: "I* CAN *do that sum."*)

"Put down 6 and carry 2,
Gee, but this is easy to do,
We just thought and thought and thought
And we're not so dumb;
We all know what the teacher wants,
We can do that sum."

(*They act this song while singing it and do amusing dancing.*)

(*King Math and his subjects applaud and the King takes Alice by the hand and leads her off the stage. Others follow. Tune played as procession leaves stage.*)

SCENE 3

(*Living Room again. Alice still asleep as Margery comes in.*)

MARGERY: Oh, Alice, wake up. I did not mean to stay so long, but I could not find that book so I talked it over with Dad. He says to find out WHAT is wanted and then HOW to get it. Let's read it again.

ALICE: Oh, I know it from memory. If $\frac{2}{3}$ of the number is 128, what is $\frac{5}{6}$ of the number. It's the number we want first of all. I know now. If I have $\frac{2}{3}$ equalling 128, then I can find $\frac{1}{2}$—

2 parts equal 128
1 part equals 64
3 parts equal 3 times 64 or 192

which is the number itself. It is only division of fractions. Now if we have the whole we can find a new part.

MARGERY: Of course—multiplication of fractions.

ALICE: Now it is easy—first you divided and then you multiplied. Hurrah! (*The two girls get to work as the curtain falls while the tune used before is heard again.*)

OUR conception of the structure of the universe bears all the marks of a transitory structure. It is not possible to predict how long our present views and interpretations will remain unaltered and how soon they will have to be replaced by perhaps very different ones, based on new observational data and new critical insight in their connection with other data. . . . By the use of mathematics, that most nearly perfect and most immaterial tool of the human mind, we try to transcend as much as possible the limitations imposed by our finiteness and materiality, and to penetrate ever nearer to the understanding of the mysterious unity of the Kosmos.—From *Kosmos*, by WILLEM DE SITTER.