

MEET THE SCIENTIST

NOTES ON TELLER LECTURE - (To be used while listening to recordings)

1. Mind-reading magic trick.

a. Write a five or six digit number on the board:

6 2 3 4 1

b. Above it, write another, with the number to the right being 4, the remaining digits consisting of the first number scrambled:

4 3 2 6 1 4

6 2 3 4 1

c. Subtract the first from the second:

4 3 2 6 1 4

6 2 3 4 1

3 7 0 2 7 3

d. Add up the digits in the answer:

3

7

0

e. This sum is probably a two digit number. The sum of its digits is 4.

2

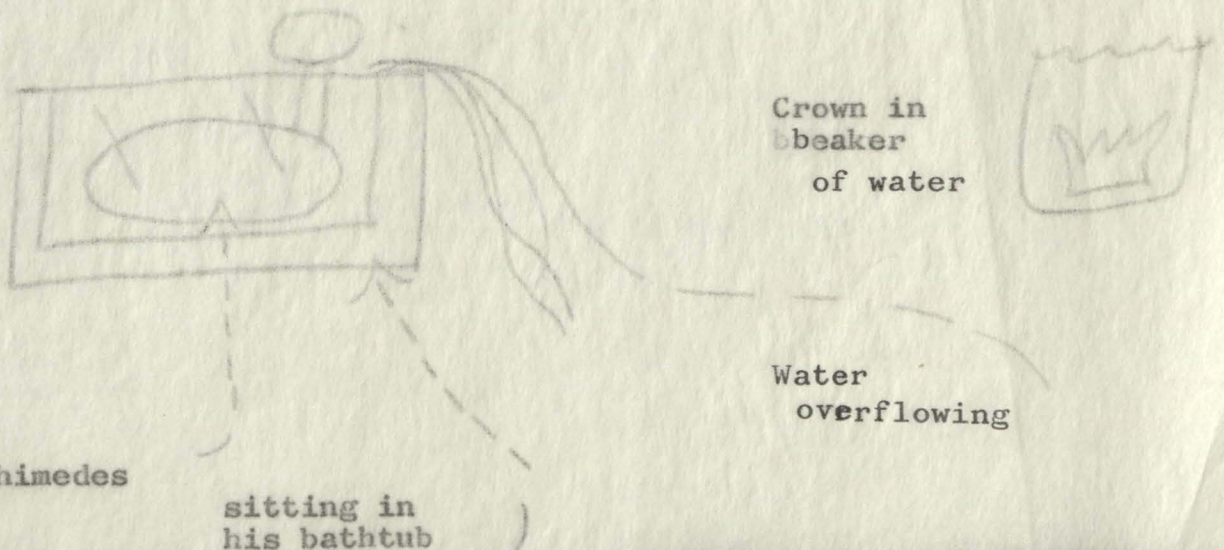
7

3

22

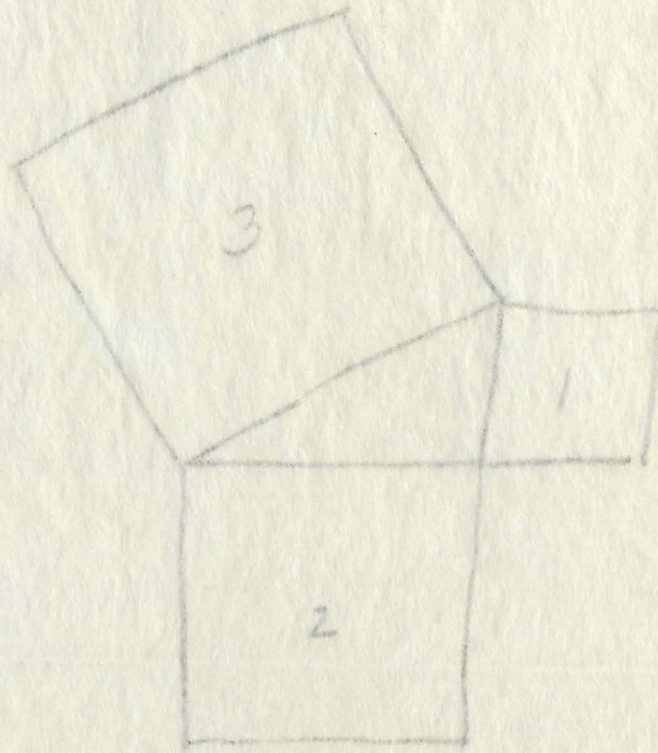
2. Archimedes Principle of Buoyancy:

To find the volume of a complex shape:



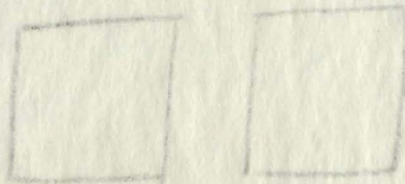
3. Theorem of Pythagoras:

If squares be erected on the sides of a right triangle:



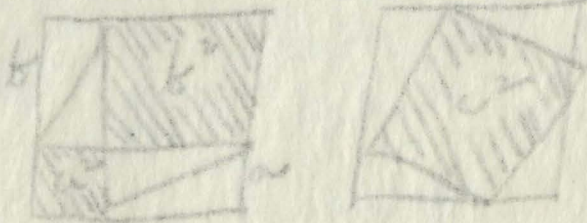
the area of 1 + 2 equals the area of 3; or: $a^2 + b^2 = c^2$

Proof: a. Draw 2 squares, equal in size:



b. We can divide each square up using 4 triangles, the same size in each square, and the same size

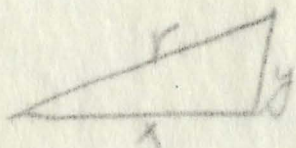
in both squares,



c. and since the areas of all the triangles are equal, the shaded areas in the two squares are equal, or,

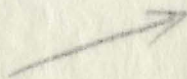
$$a^2 + b^2 = c^2$$

4. Things related to the Pythagorean Theorem:



instead of $a^2 + b^2 = c^2$
write $x^2 + y^2 = r^2$

Strange mathematical object, a vector. Draw an arrow:

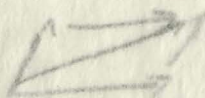


Vector means going from this place to the next place,
or a displacement. Can add vectors:



Sum of two is a third: $\vec{1} + \vec{2} = \vec{3}$

Theorem of parallelogram

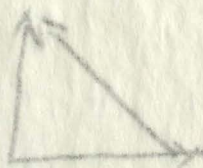


How to add two equal forces at right angles

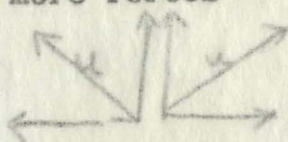
Resultant will be on bisector of
the right angle.



How to know magnitude? Draw as:



Then if vectors 1 ft. long, then resultant is $\sqrt{2}$ long.
 This would be true for displacements. Is it also true for
 forces? Draw two more forces -



u unknown

The two in opposite directions cancel out and the two
 center two add no. 2.

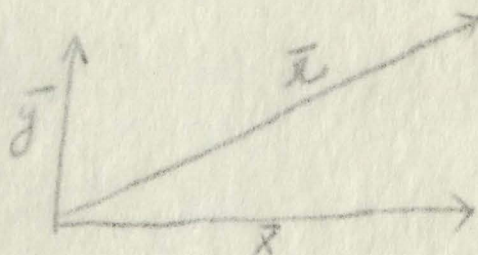
Then the resultant of u's must be u^2

$$u^2 = 2$$

$$u = \sqrt{2}$$

5. Vector components, mirrors at right angles.

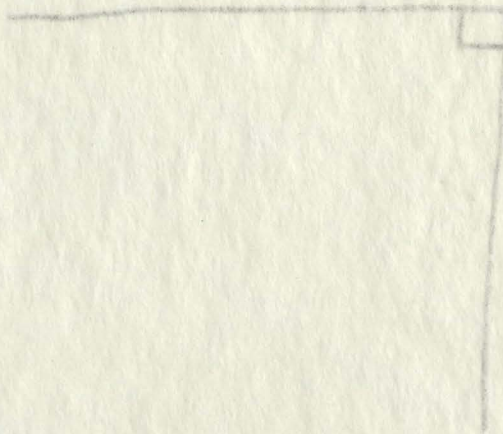
Can always resolve a vector into its components:



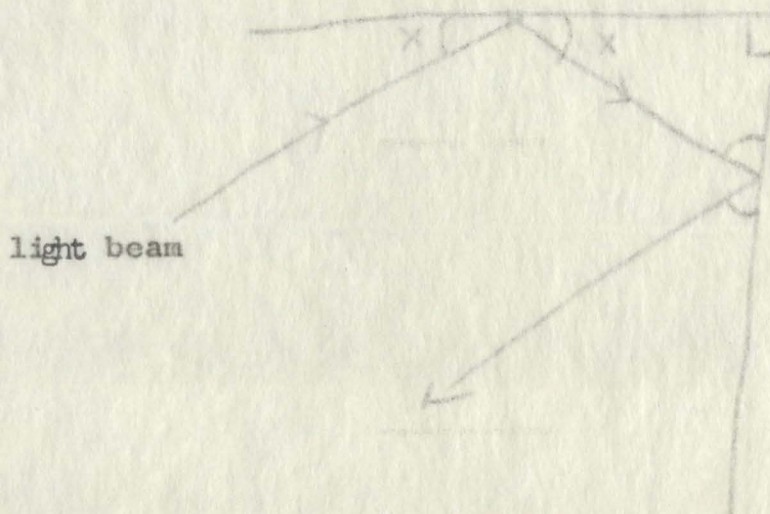
($\bar{x} + \bar{y}$ are the components of \bar{F} .)

5. (continued)

Set up two mirrors at right angles to each other:

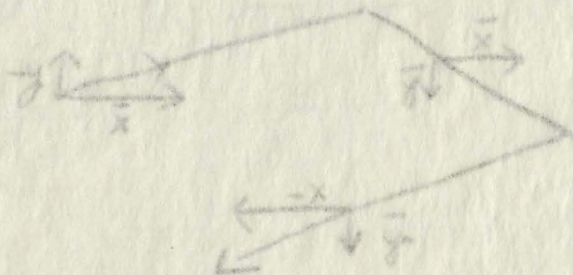


Shine a beam of light on one, it will be reflected:



The light beam emerges in the direction parallel but opposite to the original beam

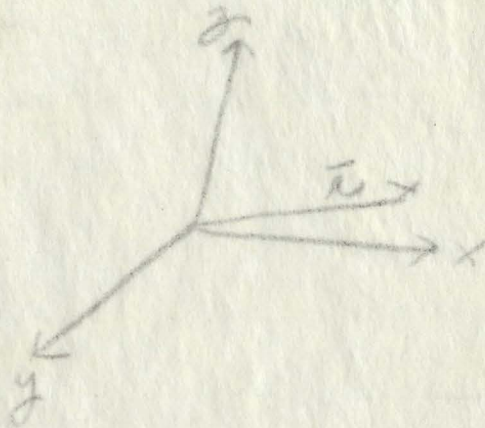
(Went thru cancellation of components here)



This is the principle of cat's eyes on road signs.

5. (continued)

Three dimensional vectors. Vectors in three coordinate axes.



$$r^2 = x^2 + y^2 + z^2$$

In a new coordinate system you could have u, v, & w, instead of x, y, & z; but still:

$$r^2 = u^2 + v^2 + w^2$$

6. Theory of relativity:

Time dimension as well as position.

Change in x dimension over the time interval t is $x = ct$

or $x^2 = c^2 t^2$

$$x^2 - c^2 t^2 = 0$$

a similarity to $x^2 + y^2 + z^2 = r^2$

Carrying coordinate system along with the observer,

First observer: $x^2 - c^2 t^2 = 0$

Second " $x^2 - c^2 t^2 = 0$