Make Maths Learning Fun!

Mathemagic Activity Book

EduHeal Foundation
• LEARNING FOR LIFE •
To help children understand, apply and enjoy MATHEMATICS
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SYLLABUS GUIDELINES
CLASS - VII
Based on CBSE, ICSE & GCSE Syllabus

Number System
(i) Knowing our Numbers: Integers
- Multiplication and division of integers (through patterns). Division by zero is meaningless.
- Properties of integers (including identities for addition & multiplication, commutative, associative, distributive) through patterns. These would include examples from whole numbers as well. Involve expressing commutative and associative properties in a general form. Construction of counter-examples, including some by children. Counter examples like subtraction is not commutative.
- Word problems including integers (all operations).

(ii) Fractions and rational numbers:
- Multiplication of fractions
- Fraction as an operator
- Reciprocal of a fraction
- Division of fractions
- Word problems involving mixed fractions
- Introduction to rational numbers (with representation on number line)
- Operations on rational numbers (all operations)
- Representation of rational number as a decimal.
- Word problems on rational numbers (all operations)
- Multiplication and division of decimal fractions
- Conversion of units (lengths & mass)
- Word problems (including all operations)

(iii) Powers:
- Exponents (only natural numbers.)
- Laws of exponents (through observing patterns to arrive at generalization.)
  i. \[ a^m \cdot a^n = a^{m+n} \]
  ii. \[ (a^m)^n = a^{mn} \]
  iii. \[ \frac{a^m}{a^n} = a^{m-n}, \text{where } m - n \in N \]
  iv. \[ a^m \cdot b^m = (ab)^m \]

Algebra
Algebraic Expressions
- Generate algebraic expressions (simple) involving one or two variables
- Identifying constants, coefficient, powers
- Like and unlike terms, degree of expressions e.g. \( x y^2 \) etc. (exponent \( \leq 3 \) number of variables \( \leq 2 \))
- Addition, subtraction of algebraic expressions (coefficients should be integers).
- Simple linear equations in one variable (in contextual problems) with two operations (avoid complicated coefficients).

Ratio and Proportion
- Ratio and proportion (revision)
- Unitary method continued consolidation, general expression.
- Percentage- an introduction.
- Understanding percentage as a fraction with denominator 100
- Converting fractions and decimals into percentage and vice-versa.
- Application to profit & loss (single transaction only)
- Application to simple interest (time period in complete years)
Geometry

(i) Understanding shapes:
• Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite) (verification and simple proof of vertically opposite angles)
• Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles).

(ii) Properties of triangles:
• Angle sum property (with notions of proof & verification through paper folding, proofs using property of parallel lines, difference between proof and verification.)
• Exterior angle property.
• Sum of two sides of a Δ > it's third side.
• Pythagoras Theorem (Verification only).

(iii) Symmetry
• Recalling reflection symmetry
• Idea of rotational symmetry, observations of rotational symmetry of 2D objects. (90°, 120°, 180°)
• Operation of rotation through 90° & 180° of simple figures.
• Examples of figures with both rotation and reflection symmetry (both operations)
• Examples of figures that have reflection and rotation symmetry and vice versa.

(iv) Representing 3D in 2D:
• Drawing 3D figures in 2D showing hidden faces.
• Identification & counting of vertices edges, faces, nets (for cubes cuboids, & cylinders, cones).
• Matching pictures with objects (Identifying names).
• Mapping the space around approximately through visual estimation.

(v) Congruence
• Congruence through superposition (examples-blades, stamps, etc.).
• Extend congruence to simple geometrical shapes e.g. triangles, circles.
• Criteria of congruence (by verification) SSS, SAS, ASA, RHS.

(vi) Construction (Using scale, protractor, compass)
• Construction of a line parallel to a given line from a point outside it. (Simple proof as remark with the reasoning of alternate angles)
• Construction of simple triangles. Like given three sides, given a side and two angles on it, given two sides and the angle between them.

Mensuration
• Revision of perimeter, Idea of π, Circumference of Circle.

Area
Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle, area between two rectangles and two concentric circles.

Data handling
(i) Collection and organisation of data - choosing the data to collect for a hypothesis testing.
(ii) Mean, median and mode of ungrouped data understanding what they represent.
(iii) Constructing bargraphs.
(iv) Feel of probability using data through experiments. Notion of chance in events like tossing coins, dice etc. Tabulating and counting occurrences of 1 through 6 in a number of throws. Comparing the observation with that for a coin. Observing strings of throws, notion of randomness.
The main reason for studying mathematics to an advanced level is that it is interesting and enjoyable. People like its challenge, its clarity, and the fact that you know when you are right. The solution of a problem has an excitement and a satisfaction.

**The importance of mathematics**

We see the use of arithmetic and the display of information by means of graphs everyday. These are the elementary aspects of mathematics. Advanced mathematics is widely used, but often in an unseen and unadvertised way.

- The mathematics of error-correcting codes is applied to CD players and to computers.
- The stunning pictures of far away planets sent by Voyager II could not have had their crispness and quality without such mathematics.
- Voyager’s journey to the planets could not have been calculated without the mathematics of differential equations.
- Whenever it is said that advances are made with supercomputers, there has to be a mathematical theory which instructs the computer what is to be done, so allowing it to apply its capacity for speed and accuracy.
- The development of computers was initiated in this country by mathematicians who continue to make important contributions to the theory of computer science.
- The next generation of software requires the latest methods from what is called category theory, a theory of mathematical structures which has given new perspectives on the foundations of mathematics and on logic.
- The physical sciences (chemistry, physics, oceanography, astronomy) require mathematics for the development of their theories.
In ecology, mathematics is used when studying the laws of population change.

Statistics provides the theory and methodology for the analysis of wide varieties of data.

Statistics is also essential in medicine, for analysing data on the causes of illness and on the utility of new drugs.

Travel by aeroplane would not be possible without the mathematics of airflow and of control systems.

Body scanners are the expression of subtle mathematics, discovered in the 19th century, which makes it possible to construct an image of the inside of an object from information on a number of single X-ray views of it. Thus mathematics is often involved in matters of life and death.

**Rapid Questions**

😊 Seven is an odd number. How do you make it even?
Take away the ‘s’!

😊 Why is it dangerous to do maths in the jungle?
Because if you add 4 and 4, you get ate!!

😊 What did the zero say to the eight?
Your belt’s a bit tight isn’t it?

😊 Why was the six nervous?
Because seven eight nine

😊 How does an Alien count to 23?
On its fingers!

😊 There was a boy who came home and told his mom that the Maths test was very easy.

**Mom:** How many did you think you got wrong?

**Boy:** Three, and there were two sums that the teacher told I got wrong.

**Mom:** How many sums were there?

**Boy:** Five
ACROSS
1. A unit of money that is based on hundredths.
4. This place value is commonly used when converting between decimals and percents.
5. The ratio whose second term is 100.
6. 100% is represented by one _____.
7. The process of changing a fraction to a decimal or to a percent.
8. A number that names a part of whole.
10. The point having one or more lights to its right.

DOWN
2. The number above the fraction bar that indicates how many equal part of the whole are being considered.
3. The number below the fraction bar that indicates how many equal parts are in the whole.
4. A percent is based on this number.
9. Used to compare two or more quantities.
Tricks For Quicker Mathematics

🌟 Instant Subtraction

(I) Rule: All from 9 and last from 10

Example: $1000 - 459$

\[
\begin{array}{c}
4 \\
5 \\
9 \\
\end{array}
\]

Subtract $\downarrow$ from 9 $\downarrow$ from 9 $\downarrow$ from 10

\[
\begin{array}{c}
5 \\
4 \\
1 \\
\end{array}
\]

So the answer is $1000 - 359 = 541$

This rule always work for subtractions from numbers consisting of a 1 followed by zeros. Other example is $10,000 - 1736$

\[
\begin{array}{c}
1 \\
7 \\
3 \\
6 \\
\end{array}
\]

$\downarrow$ From 9 $\downarrow$ From 9 $\downarrow$ from 9 $\downarrow$ from 10

\[
\begin{array}{c}
8 \\
2 \\
6 \\
4 \\
\end{array}
\]

Hence Answer is $10000 - 1736 = 8264$

Now its your chance - Do the following calculation mentally in 3 minutes.

1. $1000 - 354 = \quad $ 6. $1000 - 59 = \quad$
2. $100 - 28 = \quad $ 7. $10000 - 335 = \quad$
3. $10000 - 2354 = \quad $ 8. $10000 - 765 = \quad$
4. $10000 - 7635 = \quad $ 9. $1000 - 507 = \quad$
5. $1000 - 961 = \quad $ 10. $100 - 37 = \quad$

🌟 Multiplication of number close to 100.

- Multiply $89 \times 95$
- $89$ is 11 less than 100.
- $95$ is 5 less than 100.
- Write the sentence in the following format
- Subtract 5 from 89 or 11 from 95 you will get 84 (i.e. subtract diagonally)
- Multiply vertically; multiply the numbers in right box i.e.,
  \[11 \times 5 = 55,\]
  
  Hence \[89 \times 95 = 8455\]

| Now its your chance. Perform following multiplication mentally in 5 minutes. |
| --- | --- | --- | --- | --- |
| 1. | 89 \times 97 | 4. | 97 \times 97 | 7. | 78 \times 93 | 9. | 81 \times 96 |
| 2. | 89 \times 77 | 5. | 93 \times 95 | 8. | 68 \times 93 | 10. | 88 \times 74 |
| 3. | 64 \times 99 | 6. | 74 \times 85 |

★ Multiplication of numbers just above 100

Multiply 108 \times 107 =

- Add in this way
  \[108 + 7 = 115\]  \(\text{(A)}\)
- Multiply the extreme numbers
  \[8 \times 7 = 56\]  \(\text{(B)}\)
- So the answer is 11556

Similarly

\[105 \times 109 = 11445\]  By  \[105 + 9 = 114; \quad 9 \times 5 = 45\]

Answer is 11445

| Now its your chance. Do the following Multiplication mentally in 5 minutes |
| --- | --- | --- | --- |
| 1. | 103 \times 104 | 6. | 104 \times 109 |
| 2. | 105 \times 102 | 7. | 105 \times 104 |
| 3. | 109 \times 106 | 8. | 106 \times 108 |
| 4. | 108 \times 104 | 9. | 101 \times 109 |
| 5. | 107 \times 103 | 10. | 106 \times 103 |
1. A pandigital sum (for addition, subtraction, multiplication or division) is one which uses all of the digits 1 to 9 once and once only.
   For example: 128 + 439 = 567 is a pandigital addition sum.
   Find another one.

2. Here is a magic square using the numbers 1 to 16 (with no repeats) arranged so the magic total of the numbers along every row, column and diagonal is 34. It is possible, by replacing ONLY ONE of the numbers and then re-arranging all of them, to make the magic total 36.
   To do that - which number must be replaced by what?

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<td>13</td>
<td>2</td>
<td>3</td>
<td>16</td>
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3. Take the 2-digit number 45. Square it (45 x 45) to make 2025. Split this 4-digit number in half to make 20 and 25. Add them (20 + 25) to make 45 Which is what you started with.

   Find another 2-digit number which does the same.
Common people who are not using math in their work or anything wouldn’t typically use exponents as such in normal life, since it doesn’t occur that often that you’d need to calculate \(7 \times 7 \times 7 \times 7\) or \(0.1 \times 0.1 \times 0.1 \times 0.1\) or other such calculations. Exponents are more or less just a shorthand notation for multiplying the same number by itself several times - and in normal life you just don’t need such often.

One example of how exponents do kind of connect with our everyday lives: when we speak about square feet, square meters, square inches, square miles, square kilometres or any other area units, or when we speak about cubic feet, cubic meters, cubic centimetres or any other such volume units.

The unit “square foot” is actually 1 foot \(\times\) 1 foot, or (1 foot) squared, or (1 foot) to the power of 2. Similarly, a cubic foot is 1 foot \(\times\) 1 foot \(\times\) 1 foot, or (1 foot) cubed, or (1 foot) to the power of 3.

If you talk about SQUARE shaped areas, for example if you say “My room is twelve by twelve square”, you’re meaning your room is 12 feet \(\times\) 12 feet, or \(12^2\) square feet. Another kind of indirect example is if you talk about extremely tiny or extremely big quantities. For example, the term ‘nanometer’ means \(10^{-9}\) meter. The prefix ‘nano’ means the number \(10^{-9}\) - an extremely small number. Or, within computer world you often see megabytes, gigabytes, terabytes. “Mega” means \(10^6\) or one million, “giga” means \(10^9\), and “tera” means \(10^{12}\). Or megahertz - million hertz.

THE POWER OF POWERS

When scientists want to write really big numbers, they use powers. A million, which is 1,000,000, may be written as \(10^6\). That’s 10 to the power of 6, or \(10 \times 10 \times 10 \times 10 \times 10 \times 10\). A million million is 1,000,000,
000, 000, which is much easier to write as $10^{12}$. And $10^{10}$ saves writing 10 followed by 100 noughts!

The power of powers is endless. There’s a trick question mathematicians like to ask.

What is the highest number you can write with just three digits? If you didn’t know about powers, you might say 999. If you know a little about powers, you might guess $99^9$, which is $9$ to the power of $99$. This works out to be nearly 9,230 million million, a pretty big number.

But that’s still not the answer. The biggest number you can write with 3 digits is $9^{9^9}$. This is $9$ to the power of $9^9$. Now $9^9$ is 387, 420, 489. So $9^{9^9}$ is 9,387, 420, 489.

Are you staggering at the size of this number? How many digits do you think it has? The answer is 369 million. If you wrote these on a long, thin piece of paper, it would stretch for 1,000 km or it would fill thousands of books and take years to read. That’s some number to make from just three digits!

### POWER FACTS

Any power of a number ending in 1 also ends in 1. The same is true for 5 and 6. Try it: $5 \times 5 = 25$, $6 \times 6 = 36$, and so on. With the powers of 9, there are only two possible last digits, 1 and 9. The powers of some numbers have four possible last digits, such as 2, 4, 6 and 8 for powers of 2. See if you can work out the possible last digits for the powers of 3. Now try the powers of 7.

If you were asked to find the last digit of the fifth power of any number, you would be able to answer straight away. That’s because the fifth power always ends with the same last digit as the number itself.

Mean is so mean, you have to work it out,
Mode is most common, that’s what it’s all about,
Median is medium, the middle of them all,
Range is the largest take away a number very small.
Maths is so difficult, you have to use your brain,
Numbers puzzle your mind as though it is a game.
Are You Smart?

1. Three ducks and two ducklings weigh 32 kg. Four ducks and three ducklings weigh 44 kg. All ducks weigh the same and all ducklings weigh the same. What is the weight of two ducks and one duckling?

2. A 800 seat multiplex is divided into 3 theatres. There are 270 seats in Theatre 1, and there are 150 more seats in Theatre 2 than in Theatre 3. How many seats are in Theatre 2?

3. A rectangular sheet of wood has four small squares of 3 cm removed. It is then cut to make a box that is 5 cm by 4 cm with a volume of 60 cm$^3$. (Four pieces of size A4 are removed.) Find the original area of the sheet of wood.

4. The rent-a-stall horse barn has stalls for 1000 horses. Forty percent of the stalls are for ponies. On Tuesday, there were 200 ponies and a bunch of quarter horses at the horse barn. The horse barn was 75 percent full. How many quarter horses were in the stalls?

5. A rectangular chalk board is 3 times as long as it is wide. If it were 3 metres shorter and 3 metres wider, it would be square. What are the dimensions of the chalk board?

6. A side of the equilateral triangle A is twice the length of a side of triangle B.
7. M and N are the midpoints of the sides of a square. What is the ratio of the area of triangle AMN to the area of the complete square?

8. There are 6 short pieces of link chain, each having 4 links. It takes 10 seconds to cut a link and 25 seconds to weld it back together. What is the shortest possible time to make the longest chain?

9. Find the magic constant and fill in the numbers so that every column or diagonal has the same sum.

10. Bacteria in a petri dish double the area they cover every day. If the dish is covered after 16 days, on what day was only one quarter of it covered?
Do You Want to be a Mathematical Wizard?

This trick will make you a mathematical wizard and you can stun your friends by doing three digits multiplication in few seconds.

Example $297 \times 843 =$

• **Step 1**
  Write the numbers one below the other.

```
2 9 7
8 4 3
```

• **Step 2**
  Multiply the last digits of both the numbers and write the product at the units place. If there is any number in the product in the tens place, carry it further. The operation of multiplication will look like ‘I’ so in our example

```
2 9 7
8 4
1
```

• **Step 3**
  Now multiply the digit in the tens place of the first number with that in the tens place of the second. The multiplication operation on the paper will look like ‘X’. Now add the two products. Put the digit in the unit place of this sum, in the tens place of our answer and carry on the digit in the next place.

```
2 9 7
\underline{8 4 3}
\underline{(9 \times 3) + (4 \times 7) + 2}
```

\[5 \quad 7 \quad 1\]

• **Step 4**
  This step can be best explained through the diagram. So look at the following operation carefully.

```
5
2 9 7
\underline{8 4 3}
```

\[7 \quad 1\]

```
(2 \times 3) + (8 \times 7) + (9 \times 4) + 5
6 + 56 \quad 36 + 5
1\underline{0} \quad 7 \quad 1
```

\[10 \quad 2 \quad 9 \quad 7 \quad 8 \quad 4 \quad 3 \quad 7 \quad 1\]
What we do in this step is multiply the digit in the hundred’s place of the first number with that in the units place of the second. Separately, multiply the digits in the ten’s place of both the numbers. And further multiply the digit in the unit’s place of the first number with that of the hundred’s place of the second. Then we add all the 3 products together. The digit in the unit’s place of the sum is then written in the hundred’s place of our answer. And those in the hundred’s and ten’s place are carried further. The operation here looks like ‘I’ through ‘X’

• Step 5
Now multiply the digit in the tens place of the first number with that in the hundred’s place of the second. Separately multiply the digit in the hundred’s place of the first number with that in the tens place of the second. The multiplication operation on the paper will look like X again, but now on other side. Now add the two products. Put the digit in the units place of this sum, in the thousand’s place of our answer and carry on the digit in the tens place.

\[
\begin{array}{ccc}
2 & 9 & 7 \\
8 & 4 & 3 \\
(2 \times 4) + (8 \times 9) + 10 & 3 & 7 \\
8 & 7 & 2 \\
9 & 0 & 3 \\
9 & 0 & 3 \\
7 & 1 & 1 \\
8 & 7 & 2 \\
9 & 0 & 3 \\
7 & 1 & 1 \\
\end{array}
\]

= 371

• Step 6
Now, multiply the first digits of both the numbers. Add to this product, the number that has been carried on through the previous step and write the sum at the ten thousand’s place. If there is any number in the product in the tens place, write it in the lakh’s place. The operation of multiplication will look like ‘I’

\[
\begin{array}{ccc}
2 & 9 & 7 \\
8 & 4 & 3 \\
(2 \times 8) + 9 & 0 & 3 \\
1 & 6 & 9 \\
2 & 5 & 0 \\
7 & 1 & 1 \\
\end{array}
\]

= 250371

And that’s our final answer

\[297 \times 843 = 250371\]

Isn’t that simple? You’ll say no. But that’s because you have just read this, have you tried it with other numbers as yet? Do it with two or three numbers then you will find it really simple.
7 is the smallest number of integer-sided rectangles that tile a rectangle so that no 2 rectangles share a common length.

- 7 is a Mersenne prime ($2^3 - 1$).
- 7 is the unity digit of the number $3^{31}$.
- 7 is the positive solution to: $3x^2 = 16x + 35 = 1^2 + 1^2 + 2^2$ (sum of 4 squares) = $2^5 - 5^2$

- $7 + 47 + 47 + 57 + 97 + 97 + 27 + 97 = 14459929$
- $7^1 + 1 = 2 \times 2^2$
- $7^2 + 1 = 2 \times 5^2$

The only single digit prime number to produce a square when its cube and the cube’s proper divisors are added:

$7^1 + 7^2 + 7^3 + 1 = 20^2$

- Some multiples of 7 are palindromic, such as (Number or words which read same from any side): 77, 161, 252, 343, 434, 525, 595, 616, 686, 707, 777, 868, 959, 1001, 1771, 2002, 2772, 3003, 3773, 4004, 4774, 5005, ...

- The smallest positive integer whose reciprocal ($1/7$) has a pattern of more than one repeating digit: $1/7 = 0.142857142857142857...$

It is also the smallest number for which the periodic sequence of $1/n$ is of length $1-n$. The next such numbers are 17, 19, 23, 29, 47, 59, 61, 97, ...

Other notable properties:

by multiplying the cyclic number 142857 by 2, 3, 4, 5, or 6, the answer will be a cyclic permutation of itself...

142857 x 2 = 285714
142857 x 3 = 428571
142857 x 4 = 571428
142857 x 5 = 714285
142857 x 6 = 857142
Interestingly, if we square the last three digits of 142857 and subtract the square of the first three digits, we also get back a cyclic permutation of the number!

- $857^2 - 142^2 = 714285$
- $999,999 / 7 = 142857$
- $(987654321 - (123456789 + 9)) / 7 = 123456789$

**Divisibility by Seven:** Take the digits of the number in reverse order, from right to left, multiplying them successively by the digits 1, 3, 2, 6, 4, 5, ... (repeating with this sequence of 6 multipliers as long as necessary). Add the products.

For example: is 1708 divisible by 7? Well, reverse the number, 8071, multiply and add its digits as explained, $8 \times 1 + 0 \times 3 + 7 \times 2 + 1 \times 6 = 28$. The sum is divisible by 7, so 1708 is.

Another method to check divisibility by Seven (7): for numbers having 3 digits...

154 > (2)+1+5+4+(2) = 14 is divisible by 7, so is 154 .
245 > (4)+2+4+5+(6) = 21 is divisible by 7, so is 245 .
862 > (2)+8+6+2+(1) = 19 and 862 are not multiple of 7.
366 > (6)+3+6+6+(3) = 24 and 366 are not multiple of 7.

The numbers in brackets are added in order to form with their neighbors a 2-digit number multiple of 7. If the sum of all digits is a multiple of 7, then the related number is divisible by 7.

- 7 is a prime number
- 73 is a prime number
- 739 is a prime number
- 7393 is a prime number
- 73939 is a prime number
- 739391 is a prime number
- 7393913 is a prime number
- 73939133 is a prime number

• The opposite sides of a die cube always add up to 7.
Ratio Riddles

1. If you have spiders to lizards at the ratio below and have 12 lizards, how many spiders do you have?

2. If you have roses to diplomas at the ratio below and have 24 roses, how many diplomas do you have?

3. If you have pizza slices to girls at the ratio below, and if you have 33 girls, how many slices of pizza do you have?

4. Which row below has 2 dolls for every 1 camera?

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<td><strong>E</strong></td>
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</table>
5. Which ratio of pizza slices to girls gives each girl the most pizza?

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<td><img src="image" alt="Pizza Slices" /></td>
<td><img src="image" alt="Girls" /></td>
</tr>
<tr>
<td>E</td>
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<tr>
<td></td>
<td><img src="image" alt="Pizza Slices" /></td>
<td><img src="image" alt="Girls" /></td>
</tr>
</tbody>
</table>

6. A famous 5 star hotel chief has a secret recipe for her chili. When people ask her for it, she hands them a card with the complete recipe except for 1 detail. For the missing detail, she gives them the following clue:

For a 3-quart pot of chili, use a combination of peppers and tomatoes totalling 12 items in one of the following ratios. If the answer is in whole numbers, how many peppers and how many tomatoes should be used?

<table>
<thead>
<tr>
<th>A</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Peppers" /></td>
<td><img src="image" alt="Tomatoes" /></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Peppers" /></td>
<td><img src="image" alt="Tomatoes" /></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Peppers" /></td>
<td><img src="image" alt="Tomatoes" /></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Peppers" /></td>
<td><img src="image" alt="Tomatoes" /></td>
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<tr>
<td>E</td>
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</tr>
<tr>
<td></td>
<td><img src="image" alt="Peppers" /></td>
<td><img src="image" alt="Tomatoes" /></td>
</tr>
</tbody>
</table>
The Four Kingdoms

This card trick seems magical, but it’s not. To perform, separate all of the Aces, Kings, Queens and Jacks from the deck of card. Begin the trick by telling this story of the greatest and most powerful wizard.

*Once upon a time there were four kingdoms. In each kingdom there was a beautiful castle* (put down the four Aces face up in separate piles).

*In each castle lived a wise and just king.* (put down the four kings, the king of spades on the ace of spades, etc.)

*Each king was married to an equally wise and just queen.* (put down the four queens, the queen of spades on the king of spades, etc.)

*One year to each family was born a healthy, happy child and all seemed right with the world.* (put down the four jacks, the jack of spades on the queen of spades, etc.)

*And the greatest and most powerful wizard saw just how good things were and said, “Great! Now I can take that vacation.” And so he began to pack.* (While you are saying this put the four decks into piles and place them one on top of the other.)

*In the mean time the evil wizard, Morgana, was conjuring up an evil spell to be cast on the four kingdoms once the good wizard left - and he didn’t waste any time. He chanted, “Mouse tails, bat’s eyes, blood from a rat. Mixed up together in a great big vat.”* (While saying this, deal the cards into four piles, placing one card for each word.)

*His spell took hold of the four kingdoms and leaving no stone unturned he cast them upon the four winds.* (While saying this place the four piles in a diamond shape.)

*The results were devastating. The children become lost in the forests, the kings and queens wondered aimlessly in the desert and the castles were empty.* (While saying this turn over the four piles to show the piles of all aces, kings, queens and jacks.)
But soon the greatest, most powerful and most rested wizard returned and he saw what the Morgana had done. “This just cannot go on!”, he said. And he set about casting his own spell. It worked a magic much more powerful than the magic of Morgana - it gathered in the kings and queens, children and castles from the four corners of the earth and he said “Morgana is in trouble if ever he’s sighted. But these families four will soon be united.” (While saying this, deal the cards into four piles, placing one card for each word.)

And the wizard saw that all was right in the kingdoms. (While saying this turn over the four piles to reveal the four united families.)

Note with some practice you can cut the cards during the trick, but you have to make sure that you only cut the deck after card 4, 8 or 12.

---

**The Four Kingdoms - Why it Works.**

This trick is easy. It relies on the simple fact that as you deal the cards you are simply grouping the cards by sorting every fourth card into the same pile. Consider the arrangement of the cards on the table.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A(S) K(S) Q(S) J(S)</td>
<td>A(H) K(H) Q(H) J(H)</td>
<td>A(D) K(D) Q(D) J(D)</td>
<td>A(C) K(C) Q(C) J(C)</td>
</tr>
</tbody>
</table>

When you pick up the piles they form a deck with the J(C) at the bottom and the A(S) at the top. As shown below.

<table>
<thead>
<tr>
<th>Top of Deck —&gt;</th>
<th>S = Spade</th>
<th>K = King</th>
<th>H = Heart</th>
<th>D = Diamond</th>
<th>C = Club</th>
<th>Q = Queen</th>
<th>A = Ace</th>
<th>J = Jack</th>
</tr>
</thead>
<tbody>
<tr>
<td>A(S) —&gt; Card 1</td>
<td>J(S) —&gt; Card 4</td>
<td>A(H) —&gt; Card 5</td>
<td>K(H) —&gt; Card 6</td>
<td>Q(H) —&gt; Card 7</td>
<td>J(H) —&gt; Card 8</td>
<td>A(D) —&gt; Card 9</td>
<td>K(D) —&gt; Card 10</td>
<td>Q(D) —&gt; Card 11</td>
</tr>
</tbody>
</table>

End of Deck —> J(C) —> Card 16

When these cards are dealt, cards which are four apart in the deck end up in the same pile. As
Group 1: A(S)  A(H)  A(D)  A(C)
Group 2: K(S)  K(H)  K(D)  K(C)
Group 3: Q(S)  Q(H)  Q(D)  Q(C)
Group 4: J(S)  J(H)  J(D)  J(C)

When you pick up the piles they form a deck with the J(C) at the bottom and the A(S) at the top, but the order of cards in between is different. They are arranged into a new order as shown below.

<table>
<thead>
<tr>
<th>Top of Deck ——&gt;</th>
<th>A(S)&lt;— Card 1</th>
<th>Q(D)&lt;— Card 11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A(H)&lt;— Card 2</td>
<td>Q(C)&lt;— Card 12</td>
</tr>
<tr>
<td></td>
<td>A(D)&lt;— Card 3</td>
<td>J(S)&lt;— Card 13</td>
</tr>
<tr>
<td></td>
<td>A(C)&lt;— Card 4</td>
<td>J(H)&lt;— Card 14</td>
</tr>
<tr>
<td></td>
<td>K(S)&lt;— Card 5</td>
<td>J(D)&lt;— Card 15</td>
</tr>
<tr>
<td></td>
<td>K(H)&lt;— Card 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K(D)&lt;— Card 7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K(C)&lt;— Card 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q(S)&lt;— Card 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q(H)&lt;— Card 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>End of Deck ——&gt; J(C)&lt;— Card 16</td>
<td></td>
</tr>
</tbody>
</table>

When you deal out the cards again, you will get four piles each containing cards of only the same suit. This is because every fourth card in the deck is the same suit. In fact, at this point you can cut the cards in any location as many times as you want and the piles you get as you deal out the cards will always contain only the cards of the same suit. The reason this works is that no matter where you cut the cards the basic pattern of every fourth card being the same suit is maintained.

THE VANISHING LINE PUZZLE

This simple trick demonstrates the principle of a number of more complex tricks. This trick requires rearranging a picture containing a particular number of items, and getting a similar picture with a different number of those items. Start by drawing 10 equally spaced, vertical lines of equal length on a sheet of paper.

Next cut the sheet along a diagonal from the bottom of the first line to the top of the tenth line.

Slide the lower piece of the paper downward and to the left until there are only 9 lines on the paper.

Where did the missing line go? The answer is that a part of it became a part of each of the other lines.
One day a mathematician decides that he is sick of math. So, he walks down to the fire department and announces that he wants to become a fireman.

The fire chief says, “Well, you look like a good guy. I’d be glad to hire you, but first I have to give you a little test.”

The fire chief takes the mathematician to the alley behind the fire department which contains a dumpster, a spigot, and a hose. The chief then says, “OK, you’re walking in the alley and you see the dumpster here is on fire. What do you do?”

The mathematician replies, “Well, I hook up the hose to the spigot, turn the water on, and put out the fire.”

The chief says, “That’s great... perfect. Now I have to ask you just one more question. What do you do if you’re walking down the alley and you see the dumpster is not on fire?”

The mathematician puzzles over the question for awhile and he finally says, “I light the dumpster on fire.”

The chief yells, “What? That’s horrible! Why would you light the dumpster on fire?”

The mathematician replies, “Well, that way I reduce the problem to one I’ve already solved.”

A mathematician wandered home at 3 AM. His wife became very upset, telling him, “You’re late! You said you’d be home by 11:45!” The mathematician replied, “I’m right on time. I said I’d be home by a quarter of twelve.”

Old mathematicians never die; they just lose some of their functions.

Mathematics is made of 50 percent formulas, 50 percent proofs, and 50 percent imagination.
Dissection Activity

Cut the following seven pieces and try to make the following images using all of them.
Arithmetic Curiosities

- **Interesting Patterns**: Here are just a few interesting patterns in arithmetic that you may explore. Verify these results with paper and pencil or with calculator (if you must):

  1. \(1 \times 9 + 2 = 11\)
  2. \(9 \times 9 + 7 = 88\)
  3. \(12 \times 9 + 3 = 111\)
  4. \(98 \times 9 + 6 = 888\)
  5. \(123 \times 9 + 4 = 1111\)
  6. \(987 \times 9 + 5 = 8888\)
  7. \(1234 \times 9 + 3 = 11111\)
  8. \(9876 \times 9 + 4 = 88888\)
  9. \(9 \times 9 = 81\)
  10. \(6 \times 7 = 42\)
  11. \(99 \times 99 = 9801\)
  12. \(66 \times 67 = 4422\)
  13. \(999 \times 999 = 998001\)
  14. \(666 \times 667 = 444222\)

- **Number Pyramid**: A set of numbers obeying a pattern like the following.

  1. \(9.137 = 3367\)
  2. \(99.01367 = 333.6667\)
  3. \(999.00133667 = 333333666667\)
  4. \(999990001.3333366667 = 3333333366666667\)
  5. \(4^2 = 16\)
  6. \(34^2 = 1156\)
  7. \(224^2 = 111556\)
  8. \(7^2 = 49\)
  9. \(67^2 = 44489\)
  10. \(667^2 = 444889\)

- **Amicable Numbers**: There are a few pair of numbers that have a very peculiar affinity for each other and are so-called “amicable numbers.” Take for instance the pair of numbers 220 and 284. It turns out that all the factors of 220, that is those less than itself, add up to 284. And, surprisingly, the factors of 284 add up to 220. Other three pairs like these are 1,184 and 1,210, 17,296 and 18,416, and the large pair 9,363,584 and 9,437,056. Can you find others? send your answers to info@eduhealfoundation.org.
How many Regular Mosaic

This is a regular mosaic. This regular mosaic is a pattern made up of equilateral triangles. The pattern could continue in all directions. We are showing only a portion of it.

A regular mosaic is a pattern made up by repeating the same regular polygon over and over, with no spaces in between, and no overlap of the shapes. A regular polygon is defined as one in which all the sides are equal and the angles formed by adjacent sides are all equal. For an equilateral triangle, the three sides are all the same length and the three internal angles are each 60°.

Another regular polygon is an octagon, with 8 equal sides.

How many other regular mosaics can you find? To qualify as a regular mosaic your pattern has to

- be made up by repeating only a single regular polygon.
- have no spaces between the polygons.
- have no overlapping polygons.
- use polygons that are all the same size as well as the same shape.

When you have arrived at your answer, can you explain why you must be right?
How is it Possible?

The owner of a small automobile rental company died recently, leaving a will that specified how the fleet should be divided amongst the three children:
1/2 the cars go to the eldest
1/3 of the cars go to the middle child
1/9 goes to the youngest
There were 17 cars in the rental fleet. The children had trouble figuring out how to divide things up in the manner specified in the will, so they called in the Eduheal foundation consultant who, after a brief meeting, came up with the perfect solution. What do you think the Eduheal foundation consultant proposed?

If you would be at the place of the consultant what would you have done?
Well the Eduheal foundation consultant drove to the meeting and upon looking at the situation offered to add her own car to the estate.

Then she proposed to divide up the fleet, now totaling 18 cars, as follows:
Oldest got 1/2 of 18 = 9 cars
Middle child got 1/3 of 18 = 6 cars
Youngest got 1/9 of 18 = 2 cars
This totals 17 cars, so the Eduheal foundation consultant took her own car back and drove home leaving everyone happy with the settlement.
ANSWERS

Across
1. Cents
4. Hundredth
5. Percent
6. Whole
7. Conversion
8. Fraction
10. Decimal

Down
2. Numerator
3. Denominator
4. Hundred
9. Ratio

Page - 9
1. 646
2. 72
3. 7646
4. 2365
5. 39
6. 941
7. 9665
8. 9235
9. 493
10. 63

Page - 10
1. 8633
2. 6853
3. 6336
4. 9409
5. 8835
6. 6290
7. 7254
8. 6324
9. 7776
10. 6512

Page - 11
2. Replace 9 with 17 (and rearrange)
3. 55 or 99

Page - 14 - 15
1. 20 kgs.
2. 340 seats
3. 110 cm²
4. 550 quarter horses
5. width = x = 3 meters wide
   length = 3x = 9 meters long
6. 4 triangles
7. 1/8
8. 105 secs

Page - 20 - 21
1. 30
2. 18
3. 22
4. (D)
5. (C)
6. (C)

Page - 26
There are only three regular mosaics: square mosaics, triangular mosaics and hexagon mosaics.

Page - 28
To see why these are the only possibilities, look at the point where shapes meet. In the case of the regular mosaic made of triangles, six triangles meet at any point. In order to fit together their internal angles have to add up to 360°. Since there are six triangles, each with an internal angle of 60° this works out to 360°.

For the square mosaic, four squares meet at each point. The internal angles are 90°, which also adds up to 360°. Finally, three hexagons, each with an internal angle of 120°, meet at each point in the hexagon mosaic. Three 120° angles also add up to 360°.

The octagon cannot be used for a regular mosaic. Cut out a bunch of octagons and try it. The internal angles of an octagon are 135°. Two of them add up to 270° and three of them make 405°. There’s no way to get 360° and so there’s no way to have octagons meet at a point with no spaces or overlap.

What about a pentagon? The internal angles are each 108°. No multiple of 108 equals 360.

Could there be some regular polygon with many sides that can be used for a regular mosaic? No, because as you increase the number of sides, the internal angle also increases. With hexagons you get a perfect fit with three of them. Any polygon with more than six sides will have internal angles greater than 120° so you can’t fit three together at a point.