ARCHIMEDES MATH COMPETITION

First Round 2021-2022

Solution:

Problem 1:

The result of the calculation is **632,774**.

Following the order of operations, we first solve the expression inside the parentheses (9382·6 + 3126:3).

- First, do the multiplication and division inside the parentheses:
  - 9382 × 6 = 56,292
  - 3126 ÷ 3 = 1,042
- Now, add those results together:
  - 56,292 + 1,042 = 57,334

Finally, perform the subtraction from the initial number: 690,108 - 57,334 = 632,774

The correct answer is **632774**.

Problem 2:

Each stick has two ends. Therefore, to find the total number of ends, you multiply the number of sticks by 2.

7 sticks × 2 ends per stick = 14 ends

The correct answer is **14**.

Problem 3:

Archimedes is **in the circle and in the square but not in the triangle**.

By looking at the image, we can see that the drawing of Archimedes is located in the area where the circle and the square overlap. The triangle is in a separate area and does not cover the drawing.

The correct answer is **In the circle and in the square but not in the triangle**.

Problem 4:

To find the number of small squares that must be changed, we can compare each digit from the starting number (930) with the corresponding digit in the final number (806).

- **Changing 9 to 8:** If you compare the shape of the '9' and the '8', the only difference is that the '9' has a gap in its lower-left vertical line. To turn it into an '8', you need to fill that one gap. This requires changing **1** square.
- **Changing 3 to 0:** To turn a '3' into a '0', you need to make two changes on the left side and one in the middle.
    1. Fill in the top-left vertical line.
    2. Fill in the bottom-left vertical line.
    3. Erase the middle horizontal line. This requires changing **3** squares.
- **Changing 0 to 6:** To turn a '0' into a '6', you need to make two changes.
    1. Erase the top-right vertical line.
    2. Add the middle horizontal line. This requires changing **2** squares.

The total number of squares that must be changed is the sum of the changes for each digit: 1 + 3 + 2 = 6

The correct answer is **6**.

Problem 5:

Dana ate **6** mandarins.

First, Karl ate half of the 16 mandarins, which is 16 ÷ 2 = 8. Then, Eva ate 2 mandarins.

The total number of mandarins eaten by Karl and Eva is 8 + 2 = 10.

To find out how many Dana ate, subtract that total from the starting amount: 16 - 10 = 6

The correct answer is **6**

Problem 6:

The black line is **50 dm** long.

Here's a step-by-step explanation of how to find the length of the line:

1. **Analyze the Path:** The image shows the black line is a repeating zigzag pattern that passes through all **10** paving stones. This means the total length of the line is 10 times the length of the segment that passes through a single stone.
2. **Find the Length of One Segment:** To find the length of the line segment for one stone, we can think of it as the hypotenuse of a right-angled triangle. The legs of this triangle are determined by the stone's dimensions and how they are laid out.
    - The horizontal leg of the triangle corresponds to half the **length** of the paver: 6 dm / 2 = 3 dm.
    - The vertical leg of the triangle corresponds to the full **width** of the paver: 4 dm.
3. **Use the Pythagorean Theorem:** Now we can calculate the length of one segment of the black line.
    - $\text{Length}^2 = (3\text{ dm})^2 + (4\text{ dm})^2$
    - $\text{Length}^2 = 9 + 16 = 25$
    - $\text{Length} = \sqrt{25} = 5\text{ dm}$

So, the black line travels **5 dm** as it passes through each paving stone.

4. **Calculate the Total Length:** Since there are 10 stones, the total length of the line is: 10 stones × 5 dm per stone = 50 dm

The correct answer is **50 dm**.

Problem 7:

She rolled a six **3** times.

To solve this, we can work backward from the total score of 23. A standard die has a maximum score of 6.

The highest possible score from four rolls is 6 + 6 + 6 + 6 = 24, which is very close to 23. This suggests she must have rolled a high number of sixes.

Let's test the possibilities:

If she rolled four 6s: The total would be 6 × 4 = 24, which is too high.

If she rolled three 6s: The total from these rolls is 6 × 3 = 18. To reach the total of 23, the fourth roll must be 23 - 18 = 5. Since 5 is a valid number on a die, this scenario works. The rolls were 6, 6, 6, and 5.
If she rolled two 6s: The total from these rolls is 6 × 2 = 12. The other two rolls would need to sum to 23 - 12 = 11. This is impossible without using another 6 (e.g., 5+6), which contradicts the assumption of only rolling two sixes. The maximum sum of two rolls without a 6 is 5 + 5 = 10.
Therefore, the only possible scenario is that she rolled three 6s.
The correct answer is **3**.

Problem 8:
The film will end at **18:53**.
First, calculate the total duration of the event by adding the film's length and the two advert breaks.

- **Total Duration** = 90 minutes (film) + 8 minutes (adverts) + 5 minutes (adverts) = 103 minutes.

Next, convert this total duration into hours and minutes.

- 103 minutes = 1 hour and 43 minutes.

Finally, add this duration to the start time of 17:10.

- 17:10 + 1 hour = 18:10
- 18:10 + 43 minutes = 18:53

The correct answer is **18:53**.

Problem 9:
There will be the same number of boys and girls in **6** weeks.
Initially, there is a difference of 25 - 19 = 6 between the number of boys and girls.
Every week, 3 girls join while only 2 boys join. This means the number of girls gains on the number of boys by 3 - 2 = 1 person each week.
To close the initial gap of 6 people, it will take 6 people / 1 person per week = 6 weeks.
After 6 weeks:

- **Boys:** 25 + (6 × 2) = 25 + 12 = 37

- **Girls:** 19 + (6 × 3) = 19 + 18 = 37

The correct answer is **6**.

Problem 10:

There were **35** pieces in the entire bar of chocolate.

The information given describes the dimensions of the original rectangular chocolate bar.

When Peter broke off a **row with five pieces** for his brother, it tells us that the bar was **5 pieces wide** (it had 5 columns).

When he broke off a **column with 7 pieces** for his sister, it tells us that the bar was **7 pieces long** (it had 7 rows).

To find the total number of pieces, you multiply the number of rows by the number of columns: 7 rows × 5 columns = 35 pieces.

The correct answer is **35**.

Problem 11:

The farmer has **90** animals.

First, calculate the total number of cows' legs. Since each of the 30 cows has 4 legs:

- **Total cows' legs:** 30 × 4 = 120 legs.

The problem states the total number of chickens' legs is equal to the total number of cows' legs, so there are also **120** chickens' legs.

Next, find the number of chickens. Since each chicken has 2 legs:

- **Number of chickens:** 120 legs ÷ 2 legs per chicken = 60 chickens.

Finally, add the number of cows and chickens to find the total number of animals:

- **Total animals:** 30 cows + 60 chickens = 90 animals.

The correct answer is **90**.

Problem 12:

The correct picture is **C**.

The relationship between picture X and picture Y is a simple color inversion. Every black square in X becomes white in Y, and every white square in X becomes black in Y.
To find the picture paired with G, we must apply the same color inversion rule. If we flip all the black squares in picture G to white and all the white squares to black, the resulting image is picture C.
The correct answer is **C**.