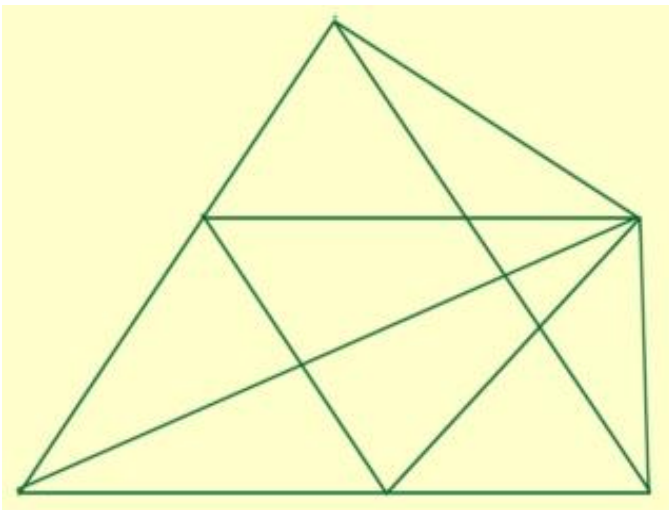1.

The picture shows a device for registering the level of a river. A float in the river rises and falls and is connected to a gear train. The gear on the right hand side causes a pointer to move up or down.

Has it been labelled correctly or incorrectly?

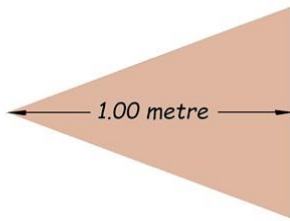2. What is the next number in this sequence?

$$99, 95, 87, 75, 59, \_\_\_\_$$

3.

What is the total number of triangles in this figure?

4

The figure to the left represents a sheet of wood cut to the shape of an isosceles triangle. Its axis is 1.00 metres long as shown.

Each of the fine green dotted lines below represent a possible second saw cut. Which of the four possible saw cuts shown below (A, B, C or D) will most nearly result in two pieces, each half the area of the original sheet?

1.00 metre

A   63 cm

B   67 cm

C   71 cm

D   75 cm
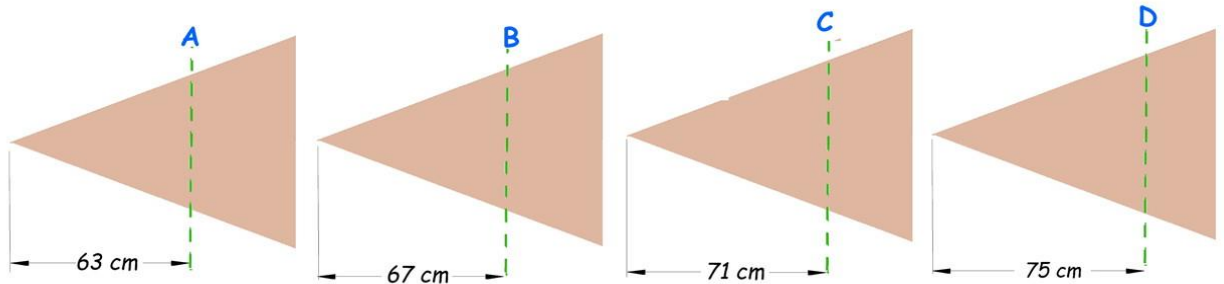
5. What are the two missing numbers in this sequence?

2, 5, 10, 17, 28, 41, 58, _____, 100, _____, 160

6. a. 529 is a perfect square. What is its square root?

   b. $5^n = 625$ What number is n?

7. If a hen and a half lays an egg and a half in a day and a half, how many eggs can half a dozen hens lay in half a dozen days?

8. There are four AFL matches taking place on the same day in an upcoming round. Dave, Nick and John are avid tipsters.

Dave selects Collingwood, Carlton, Adelaide, and Richmond as his four winners.

Nick thinks Richmond, Melbourne, Adelaide, and Sydney will be the winning teams.

John says "St Kilda, Melbourne, Carlton, and Richmond will all win their matches and Geelong will be the lowest scoring team on the day."

What are the four matchups? (Who's playing who?)

9. A Petri dish hosts a healthy colony of bacteria. Once a minute every bacterium divides into two. The colony was founded by a single cell at noon. At exactly 12:43 (43 minutes later) the Petri dish was half full.

At what time will the dish be full?

10. An audience attends the opening night of a fairly bad play.

Five minutes after it opens, three people walk out, leaving the theatre only 60% full.

Shortly after, another four people leave. The theatre is now only 50% full.
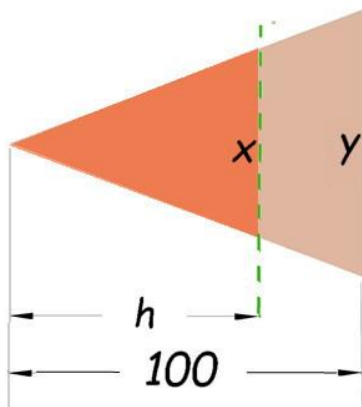
a. What is the capacity of the theatre?

b. How many were in the audience when the play began?

Answers:

1. Incorrectly (Pointer moves down during a flood)

2. 39

3. 27

4. C (71 cm)

If the two pieces are to have the same area, then the piece to the left of the saw cut will be a similar triangle to the original piece, but with half the area.

The formula for the area of a triangle

$$A = \frac{b \times a}{2}$$

Where A is the area of the triangle
b = the the base of the triangle
a is the altitude measured at right angles to the base.
Small triangle:

$$A_1 = \frac{x\,h}{2}$$

Original triangle:

$$A_2 = \frac{100\,y}{2}$$

and since the triangles are similar,

$$\frac{h}{x} = \frac{100}{y}$$

$$h = \frac{100\,x}{y}$$

substituting:

$$A_1 = \frac{xh}{2}$$

$$= \frac{x \times 100x}{2y}$$

$$= \frac{100x^2}{}$$

$$2y$$

$$A_2 = \frac{100y}{2}$$

But $A_1 = \frac{A_2}{2}$

So $A_1 = \frac{50y}{2}$

$$y = \frac{100x}{h}$$

$$A_1 = \frac{50 \times 100x}{2h} = \frac{xh}{2}$$

$$2xh^2 = 10^4 x$$

$$h = \sqrt{(5000)}$$

$$\sim 70.7$$

5. 77, 129

Each number is greater than the previous number by the next highest prime number

6. a. 23   b. 4

a. Two "tricks" to make calculation of square roots of perfect squares easier.
529 is between 400 (20^2) and 900 (30^2). So the answer is greater than 20, less than 30.
Squares that end in 9 must be the product of square roots that end in 3 or 7. So the answer is either 23 or 27.
More likely to be 23 as 529 is much closer to 20^2 than it is to 30^2

b. 5^n is "5 to the power of n" or the product of n fives.
By trial-and- error,

$5^2 = 5 \times 5 = 25$ n is not 2
$5^3 = 5 \times 5 \times 5 = 125$ n is not 3
$5^4 = 5 \times 5 \times 5 \times 5 = 625$ n = 4

7. 24 eggs

If a hen and a half lays an egg and a half in a day and a half, that simplifies to 1 hen laying 1 egg each day and a half; NOT each day.
Therefore each hen will lay 4 eggs in 6 days.
6 hens will lay 24 eggs in 6 days.

8. Richmond v Geelong;   Melbourne v Collingwood;   Adelaide v St Kilda;   Carlton v Sydney

Dave, Nick and John all think Richmond can win. However, between them Dave, Nick and John all put up every other team except Geelong as possible winners. Richmond must be playing Geelong.

Adelaide can't be playing Collingwood, Carlton, Richmond, Melbourne or Sydney (picked as possible co-winners by Dave and Nick) OR Geelong (who we've already concluded are playing Richmond). That only leaves St Kilda as Adelaide's opponent

Similarly, Melbourne can't be playing Richmond, Adelaide, Sydney, St Kilda or Carlton; OR Geelong (playing Richmond). Melbourne must be playing Collingwood.

The only two teams not accounted for are Carlton and Sydney. It's Carlton v Sydney.

9. 12:44 pm

10. a. 40 people   b. 27 people

At no stage is it suggested that the theatre is full at the beginning

The easiest way to calculate the capacity of the theatre is to use the fact that four people leaving represents (60 − 50) = 10 percent of the possible audience. 100% of the possible audience (theatre capacity) is therefore 40 people.

After the first three people leave, the theatre is at 60% capacity, i.e. 24 people. There were 27 people at the start.