1. A number is called "jolly" if the sum of its digits is even. How many two-digit jolly numbers are there?

   Solution: The first digit of a two-digit jolly number might be 1, 2, 3, 4, 5, 6, 7, 8, or 9. There are therefore 9 options for the first digit of a two-digit jolly number. If the first digit is even, the number is jolly as long as the second digit is even. Therefore, if the first digit is even, the second digit has 5 options: it may be 0, 2, 4, 6, or 8. If the first digit is odd, the number is jolly as long as the second digit is also odd. Hence if the first digit is odd, the second digit has 5 options: it may be 1, 3, 5, 7, or 9. So regardless of the first digit, the second digit has 5 options that make the number jolly. Since there are 9 options for the first digit, we conclude that there are 9x5=**45** different two-digit jolly numbers.

2. Ten years ago, Alex was three times as old as Beth. Now, Alex is six years older than Beth. How old is Beth now?

   Solution: Since Alex is 6 years older than Beth, he would have still been 6 years older 10 years ago. This means that 10 years ago, Alex was 3 times older than Beth, and also 6 years older than Beth. Therefore 3 times Beth's age was equal to Beth's age plus 6, so twice Beth's age was equal to 6. In other words, Beth was 3 years old. All this was 10 years ago, so Beth is 3+10=**13** now.

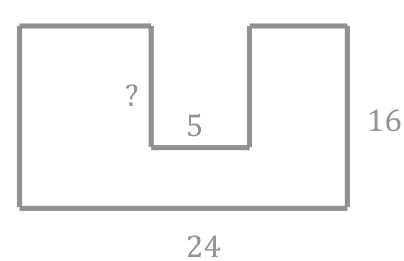
3. Cindy is a scientist studying a certain type of bacteria. She notices that the number of bacteria on a Petri dish doubles every 20 minutes. If she has 2 bacteria at 5pm, how many bacteria will she have at 8pm the same day?

   Solution: There are 3 hours between 5pm and 8pm, which is equal to 3x60=180 minutes. The number of bacteria doubles every 20 minutes, and this happens 180/20 = 9 times between 5pm and 8pm. In total, the number of bacteria grew by 2^9 during this time. Since there were 2 bacteria at 5pm, there were $2 \times 2^9 = 2^{10} =$ **1024** bacteria at 8pm.

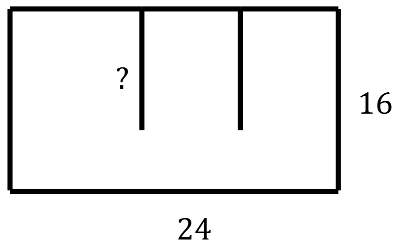
4. Dan wrote down 3 different natural numbers on a blackboard. The product of these numbers is 15. What is the sum of these 3 numbers? (Reminder: a natural number is a whole number that is positive. In other words, the natural numbers are 1, 2, 3, 4, 5, …)

   Solution: The factors of 15 are 1, 3, 5, and 15. This means that the only possible natural numbers we can multiply with anything to get 15 are 1, 3, 5, and 15. We need three different natural numbers whose product is 15, so it is clear that the only choice is 1x3x5. The sum of these three numbers is 1+3+5=**9**.

5. The perimeter of the figure below is 100. Find the length of the side labelled "?".



Solution: If we shift the segment of length 5 upwards, we get the shape



The perimeter of the outside rectangle is 24+16+24+16=80. We know that the perimeter of the original shape was 100, but this must be equal to 80 plus the length of the two segments inside the rectangle. These segments each have length "?", so two times "?" plus 80 is equal to 100. It follows that two times "?" is equal to 20, so "?" is **10**. (Note: the information that the segment is of length 5 is not actually needed).

6. Five people, named Al, Bob, Cindy, Dan, and Ed, are in a pie-eating contest. Al cuts his pie into 3 equal pieces and eats 2 pieces. Bob cuts his pie into 4 equal pieces and eats 2 pieces. Cindy cuts her pie into 5 equal pieces and eats 3 pieces. Dan cuts his pie into 7 equal pieces and eats 4 pieces. Ed cuts his pie into 10 equal pieces and eats 5 pieces. Who ate the most pie?

   Solution: Al ate 2/3 of the pie. Bob ate 2/4 = 1/2 of the pie. Cindy ate 3/5 of the pie. Dan ate 4/7 of the pie. Ed ate 5/10=1/2 of the pie. Since 2/3 is more than 1/2, Al ate more pie than Bob and Ed. Notice that 2/3=10/15, and 3/5=9/15. This means 2/3 is more than 3/5, so Al ate more pie than Cindy. Finally, note that 2/3=14/21, and 4/7=12/21. This means that 2/3 is more than 4/7, so Al ate more pie than Dan. Therefore **Al** ate the most pie.

7. There are 46 students in a class. 17 students know how to ride a bike, 14 students know how to swim, and 19 students don't know how to swim or ride a bike. How many students know both how to swim and how to ride a bike?

   Solution: Consider the categories "can swim", "can ride a bike", "can't swim or ride a bike". The number of students in them is 14, 17, and 19. Notice that 17+14+19=50, but there are only 46 students in the class. This means 4 students were counted twice. These 4 students must be in two of the categories. The only way a student can be in two categories is if he can swim and can ride a bike. Therefore **4** students know how to swim and bike.

8. The distance between Ed's house and Fiona's house is 3000 metres. Fiona takes 30 minutes to walk this distance. Ed takes 60 minutes to walk this distance. One day, Fiona and Ed both started walking towards each other at the same time. After how much time did they meet?

   Solution: Fiona's speed is 3000m/30min, which is 100 metres per minute. Ed's speed is 3000/60=50 metres per minute. When they walk towards each other, they get closer at a speed of 50+100=150 metres per minute. This means it takes them 3000/150=**20 minutes** to meet. (Note: the information that the distance is 3000 metres is not actually needed).