

Substitution Word Problems

Example Problems

EXAMPLE 1: The number of paper plates (p) needed to cater a party is determined by the number of guests who will attend (n). This is calculated using the formula $p = 3n$. How many paper plates will be needed for a party of 5 people?

SOLUTION: First, when confronting a word problem it is helpful to determine and note down which variable represents what aspect of the question or situation. For example in the above question we have,

- n is the number of guests,
- p is the number of paper plates required.

Then we can extract from the question the important information. The most important part of any word problem is identifying what the question wants you to find. In this question

How many paper plates will be needed

tells us we are looking for the number of paper plates, represented by p (recall the list we made at the start). In order to find the value of p using the formula,

$$p = 3n,$$

we will need to substitute the value of the other pronumerals in the formula, in this case we need to know the value of n . Thankfully, the phrase

a party of 5 people

which tells us that the variable representing the number of guests (n) is 5. We could represent this as a simple equation

$$n = 5.$$

Once we have this information we can substitute $n = 5$ into the formula and find the appropriate value of p ,

$$\begin{aligned}
p &= 3n, \\
p &= 3 \times 5, \\
p &= 15.
\end{aligned}$$

Finally we might write a short sentence to answer the question,

15 paper plates will be needed for the party.

EXAMPLE 2: The formula for calculating the interior angle sum (S) of an n sided polygon is $S = 180(n - 2)$. What would be the interior angle sum of a heptagon (polygon with 7 sides)?

SOLUTION: First we have the two variables involved in this question

- S represents the sum of all the angles inside the polygon.
- n is the number of sides that the polygon has.

Since we know the polygon is a heptagon and has 7 sides this tells us that

$$n = 7.$$

We can then substitute this into the equation and evaluate the RHS to determine the value of S ,

$$\begin{aligned}
S &= 180(n - 2), \\
S &= 180(7 - 2), \\
S &= 180 \times 5, \\
S &= 900.
\end{aligned}$$

EXAMPLE 3:

SOLUTION:

Question Bank

NOTE: Any questions where you get a decimal or fraction as an answer can be rounded to 2 decimal places or left as an exact value.

1. For a restaurant with n tables that each seat 4 people, the formula to calculate the maximum capacity (C) of the restaurant is $C = 4n$. How many people would fit in a restaurant with 14 tables?
2. The number of display items (n) that will fit behind a shop window is determined by the width (w meters) of the window. The formula is $n = 5(w - 1)$. How many items can be placed behind a window that is 3m wide?
3. A pizzeria has two types of seating, it has some bar seating that can seat 9 people, and n tables that each seat 5. The formula for calculating the maximum capacity (C) of the pizzeria is $C = 5n + 9$, what would be the maximum capacity when there are 4 tables?
4. The number of wait staff (S) needed to work at a restaurant is determined by the number of tables (n) on the floor. Formula to work out the minimum number of staff required is $S = \frac{n + 12}{8}$. How many staff would be needed for a restaurant with 48 tables? Round up to the nearest whole number of staff.
5. In order to calculate the perimeter (P) of a rectangle you need to know its length (l) and width (w). The formula to calculate the perimeter is $P = 2l + 2w$. What would be the perimeter of a rectangle that is 6cm wide and 9cm long?
6. The formula to calculate the area (A) of a trapezium is $A = \frac{a + b}{2}h$. In this formula a and b are the lengths of the two parallel sides, and h is the perpendicular height between them.
 - a) Find the area of a trapezium with parallel side lengths of 4cm and 7cm, and a perpendicular height of 6cm.
 - b) Using this alternate formula $A = 0.5(ah + bh)$, calculate the area of the trapezium from part a).

- c) For you, which formula, $A = \frac{a+b}{2}h$ or $A = 0.5(ah + bh)$, was easier to use and why? Which formula do you think is simpler or which do you prefer?
7. The distance (d meters) that a ball has travelled since being thrown down a cliff is given by the formula $d = ut + \frac{1}{2}at^2$. In the formula u is the speed the ball was thrown at (in m/s), a is the acceleration due to gravity (in m/s²), and t is the time in seconds since the ball was thrown. If the speed the ball was thrown at is 14m/s and the acceleration due to gravity is 10m/s², how far will the ball have fallen after 3 seconds?

Answers

1. 56 people
2. 10 items
3. 29 people
4. 8 wait staff
5. 30cm
6.
 - a) 33cm^2
 - b) 33cm^2
 - c) Any reasonable answer is correct here, but common observations might include the number of evaluation steps, the presence of fractions or decimals, or how hard a formula is to read.
7. 87m