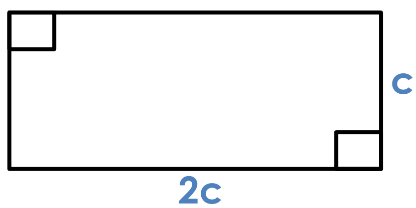
CHAPTER 3
ALGEBRAIC FORMULAE

3.1 Algebraic formulae

1. Algebraic formula is an equation that shows the relationship between a few variable and a constant.
2. A formula can be formed based on
   a. statement
   b. situation

Example 1



Write a formula for area, A, of the rectangle shown in the diagram above.

Solution:
Area = length x width
Thus, $A = 2c \times c$
$A = 2c^2$

Example 2

Based on the following statement, form an algebraic formula.
a. Square of the sum of two number is 81.
b. A number which is the product of another number and 7.

Solution:
a. Let a and b be the two number.
   Square of the sum of 2 number is $(a + b)^2$

   Thus, sum of the square of two number equal to 81 is $(a + b)^2 = 81$.

b. Let v be the first number and w be the second number.

The product of the second number and 7 is 7 w.

Thus, $v = 7w$

Example 3

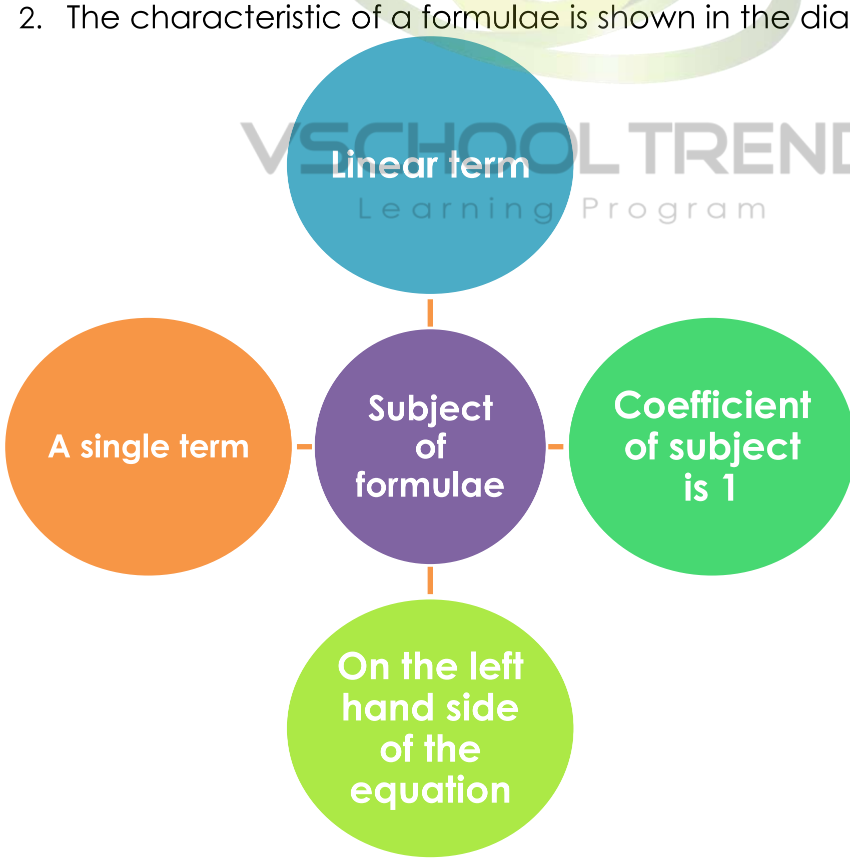
Given the price of a banana is RM m and the price of a kiwi is RM n.
Shila buys 7 bananas and 10 kiwis.
Write a formula for the total amount, RM t that Shila needs to pay.

Solution:

Price of a banana = m
Price of 7 bananas = 7m
Price of a kiwi = n
Price of 10 kiwis = 10n
Total amount that Shila needs to pay = t
Thus, $t = 7m + 10n$

Changing the Subject of Algebraic Formulae

1. The subject of a formulae is a variable that is expressed in terms of other variable and a constant.
2. The characteristic of a formulae is shown in the diagram below.



Example 4

Express the variable in the bracket as the subject of the formula.

a. $t = u + w$ [u]

b. $g = \frac{e}{2f}$ [e]

c. $n = \sqrt{w}$ [w]

d. $s = ab$ [a]

e. $q = o^3$ [o]

Solution:

a. $t = u + w$

$t - w = u + w - w$ ← Subtract both side of the equation by w

$t - w = u$

Thus, $u = t - w$

b. $g = \frac{e}{2f}$

$g \times 2f = \left(\frac{e}{2f}\right) \times 2f$ ← Multiply both side of the equation by 2f

$2gf = e$

Thus, $e = 2gf$

c. $n = \sqrt{w}$

$n^2 = (\sqrt{w})^2$ ← Square both side of the equation

$n^2 = w$

Thus, $w = n^2$

d. $s = ab$

$s \div b = ab \div b$ ← Divide both side of the equation by b

$\frac{s}{b} = a$

Thus, $a = \frac{s}{b}$

e. $q = o^3$

$\sqrt[3]{q} = \sqrt[3]{(o^3)}$ ← Take cube roots on both side of the equation

$\sqrt[3]{q} = o$

Thus, $o = \sqrt[3]{q}$

Example 5

a. Given the formula m = $\frac{3p-pq}{4}$, express p in term of m and q.

b. Given the formula $\frac{(2y-3)}{y+z}$ = 4, express y in term of z.

Solution:

a. m = $\frac{3p-pq}{4}$

4m = 3p – pq

4m = p(3 – q)

p = $\frac{4m}{3-q}$

Thus, p = $\frac{4m}{3-q}$

b. $\frac{(2y-3)}{y+z}$ = 4

2y – 3 = 4y + 4z

-2y = 4z + 3

y = $\frac{4z+3}{-2}$

Thus, y = $\frac{4z+3}{-2}$

Determining the value of a variable

Example 6

Given that s = 4p - 3q, find

a. the value of s when p = 4 and q = 3
b. the value of q when s = 2 and p = 5

Solution:

a. Given that p = 4 and q = 3 ;

s = 4p – 3q

Substitute the value of p and q into the equation.

s = 4p – 3q

s = 4(4) – 3(3)

= 16 – 9

= 7

b. Given that s = 2 and p = 5

s = 4p – 3q

Substitute the value of s and p into the equation.

s = 4p – 3q

2 = 4(5) – 3q

2 = 20 – 3q

3q =18

q = $\frac{18}{3}$ = 6

Problem involving Algebraic Formulae

Example 7

The price in RM for Jenny who stays in hotel for t days following the formula of $P = 215 + 75t$.

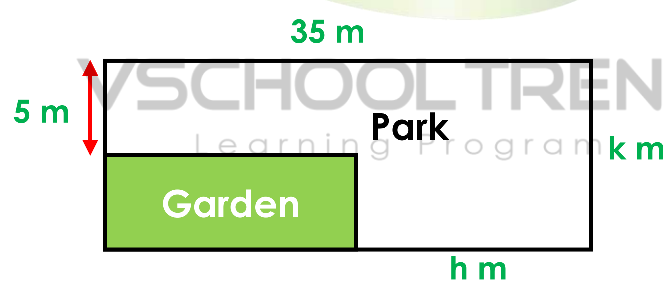
a. Find the value of P when $t = 3$.
b. Calculate the numbers of days the customer stays in the hotel if he pays RM 815.

Solution:

a. Given $t = 3$
   $P = 215 + 75t$
   Substitute $t = 3$ into the equation.
   $P = 215 + 75\,(3) = 440$

b. Given that P is 815, t = ?
   $215 + 75t = 815$
   $75t = 815 - 215$
   $75t = 600$
   $t = \frac{600}{75} = 8$
   Thus, the number of days the customer stay in the hotel is 8.

Example 8



A piece of rectangle land that used to build park and a garden is shown in the diagram above.

a. Ali wants to fence the garden with wires. Express the perimeter, P, of the garden in terms of h and k.
b. If the area of the park is 265 m² and $k = 10$, calculate the value of h.

Solution:

a. Given the length of the garden = (35 – h) m
Width of the garden = (k – 5) m
Perimeter of the garden, P = 2 × (35 – h) + 2 × (k – 5) = 2 k – 2 h + 60

b. Area of the park
= 35 × k – (35 – h)(k – 5)
= 35k – (35 – h) (k – 5)

When k = 10,
35k – (35 – h) (k – 5) = 265
35(10) – (35 – h)(10 – 5) = 265
350 – 5(35-h) = 265
-5 (35 – h) = 265 – 350
-5(35 – h) = -85
35 – h = $\frac{-85}{-5}$
35 – h = 17
h = 35 – 17
h = 18

Example 9

Jaryl bought n bottles of carbonated drinks at the price of RM t per bottle, he sold all the carbonated drinks at the price of RM k per bottle and earned a profit of RM j. Express n in terms of t, k and j.

Purchasing price = n × RM t

Selling price = n × RM k

Profit = RM j

Profit = Selling price – purchasing price

Thus,

j = nk – nt
j = n(k-t)
n = $\frac{j}{k-t}$