CHAPTER FOUR

CHANGE OF SUBJECT:

To make a letter the subject of an equation, we let it stand alone on one side of the given equation.

Q1. Given that C= 2πr,

a. make r the subject.
b. calculate r when C = 20cm and $\pi = 3.14$.

Soln.

a. C =2πr.

Divide through using 2π.

$$\Rightarrow \frac{C}{2\pi} = \frac{2\pi r}{2\pi} \Rightarrow \frac{C}{2\pi} = r,$$

$$\Rightarrow \quad r = \frac{c}{2\pi}.$$

b. When c = 20 and $\pi = 3.14, then\ r = \frac{c}{2\pi} = \frac{20}{2(3.14)} = \frac{20}{6.28} \Rightarrow \quad r = 3.2cm.$

Q2. Given that M = RVL,

a. make V the subject.
b. Calculate V when M=50, R=20 and L = 10.

Soln.

a. M = RVL

Divide through using RL

$$\Rightarrow \frac{M}{RL} = \frac{RVL}{RL} \Rightarrow \frac{M}{RL} = V, \Rightarrow V = \frac{M}{RL}.$$

b. Given that M = 50 and R = 20 when L = 10, then V=.$\frac{M}{RL} = \frac{50}{20(10)} = \frac{50}{200}, \Rightarrow V = 0.25.$

Q3. You are given the formula $2RV^2 = mg$. Calculate R when V= 3, m = 5 and g = 2.

N/B: Before you can calculate R, you must first make it the subject.

Soln.

$2RV^2 = mg.$

Divide through using $2V^2$

$\Rightarrow \frac{2RV^2}{2V^2} = \frac{mg}{2V^2} \Rightarrow R = \frac{mg}{2V^2}.$

But since when V=3, m = 5 and g = 2,$\Rightarrow$R= $\frac{mg}{2V^2} = \frac{5(2)}{2(3)^2} = \frac{10}{2(9)} = \frac{10}{18} \Rightarrow R = 0.56.$

Q4. If $5b^2r^3v = 2N$, make v the subject.

Soln.

$5b^2r^3v = 2N$

For V to stand alone on the left hand side of the given equation, we divide through the given equation using $5b^2r^3$

$$\Rightarrow \frac{5b^2r^3v}{5b^2r^3} = \frac{2N}{5b^2r^3} \Rightarrow V = \frac{2N}{5b^2r^3}$$

N/B: - If $a^2 = 10 \Rightarrow a = \sqrt{10} = 3.2.$

- If $y^2 = k \Rightarrow y = \sqrt{k}.$
- If $x^2 = 9 \Rightarrow x = \sqrt{9} = 3.$

Q5. Given that $2RV^2 = mg$, calculate V when m = 50, g = 4 and R = 1.

Soln.

First make V the subject.

$2RV^2 = mg.$

Divide through using 2R,

$\Rightarrow \frac{2RV^2}{2R} = \frac{mg}{2R}, \Rightarrow V^2 = \frac{mg}{2R} \Rightarrow V = \sqrt{\frac{mg}{2R}}.$

But since when m = 50, g = 4 and R = 1,

$$\Rightarrow V = \sqrt{\frac{mg}{2R}} = \sqrt{\frac{50(4)}{2(1)}} = \sqrt{\frac{200}{2}} = \sqrt{100} = 10.$$

<u>Change of subject involving the addition and the subtraction symbols:</u>

Q1. If a+b = 2R,

i) make a the subject.
ii) calculate a when b = 3 and R=3.

Soln.

i) From a +b = 2R $\Longrightarrow a = 2R - b$.
ii) when b = 3 and R = 3,
$\Longrightarrow a = 2R - b = 2(3) - 3 = 6 - 3 = 3.$

Q2. Given that a+b = 2R,
i) make b the subject.
ii) make R the subject.

Soln.

i) Since a + b = 2R,$\Longrightarrow b = 2R - a$.
ii) Considering a + b = 2R, and dividing through using 2 $\Longrightarrow \frac{a+b}{2} = \frac{2R}{2}, \Longrightarrow \frac{a+b}{2} = R, \Longrightarrow R = \frac{a+b}{2}$.

Q3. Given that 2V+3R = 4b,

a. make V the subject.
b. calculate V when R = 3 and b = 1.

Soln.

a. From 2V+3R = 4b,$\Longrightarrow 2V = 4b - 3R$.

Divide through using 2
$\Longrightarrow \frac{2V}{2} = \frac{4b-3R}{2}, \Longrightarrow V = \frac{4b-3R}{2}$.

b. When R = 3 and b = 1, then V = $\frac{4b-3R}{2} = \frac{4(1)-3(3)}{2} = \frac{4-9}{2} = \frac{-5}{2} = -2.5$.

Q4. You are given that 2V+3R = 4b.

a. Make R the subject.
b. Make b the subject.

Soln.

a. From 2V+3R = 4b,$\Longrightarrow 3R = 4b - 2V$.
   Divide through using 3,

$\Rightarrow \frac{3R}{3} = \frac{4b-2V}{3}, \Rightarrow R = \frac{4b-2V}{3}.$

b. Consider 2V+3R = 4b.

Divide through using 4 $\Rightarrow \frac{2V+3R}{4} = \frac{4b}{4}, \Rightarrow \frac{2V+3R}{4} = b \ \Rightarrow b = \frac{2V+3R}{4}.$

Q5. Given the formula V = 3u + at^2,

a. calculate a, when V = 10, t = 1 and u = 3.
b. make t the subject.
c. calculate t when V = 115, u = 10 and
   a = 4.

Soln.

a. From V = 3u + at^2$\Rightarrow$ V – 3u = at^2,

Divide through using t^2

$\Rightarrow \frac{V-3u}{t^2} = \frac{at^2}{t^2},$

$\Rightarrow \frac{V-3u}{t^2} = a, \Rightarrow a = \frac{V-3u}{t^2}.$

$Since\ when\ v = 10, t = 1\ and\ u = 3,$

$\Rightarrow a = \frac{10-3(3)}{(1)^2} = \frac{10-9}{1} = \frac{1}{1},$

$\Rightarrow a = 1.$

b. Since V = 3u + at^2 $\Rightarrow V - 3u = at.^2$

Divide through using a $\Rightarrow \frac{V-3u}{a} = \frac{at^2}{a}, \Rightarrow \frac{V-3u}{a} = t^2, \Rightarrow t = \sqrt{\frac{V-3u}{a}}.$

When V = 115, u = 5 and a = 4,$\Rightarrow t = \sqrt{\frac{115-3(5)}{4}} = \sqrt{\frac{100}{4}} = \sqrt{25} \Rightarrow t = 5.$

Q6. If 2VK=ga^2 – u,

a. make k the subject.
b. make a the subject.

Soln.

a) 2VK = ga^2 – u.

Divide through using 2v.

$$\Rightarrow \frac{2vk}{2v} = \frac{ga^2-u}{2v}$$

$\Rightarrow k = \frac{ga^2-u}{2v}.$

b) Considering 2v$k + u = ga^2$, and dividing through using g,

$$\Longrightarrow \frac{2vk+u}{g} = \frac{ga^2}{g} \Longrightarrow \frac{2vk+u}{g} = a^2, \Longrightarrow a^2 = \frac{2vk+u}{g}, \Longrightarrow a = \sqrt{\frac{2vk+u}{g}}$$

Q7. If MN + $2V^2b^3$ = 6r, calculate N when M = 6, b = 1, r = 4 and v = 1.

Soln.

From MN +$2V^2b^3$ = 6r $\Longrightarrow MN = 6r - 2V^2b^{\,3}$.

Dividing through using M,

$\Longrightarrow \frac{MN}{M} = \frac{6r-2V^2b^3}{M}$,

$\Longrightarrow N = \frac{6r-2V^2b^2}{M}$

Since when M = 6, b = 1, r = 4 and v = 1,

=> N = $\frac{6(4)-2(1)^2(1)^3}{6}, \Longrightarrow N = \frac{24\ -2(1)(1)}{6}$

$= \frac{24-2}{6} = \frac{22}{6} = 3\frac{2}{3}$ = 3.6.

N/B: When the letter that we are required to make the subject appears more than ones within the given equation, group all of them on one side of the equation and factorize it out.

Q8. Assuming that 5b+k = 3b+10, calculate b when k = 4.

N/B: First make b the subject, but since it occurs twice, bring all of them to one side of the equation and factorize it out.

Soln.

From 5b+k = 3b+10,$\Longrightarrow 5b = 3b + 10 - k$,

$\Longrightarrow 5b - 3b = 10 - k, \Longrightarrow b(5-3) = 10 - k, \Longrightarrow b(2) = 10 - k, \Longrightarrow 2b = 10 - k, \Longrightarrow \frac{2b}{2} = \frac{10-k}{2}, \Longrightarrow$

b $= \frac{10-\mathrm{k}}{2}$.