# CHAPTER TWO

## CHANGE OF SUBJECT

## Introduction:

To make a letter the subject of a given equation is to let it stand alone, on one side of the equal to symbol.

Q1. Given that c = 2πr,

i) make r the subject.
ii) calculate r when c = 20 and π = 3.14 .

Soln.

c = 2πr

Divide through using 2π $\Rightarrow \frac{c}{2\pi} = \frac{2\pi r}{2\pi} \Rightarrow \frac{c}{2\pi} = r \Rightarrow$ r = $\frac{c}{2\pi}$

When c = 20 and π = 3.14

$\Rightarrow$ r = $\frac{c}{2\pi} = \frac{20}{2(3.14)} = \frac{20}{6.28}$

= 3.2 $\Rightarrow$ r = 3.2.

Q2. Given that M = RVL,

i) make V the subject.
ii) Calculate V when M = 50, R = 20 and L = 10.

Soln.

i) M = RVL

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

ii) When M = 50, R = 20 and L = 10 $\Rightarrow$ V = $\frac{M}{RL} = \frac{50}{(20)(10)}$

= $\frac{50}{200} = 0.25$.

Q3. You are given the formula $2RV^2$ = mg.

i) Make R the subject.

ii) Calculate R when V = 3, M = 5 and g = 2.

Soln.

i) $2RV^2 = mg$.

Divide through using $2V^2 \Rightarrow \frac{2RV^2}{2V^2} =$ R = $\frac{mg}{2V^2}$

ii) If 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 = 0.55 .

Q4. Given that a + b = 2R,

i) make a the subject.
ii) calculate a, when b = 3 and R = 10.
iii) make R the subject.
iv) calculate R when a = 3 and b = 5.

Soln.

i) a + b = 2R $\Rightarrow$ a = 2R – b

ii) When b = 3 and R = 10 $\Rightarrow$ a = 2R – b, $\Rightarrow$ a = 2(10) – 3
= 20 – 3 = 17.

iii) To make R the subject, a + b = 2R. Divide through using 2 $\Rightarrow \frac{a+b}{2} = \frac{2R}{2} \Rightarrow \frac{a+b}{2} = R$
$\Rightarrow$ R = $\frac{a+b}{2}$ .
When a = 3 and b = 5
$\Rightarrow$ R = $\frac{a+b}{2} = \frac{3+5}{2} = \frac{8}{2} = 4$ .

Q5. Given that 2V + 3R = 4b,

i) make V the subject.
ii) calculate V when R = 3 and b = 1.

Soln.

i) 2V + 3R = 4b $\Rightarrow$ 2V = 4b – 3R

Divide through using 2 $\Rightarrow \frac{2v}{2} = \frac{4b-3R}{2} \Rightarrow V = \frac{4b - 3R}{2}$

ii) When R = 3 and b = 1

$\Rightarrow$ V = $\frac{4(1) - 3(3)}{2} = \frac{4 - 9}{2} = \frac{-5}{2} = -2.5.$

Q6. Given that the three quantities V, u and t are connected by the formula V = 3u + a$t^2$, calculate a when V = 10, t = 1 and u = 3.

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

Soln.

V = 3u + a$t^2 \Rightarrow V - 3u = at^2$

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

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

When V = 10, t = 1 and u = 3

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

= 1 .

N/B: If $a^2 = 4 \Rightarrow a = \sqrt{4} = 2.$

If $x^2 = 25 \Rightarrow x = \sqrt{25} = 5.$

Q7. If 2V = u – g$a^2$,

(i) make a the subject.

(ii) calculate a when V = 3, u = 30 and g = 1.

Soln.

(i) 2V = u – g$a^2 \Rightarrow 2V + ga^2 = u$

$\Rightarrow ga^2 = u - 2V$.

Divide through using g

$\Rightarrow \frac{ga^2}{g} = \frac{u-2v}{g} \Rightarrow a^2 = \frac{u-2V}{g} \Rightarrow a = \sqrt{\frac{u-2v}{g}}$.

(ii) When V = 3, u = 30 and g = 1

$\Rightarrow a = \sqrt{\frac{30-2(3)}{1}} \Rightarrow a = \sqrt{\frac{30-6}{1}}$

$\Rightarrow a = \sqrt{\frac{24}{1}} \Rightarrow a = \sqrt{24} = 4.9$ .

Q8. The movement of a particle is such that its final velocity V, its initial velocity u, its acceleration a and its time t, are connected by the formula V = 3u + a$t^2$ . Calculate the time in seconds when $V = 115m/s$ , $u = 5m/s$ and $a = 4m/s^2$ .

Soln.

V = 3u + a$t^2 \Rightarrow V - 3u = at^2$

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

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

But V = 115, u = 5 and a = 4

$\Rightarrow$ t = $\sqrt{\frac{115-3(5)}{4}} = \sqrt{\frac{100}{4}} = \sqrt{25}$

= 5 $\Rightarrow$ t = 5seconds.

N/B: If the letter we are required to make the subject appears twice, then we must factorize it by bringing it outside the bracket.

Q9. The variables b and v are connected by the formula 5b - $v^2$ = vb + 2. Make b the subject.

Soln.

$5\mathrm{b} - v^2 = vb + 2 \Rightarrow 5\mathrm{b} = \mathrm{vb} + 2 + \mathrm{v}^2, \Rightarrow 5\mathrm{b} - \mathrm{vb} = 2 + \mathrm{v}^2$ . Factorize the b

$\Rightarrow \mathrm{b}(5 - \mathrm{v}) = 2 + \mathrm{v}^2$

Divide through using $5 - \mathrm{v} \Rightarrow \frac{b(5-v)}{5-v} = \frac{2+v^2}{5-v}$

$\Rightarrow$ b = $\frac{2+v^2}{5-v}$.

Q10. Given that a$v^2 + 2 = 2v^2 - 2c, make\ v\ the\ subject.$

Soln.

a$v^2 + 2 = 2v^2 - 2c$

$\Rightarrow$ a$v^2 + 2 - 2v^2 = -2c,$

$\Rightarrow av^2 - 2v^2 = -2c - 2$

$\Rightarrow v^2(a-2) = -2c - 2,$

Divide through using a – 2.

$\Rightarrow \frac{v^2(a-2)}{(a-2)} = \frac{-2c-2}{(a-2)}$

$\Rightarrow v^2 = \frac{-2c - 2}{(a - 2)} \Rightarrow \text{v} = \sqrt{\frac{-2\text{c} - 2}{\text{a} - 2}}$.

N/B: (1) If $a^2 = b \Rightarrow \text{a} = \sqrt{\text{b}}$

(2) If $a^3 = b \Rightarrow \text{a} = \sqrt[3]{\text{b}}$

(3) If $a^4 = b \Rightarrow \text{a} = \sqrt[4]{\text{b}}$

(4) If $a^5 = b \Rightarrow \text{a} = \sqrt[5]{\text{b}}$.

Q11. Given that $5b^3 - 1 = v^2$

(i) make b the subject

(ii) calculate b when v = 10.

Soln.

$5b^3 - 1 = v^2 \Rightarrow 5\text{b}^3 = v^2 + 1,$

$\Rightarrow \frac{5b^3}{5} = \frac{v^2 + 1}{5} \Rightarrow \text{b}^3 = \frac{v^2 + 1}{5},$

$\Rightarrow \text{b} = \sqrt[3]{\frac{v^2 + 1}{5}}. \quad If\ v = 10$

$\Rightarrow \text{b} = \sqrt[3]{\frac{10^2 + 1}{5}} = \sqrt[3]{\frac{100 + 1}{5}} = \sqrt[3]{\frac{101}{5}}$

$= \sqrt[3]{50.5} = 3.6$.

Q12. If $b^3 + 3 = v^4 + 5, make\ b\ the\ subject.$

Soln.

$b^3 + 3 = v^4 + 5 \Rightarrow b^3 = v^4 + 5 - 3, \Rightarrow b^3 = v^4 + 2 \Rightarrow \text{b} = \sqrt[3]{v^4 + 2}.$

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