CHAPTER THREE
Change of Subject and Substitution

(Q1) If q = at + $\frac{1}{2}$ft, find q, when a = 20, t = 0 and f = 15.

(a) If v = u + at, find v when u = 6, a = 10 and t = 2.

(b) Given that y = $\frac{x+8}{x-4}$, determine the value of y when x = 2.

Soln:

(a) If a = 20, t = 0 and f = 15, then q = at + $\frac{1}{2}$ft

=> q = (20)(0) + $\frac{1}{2}(15)(0)$,

=> q = 0 + $\frac{1}{2}(0) \Rightarrow q = 0 + 0 = 0$.

N/B: Any number multiplied by zero = 0.

(b) If u = 6, a = 10 and t = 2, then from v = u + at

=> v = 6 + (10)(2), => v = 6 + 20 = 26.

(c) Since x = 2, then y = $\frac{x+8}{x-4}$

=> y = $\frac{2+8}{2-4} = \frac{10}{-2} = -5$.

(Q2)(a) If R = $\frac{h}{2} + \frac{d^2}{8h}$, find R when d = 8 and h = 6.

(b) If a = - 4 and b = 3, evaluate $\frac{3a+2b}{ab}$.

(c)Given that w = $\frac{n-q}{q}$, make q the subject.

Soln:

(a)If d = 8 and h = 6, then R = $\frac{h}{2} + \frac{d^2}{8h} \Rightarrow R = \frac{6}{2} + \frac{8^2}{8(6)}$

=> R = 3 + $\frac{(8)(8)}{8(6)}, \Rightarrow R = 3 + \frac{8}{6}$,

=> R = 3 + $\frac{4}{3} = 3 + 1\frac{1}{3} = 4\frac{1}{3}$.

(b)Since b = 3 and a = - 4, then $\frac{3a + 2b}{ab} = \frac{3(-4) + 2(3)}{(-4)(3)} = \frac{-12 + 6}{-12}$

= $\frac{-6}{-12} = \frac{1}{2}$.

(d) From W = $\frac{n - q}{q} => \frac{W}{1} = \frac{n - q}{q}$

By cross multiplication =>

w x q = 1 (n – q), => wq = n – q

=> wq + q = n, => q(w + 1) = n

=> $\frac{q\ (W + 1)}{W + 1} = \frac{n}{W + 1}, => q = \frac{n}{W + 1}$.

(Q3)(a) If F = $\frac{t}{s} - \mathrm{m}$, make m the subject.

(b) Given that a = 2 and b = 3, find (2a + b)(a – 2b).

(c) Find the difference between the values of $(2d)^2$ and $2d^2$, when d = 3.

Soln:

(a)From F = $\frac{t}{s} - \mathrm{m}$

=> F – $\frac{t}{s} = -\mathrm{m}$, and multiplying through by $-1 => -F + \frac{t}{s} = \mathrm{m}$,

=> $\frac{t}{s} - F = \mathrm{m} => m = \frac{t}{s} - F$.

(b) If a = 2 and b = 3, then,

(2a + b)(a – 2b) = {2(2) + 3}{2 – 2(3)}

= {4 + 3}{2 – 6} = {7}{-4} = -28.

(d) If d = 2, then $(2d)^2 = \{2(2)\}^2$

= $\{4\}^2$ = 16.

Also $2d^2 = 2(2)^2$ = 2(4) = 8.

The difference between these two values = 16 – 8 = 8.

(Q4)(a) Determine the value of $\frac{20}{a} - \text{b}$, if a = 30 and b = 1.

(b) If R = $\frac{(\text{P + Q})}{2}$, make P the subject.

(c) If R = $\frac{1}{2}(a + b)k$, find k in terms of R, a and b.

Soln:

(a) If a = 30 and b = 1, then $\frac{20}{a} - \text{b} = \frac{20}{30} - 1 = \frac{2}{3} - 1$

= $\frac{2}{3} - \frac{1}{1}$

= $\frac{2-3}{3} = \frac{-1}{3}$.

(b)From R = $\frac{(P+Q)}{2}$ => $\frac{R}{1} = \frac{(P+\ Q)}{2}$,

=> 2 x R = 1(P + Q) => 2R = P + Q,

=> 2R – Q = P, => P = 2R – Q.

(c)**N//B:** To find k in terms of r, a and b means make k the subject.

R = $\frac{1}{2}(a + b)k$.

Multiply through using 2

=>2 x R = 2 x $\frac{1}{2}(a + b)k$, => 2R = $1(a + b)k$,

=>2R = (1a + 1b)k => 2R = (a + b)k.

Dividing through using (a + b)

=> $\frac{2R}{(\ a+b)} = \frac{(a+b)K}{(a+b)}$

=> k = $\frac{2R}{(\ a+b)}$

(Q5)(a) The length of a spring when a mass of nkg is hanged on it, is given by L = (74 + 15n)mm. Find the length when a mass of 1.20kg is hanged on it.

(b) (i)Make r the subject of the relation: y = $\frac{x-r}{x+r}$.

(ii)From (b)(i), find the value of r when y = 3 and x = 10.

Soln:

(a) L = (74 + 15n)mm.

If a mass of 1.20kg is hanged on it, => n = 1.20kg.∴ $L = (74 + 15N)\text{mm} = \{74 + 15(1.20)\}\text{mm} = (74 + 18)\text{mm} = 92\text{mm}.$

The length = 92mm.

((b) (i)From y = $\frac{x-r}{x+r} \Rightarrow \frac{y}{1} = \frac{x-r}{x+r}$.

By cross multiplication => y (x + r) = 1(x – r)

=> yx + yr = x – r, => yr + r = x – yx,

=> yr + 1 x r = x – yx => r(y + 1) = x – yx.

Dividing trough using (y + 1)

$\Rightarrow \frac{r(y+1)}{y+1} = \frac{x-yx}{y+1}$ => r = $\frac{x-yx}{y+1}$.

(ii)If y = 3 and x = 10, then r = $\frac{x-yx}{y+1} = \frac{10-(3)(10)}{3+1}$

= $\frac{10-30}{4} = \frac{-20}{4} = -5.$