Substitution

When we replace one mathematical entity with another of equal value we call this 'substitution'. We need to be aware of algebraic conventions and the order of operations.

Example

Substitute $b = 9, c = 7, d = -\frac{1}{3}, n = -10, m = \frac{1}{2}, r = -6$ into $A = n(1 - mr^2) + \frac{\sqrt{b+c}}{4d}$ to determine the value of A.

We 'sub' these numbers in (being careful with negatives) and write
$$A = -10\left(1 - \frac{1}{2}(-6)^2\right) + \frac{\sqrt{9+7}}{4\left(-\frac{1}{3}\right)}$$

We could then type this into the calculator or we could work it out manually:
$$A = -10\left(1 - \frac{1}{2}(36)\right) + \frac{4}{4\left(-\frac{1}{3}\right)}$$
$$= -10(1 - 18) + \frac{1}{\left(-\frac{1}{3}\right)}$$
$$= -10(-17) - 3$$
$$= 170 - 3$$
$$= 167$$

And so, in this case, the value of A is 167

Recall, when two things are written next to each other this often indicates multiplication. As seen above, $-10(-17) = (-10) \times (-17)$, $4d = 4 \times d$ and $mr^2 = m \times r^2$.

Be careful with negatives. In the above example, when calculating $-mr^2$ the value $r = -6$ is squared, this means that both the negative and the six are squared to give 36. If we didn't put brackets around -6 we might have mistakenly calculated -6^2 which actually is -36.

Exercises

1) Substitute $m = 10, v = 3, c = -2, d = 4$ into the following equations and simplify

    a) $p = mv$

    b) $E = \frac{1}{2}mv^2$

    c) $H = (m - c)^2 - (v - d)^2$

2) Substitute $P = 5000, r = 0.06, n = 4, t = 3$ into the following equations and give your answer correct to 4 decimal places if necessary.

    a) $I = Prt$

    b) $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$

    c) $p = \dfrac{P\left(\frac{r}{n}\right)}{1 - \left(1 + \frac{r}{n}\right)^{-nt}}$

    d) $V_f = P\left(\dfrac{(1+r)^t}{r} - \dfrac{1}{r}\right)$

Answers

1)
    a) $p = 30$
    b) $E = 45$
    c) $H = 143$

2)
    a) $I = 900$
    b) $A \approx 5978.0909$
    c) $p \approx 458.4000$
    d) $V_f = 15918$

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