Units and dimensions of sums and products

Starter

1. Find the dimensions of quantities measured in these units:
   (a) kg ms^{-2} (b) N ms^{-1} (c) J s^2

   Working: (a) [kg ms^{-2}] = MLT^{-2}

   (b) [N] = MLT^{-2} $\Rightarrow$ [N ms^{-1}] = ML^{2}T^{-3}

   (c) For joules think kinetic energy: [J] = ML^{2}T^{-2}
   So [J s^2] = ML^2

2. Show that the formula $\frac{1}{2}mv = mgh$ must be wrong.

   Working: $\left[\frac{1}{2}mv\right]$ = MLT^{-1}
   $[mgh]$ = M × LT^{-2} × L = ML^{2}T^{-2}
   Since the dimensions of the two sides are different, the formula must be wrong.

E.g. 1 Show that the formula $s = ut + \frac{1}{2}at^2$ is dimensionally consistent.

Working: $[s]$ = L
$[ut]$ = LT^{-1} × T = L
$\left[\frac{1}{2}at^2\right]$ = LT^{-2} × T^2 = L
Since all three parts of the formula have the same dimensions, the formula is dimensionally correct.

E.g. 2 Check the dimensional accuracy of these formulae:
(a) $Fs = mv - mu$ (b) $Ft(u + v) = v^2 - u^2$

Working: (a) $[Fs]$ = MLT^{-2} × L = ML^{2}T^{-2}
$[mv - mu] = [mv]$ = MLT^{-1}
The formula is dimensionally inaccurate.

(c) $[Ft(u + v)] = [Ftv]$ = MLT^{-2} × T × LT^{-1} = ML^{2}T^{-2}
$[v^2 - u^2] = [v^2]$ = L^{2}T^{-2}
The formula is dimensionally inaccurate.

Video: Dimensional consistency

Solutions to Starter and E.g.s

Exercise
p35 2B Qu 1-5 (6-9 red)