King Abdulaziz University
Faculty of Engineering
Introduction to Engineering Design II – IE 202
Spring 2015

Quiz # 1 - Section XBG – Team # 7 - Grade = 2.3

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"Dimensional Analysis"

Dimensional analysis is used in *modeling*. All equations have to be dimensionally consistent/homogeneous.
You are asked to find the dimensions of each term in the equations below, in terms of the basic dimensions, as you have learned in last lecture. Put all dimensions for each term within the brackets. In your solution:

1- First put all basic dimensions for each element in the first line within brackets.
2- In the next lines, simplify the dimensions of each term to their simplest form.
3- For each question, answer whether it is homogeneous or not.

Terminology: A=area, a=acceleration, C=constant, dx, dy and dz=difference in length, F=force, dF=difference in force, g=gravitational acceleration, L=length, m=mass, p=pressure, dp=difference in pressure, v=velocity, W=weight, ρ=density, μ=viscosity, t=time, h=height, dh=difference in height, τ=shear stress, ξ=dimensionless number, π=22/7

Show your work in full.

$$C\left(\frac{dp}{dx}\,dx\right)dx\,dy\frac{dz}{L} + P\,L\,h - F\frac{dh}{dx} = (3+2p)dy\,dx$$

- 1*[M/L*T^2]*[L/L]*L*L*(L/L) + (M/L*T^2)*(L)*(L) - (M*L/T^2)*(L/L) = (1+(1*M/L*T^2))*L*L
- [M*L/*T^2] + (M*L/T^2) - (M*L/T^2) = (L^2 + (M*L/T^2))
- (M*L/T^2) = (L^2 + (M*L/T^2))

Is it dimensionally consistent? **NO** Marks = 1

$$L\,(v_2 - v_3)^3 = (1 / \mu)\,(p_1 - p_2) + L_1/(A_2)^{0.5}\,(v_1)^2\,(g\,t\,\sin\theta) - \pi\,a\,A_3 / W$$

- (L)*(L^3/t^3) = (LT/M)*(M/LT^2) + (L)/(sqrt(L^2))*(L^2/T^2)*[(L/T^2)*T*1] – 1*(L/T^2) * (L^2)*(T^2/ ML)
- L^4/T^3= 1/T + 1 + L^3/ T^3 – L^2/ M

Is it dimensionally consistent? **NO** Marks = 0.7

$$C\,\tau\,dx = m\,g\,\sin\psi - \xi\,p\,a\,h\,L / \tan\Theta + F / A_2$$

- (1*M/L*T^2)*L = (M*L/T^2*1) - (1*M/L*T^2)*(L/T^2)*(L*L/1) + (M*L/T^2)*L^2
- (M*T^2) = (M*L/T^2)-(M* L^2/T^4) + (M*L^3/T^2)
- (M*T^2) =(M*L/T^2)*(1-(L/T^2)+(L^2))

Is it dimensionally consistent? **NO** Marks = 0.6