CIV102F Assignment #1 – September 8th, 2025

Due September 15-19 (before assigned tutorial time), 2025

Important Instructions

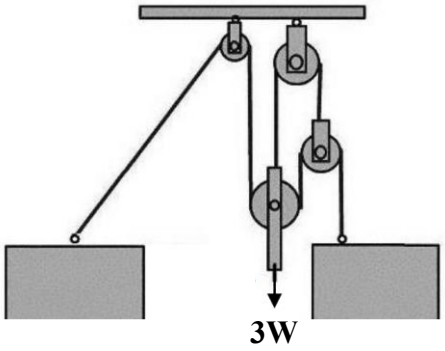
- There are four questions on this assignment. All questions must be attempted; but only one question will be graded.
- Submissions which do not contain a serious attempt to solve every question will receive a grade of 0.
- Intermediate steps must be provided to explain how you arrived at your final answer. Receiving full marks requires both the correct process and answer.
- All final answers must be reported using slide-rule precision (i.e., four significant figures if the first digit is a "1", three otherwise), and engineering notation.
- Submissions must be prepared neatly and be formatted using the requirements discussed in the course syllabus. Marks will be deducted for poor presentation of work.

1. The following equations will be used later in the course. Derive the units of the specified parameters so that the equations remain dimensionally consistent (i.e. the units work out without requiring any conversion parameters). For example, the equation $v_{\text{avg}} = \Delta x/\Delta t$ is dimensionally consistent if the average velocity v_{avg} is in [m/s], the distance Δx is in [m] and the change in time Δt is in [s].

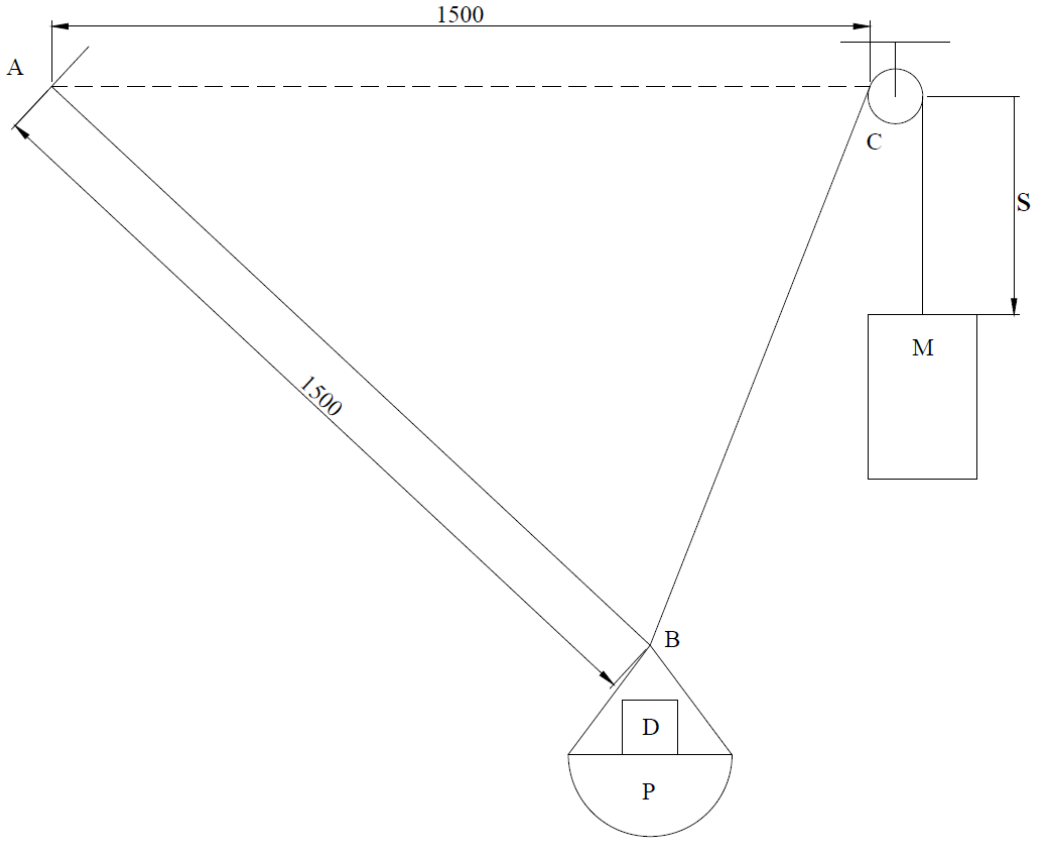
	Equation	Derive the units of the following:	Units of other variables
a)	$\sigma = \frac{P}{A}$	P, a force	σ is in GPa A is in mm^2
b)	$P = \frac{\pi^2 EI}{L^2}$	L, a length	P is in N E is in MPa I is in mm^4
c)	$\phi = \frac{M}{EI}$	E, a material stiffness with dimensions of [force per unit area]	M is in Nmm I is in mm^4 ϕ is in rad/mm
d)	$\tau = \frac{VQ}{Ib}$	b, a length	τ is in MPa V is in N Q is in mm^3 I is in mm^4
e)	$V_s = \phi_s \frac{A_v f_y d_v}{s} \cot\theta$	f_y, a material stress with dimensions of [force per unit area]	V_s is in N ϕ_s and θ are unitless A_v is in mm^2 d_v and s are in mm

For questions 2-4, a free body diagram showing a sign convention and corresponding equations of equilibrium must be presented for full marks.

2. For the system of pulleys, weights and wires shown below, solve for the forces in each of the wires. The variable "W" is a positive real number.



3. The image below shows a scale using a pulley/cable system. The plate P is 3 kilograms, and the mass D is 16 kilograms. All given distances are in millimetres. Cable BCM is 2.2 metres long. If $S = 0.8$ metres, determine mass M in kg. Neglect the dimensions of the pulley.



4. For the three-wire system shown below, each of the wires can carry a force of 800 N before breaking. Plot the relationship between the angle θ and the failure load P over values of θ over the domain $0 \leq \theta < 90°$ in increments of 10°. What value of θ will cause all three wires to fail simultaneously?