EXAMINATION COVERSHEET

Winter 2022 Supplementary Final Examination

UNIVERSITY OF WOLLONGONG IN DUBAI

THIS EXAMINATION CONTENT IS STRICTLY CONFIDENTIAL Students must comply with requirements stated in the Examination Policy & Procedures	
Student Number:	
First Name:	
Family Name:	
Date of Examination: (DD/MM/YY)	**21/04/2022**
Subject Code:	**ENGG102**
Subject Title:	**Fundamentals of Engineering Mechanics**
Time Permitted to Write Exam:	**2 Hours**
Total Number of Questions:	**6**
Total Number of Pages *(including this page):*	**4**

INSTRUCTIONS TO STUDENTS FOR THE EXAM

1. Please note that subject lecturer/tutor will be unavailable during exams. *If there is a doubt in any of the exam questions i.e. problem solving etc. students should proceed by assuming values etc. Students should mention their assumption on the question paper.*
2. Answers must be written (and drawn) in black or blue ink
3. Any mistakes must be crossed out. Whitener and ink erasers must not be used.
4. Answer ALL/SIX questions. The marks for each question are shown next to each question.
5. Total marks: 100. This Exam is worth 45% of your final marks for ENGG102.

EXAMINATION MATERIALS/AIDS ALLOWED
and UOWD approved calculators.

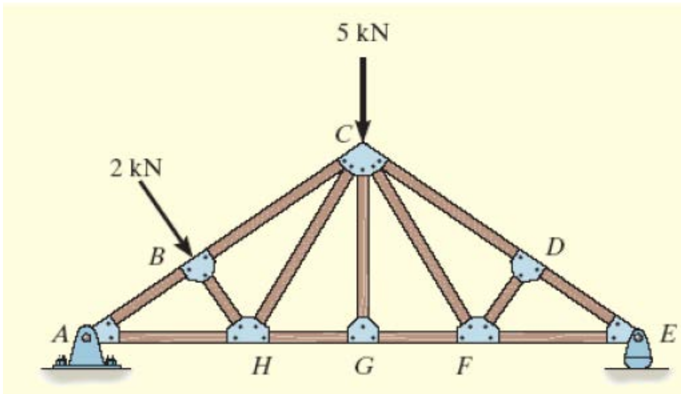
Exam Unauthorised Items - Students bringing these items to the examination room must follow the instructions of the invigilators with regards to these items.

6. Bags, including carrier bags, backpacks, shoulder bags and briefcases
7. Any form of electronic device including but not limited to mobile phones, smart watches, MP3 players, handheld computers and unauthorised calculators;
8. Calculator cases and covers, opaque pencil cases
9. Blank paper
10. Any written material except printed class lectures.

NOTE: The University does not guarantee the safe-keeping of students' personal items during examinations. Students concerned about the safety of their valuable items should make alternative arrangements for their care.

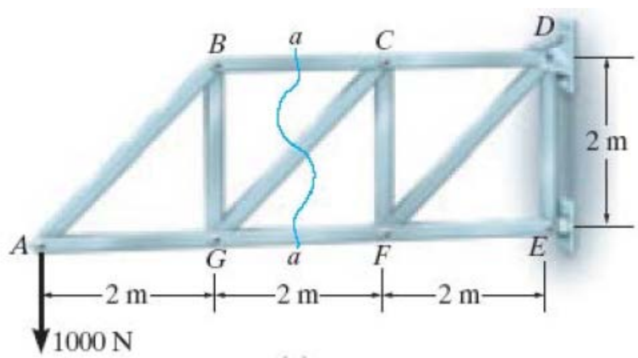
Question 1: **(20 marks)**

Find out the zero force members for the truss shown in the figure below.



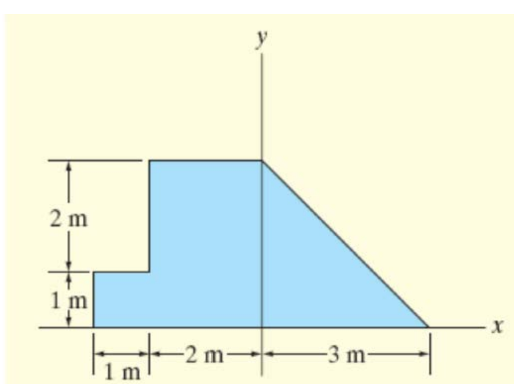
Question 2: **(10 marks)**

Find out the member force GC by method of sections.



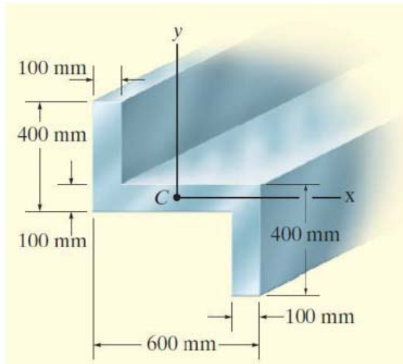
Question 3: **(15 marks)**

Find out the X centroid of the shaded area shown below.



Question 4: **(15 marks)**

Find out the moment of inertia of the beam's cross-sectional area about the centroidal x axis.



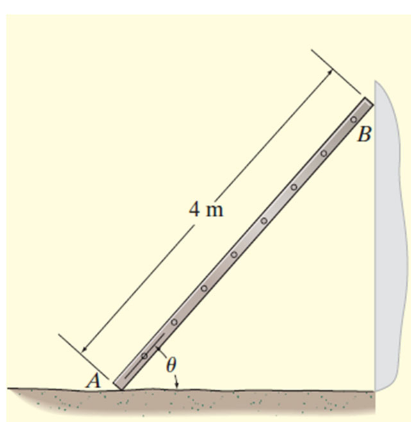
Question 5: **(20 marks)**

An elevator cab of mass m = 400 kg is descending with speed $v_i = 5.0$ m/s when its supporting cable begins to slip, allowing it to fall with a constant acceleration of 2.60 m/s^2.

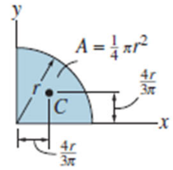
a) During the fall through a distance d = 10 m, what is the work done on the cab by the gravitational force?
b) During the 10 m fall, what is the work done on the cab by the upward pull of the elevator cable?
c) What is the net work done on the cab during the fall?
d) What is the cab's kinetic energy at the end of the 10 m fall?

Question 6: **(20 marks)**

The uniform 15-kg ladder in the figure below rests against the smooth wall at B, and the end A rests on the rough horizontal plane for which the coefficient of static friction is $\mu_s = 0.35$. Determine the angle of inclination θ of the ladder and the normal reaction at B if the ladder is on the verge of slipping. Use Hagen's six step method of analysis to solve the problem. Label each step clearly.



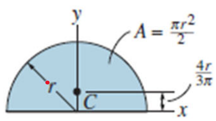
Formulae



Quarter circle area

$I_x = \frac{1}{16}\pi r^4$

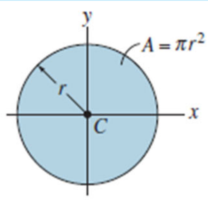
$I_y = \frac{1}{16}\pi r^4$



Semicircular area

$I_x = \frac{1}{8}\pi r^4$

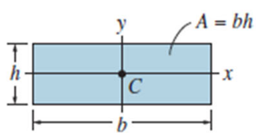
$I_y = \frac{1}{8}\pi r^4$



Circular area

$I_x = \frac{1}{4}\pi r^4$

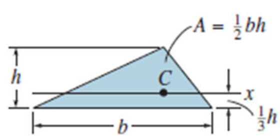
$I_y = \frac{1}{4}\pi r^4$



Rectangular area

$I_x = \frac{1}{12}bh^3$

$I_y = \frac{1}{12}hb^3$



Triangular area

$I_x = \frac{1}{36}bh^3$

$$\bar{x} = \frac{\int_A \tilde{x}\,dA}{\int_A dA}; \quad \bar{y} = \frac{\int_A \tilde{y}\,dA}{\int_A dA}; \quad \bar{z} = \frac{\int_A \tilde{z}\,dA}{\int_A dA}$$

$$I_x = \int_A y^2 dA$$

$$I_y = \int_A x^2 dA$$

$$I_x = I_{x'} + Ad_y^2$$

$$I_y = I_{y'} + Ad_x^2$$

$$\Delta E_{\text{mec}} = \Delta K + \Delta U = 0.$$

$$W = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2.$$

$$W_s = \tfrac{1}{2}kx_i^2 - \tfrac{1}{2}kx_f^2 \quad \text{(work by a spring force).}$$

$$\Delta U = mg(y_f - y_i) = mg\,\Delta y.$$

$$F_s = \mu_s N$$

$$\Delta U = -W.$$

$$\phi_s = \tan^{-1}\left(\frac{F_s}{N}\right) = \tan^{-1}\left(\frac{\mu_s N}{N}\right) = \tan^{-1}\mu_s$$