THE UNIVERSITY OF CALGARY
Schulich School of Engineering

ENGG 202 – Engineering Statics
Second Midterm Exam
March 22, 2012 (Thursday)
19:00 – 20:30 (90 minutes)

1. The examination is closed textbook
2. There are 6 short answer questions and 2 comprehensive questions. Answer all questions directly on the question sheets. For the short answer questions, write your answer in the space provided; only the answer will be marked.
3. Only the SSE sanctioned, non-programmable, scientific calculator is permitted.
4. Free body diagrams are required on all comprehensive equilibrium questions to obtain full marks.

DO NOT OPEN THE EXAM BOOKLET UNTIL INSTRUCTED TO DO SO

Student's Last name: _____

Student's First name: _____

Lecture Section (Circle One):

L01	Tu Th	15:30	Raaflaub
L02	Tu Th	12:30	Anglin
L03	Tu Th	11:00	Lissel
L04	Tu Th	09:30	Grozic

Student ID#: _____

USEFUL FORMULAE:

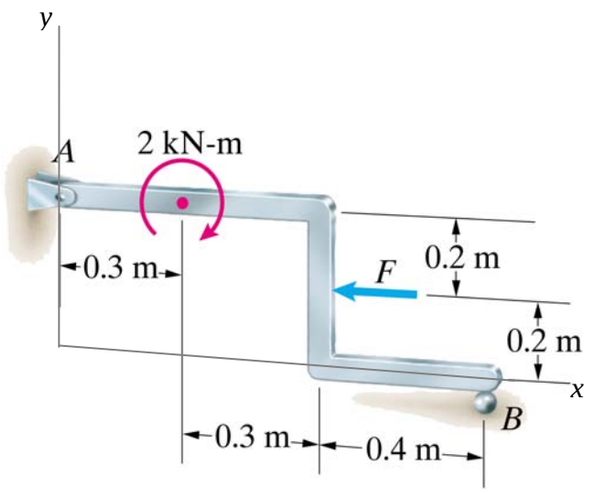
Sine Law: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Cosine Law: $c^2 = a^2 + b^2 - 2ab\cos C$

Question	Maximum mark	Mark
1 – 6	17	
7	14	
8	16	
Total	47	

All figures modified from:
"Engineering Mechanics, Statics", 5th Edition in SI Edition, Bedford and Fowler, Prentice Hall, 2008.

Q1. For F = 4 kN, what are the reactions at hinge A and roller B for equilibrium of the bar AB? Provide the variable name (e.g. D_x), the magnitude (with appropriate units) and direction (indicated by an arrow) for each reaction.

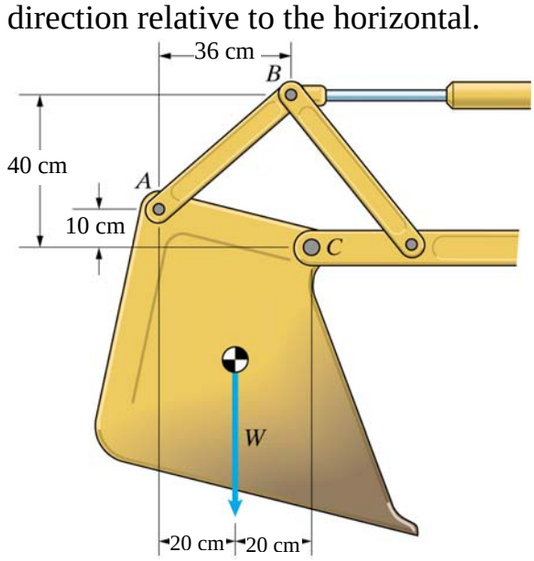


ANSWER: Reaction 1: _____ = _____ (_____) /1 mark
Name magnitude direction (arrow)

Reaction 2: _____ = _____ (_____) /1 mark
Name magnitude direction (arrow)

Reaction 3: _____ = _____ (_____) /1 mark
Name magnitude direction (arrow)

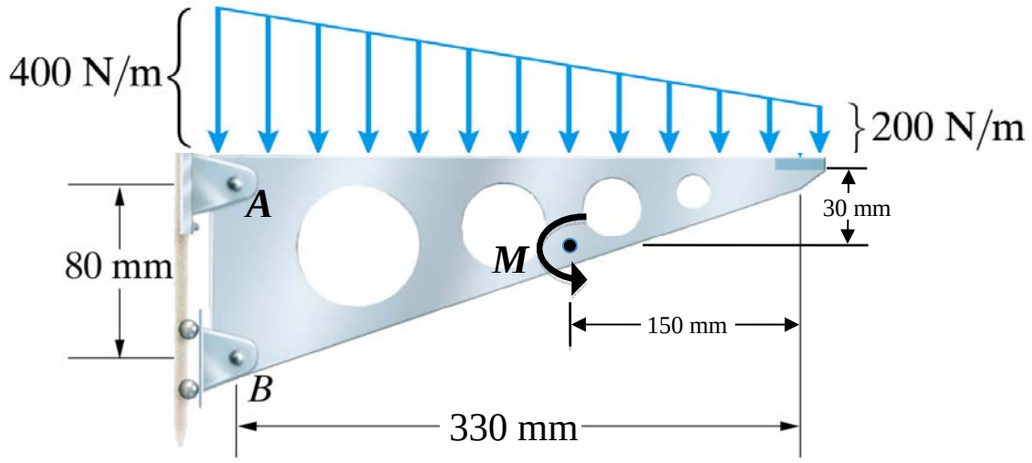
Q2. The bucket of the excavator is supported in the position shown by rod AB and the pin support at C. The weight of the bucket is W = 6500 N. What is the magnitude and direction of the reaction force at point A? Provide the direction relative to the horizontal.



ANSWER: (a) Magnitude of F_A = _____ /2 marks

(b) Direction of F_A = _____ /1 mark

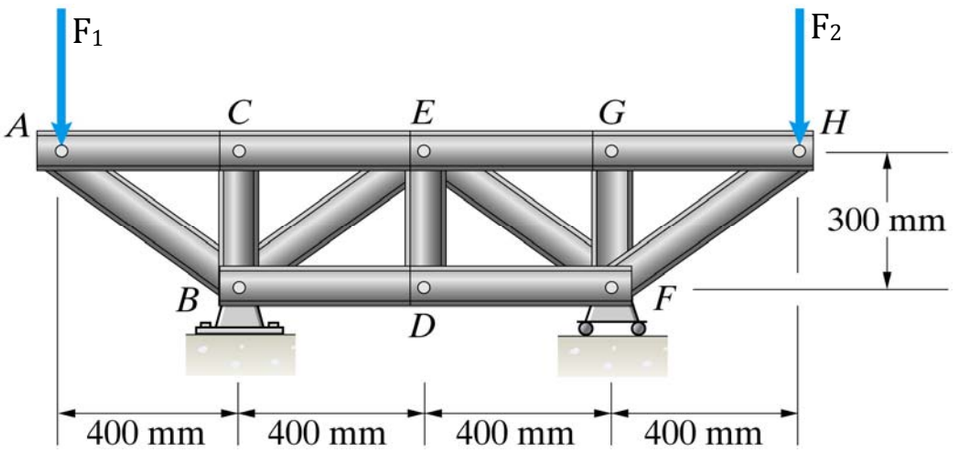
Q3. Draw the FBD(s) that would be required to determine the reactions at hinge A and roller B. Label and show the direction of all forces and moments on the FBD(s). Represent the distributed load by one or more equivalent force(s) indicating both magnitude and distance from A on the FBD(s). M = 100 N·m. Neglect the weight of the plate. Do NOT solve for the reactions.



ANSWER (draw in the space below):

/3 marks

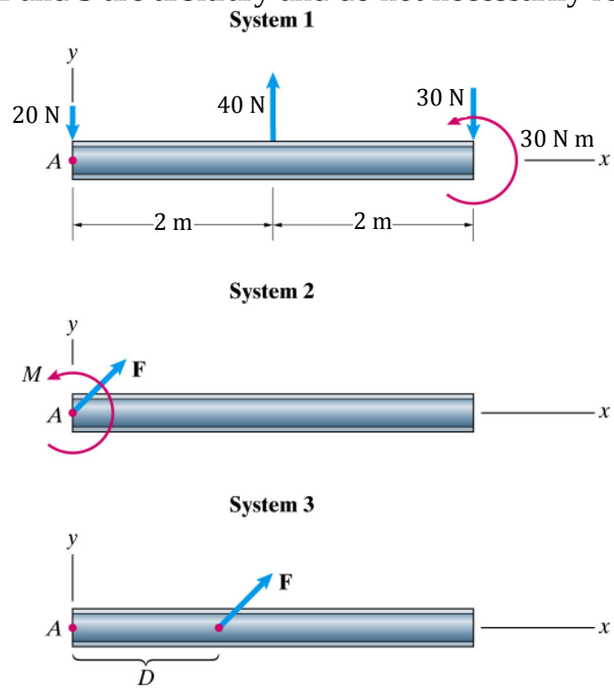
Q4. Identify the zero force members in the truss if F_1 = 0 N and F_2 = 14 N.



NOTE This question will be marked right minus wrong.

ANSWER: _____ /3 marks

Q5. Three forces and a couple are applied to a beam in System 1. To make System 2 and 3 equivalent to System 1, what are the required magnitude (with appropriate units) and direction for (a) ***F*** and (b) ***M***? (c) What is the required distance *D*? Note that the directions of ***F*** and ***M*** shown in Systems 2 and 3 are arbitrary and do not necessarily represent the true directions.

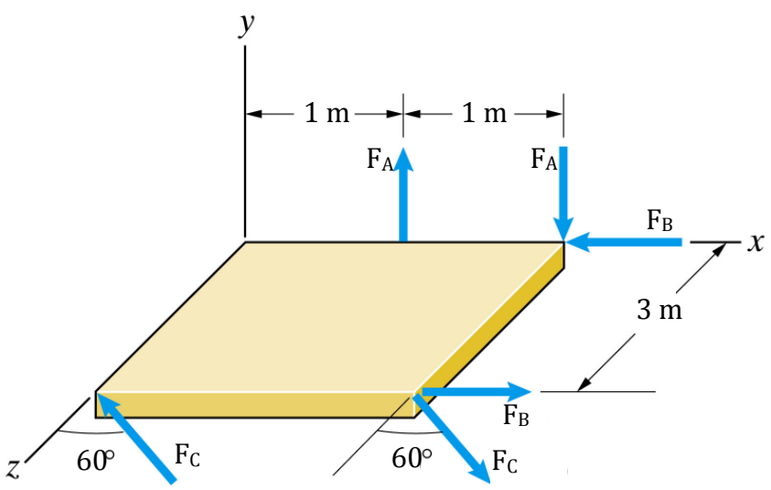


ANSWER: (a) ***F*** = _____ /1 mark

(b) ***M*** = _____ /1 mark

(c) *D* = _____ /1 mark

Q6. Three couples are exerted on a plate as shown. Determine the moment exerted on the plate by each of the three couples if the force magnitudes are F_A = 20 N, F_B = 40 N, and F_C = 80 N. The F_C forces lie in the *x*-*z* plane. Express your answers in Cartesian vector format with appropriate units.



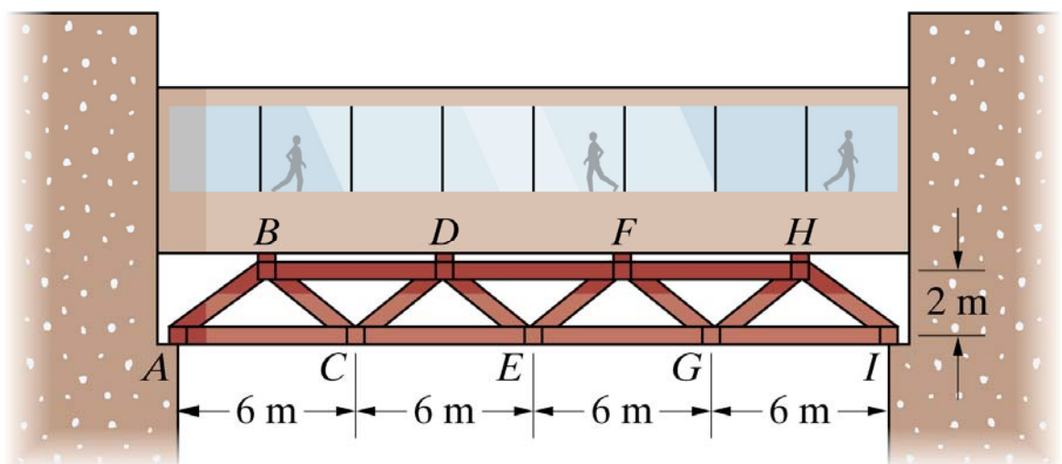
ANSWER: $\mathbf{M}_A$ = _____ /0.5 marks

$\mathbf{M}_B$ = _____ /0.5 marks

$\mathbf{M}_C$ = _____ /1 mark

Q7. The truss is subject to four vertical 50 kN loads located at *B, D, F*, and *H*. All joints may be assumed to act as pins, and the supports at *A* and *I* may be assumed to behave like rollers. The joints in the upper chord (*BDFH*) are halfway between the joints in the bottom chord (*ACEGI*). For this loading and support condition, determine the forces in members AB, AC, BC, BD, CD, and CE. Indicate whether the members are in tension or compression.

/14 marks



Q8. The door shown below is supported by hinges at *A* and *B* and a cable attached to the knob on the back of the door (not visible). The cable is parallel to the *z*-axis and Point *D* lies in the *x*-*y* plane. Neither hinge is capable of exerting couples, and the hinge at *B* is not capable of exerting axial thrust. The weight of the door is 200 N and acts at its midpoint. In addition to its own weight, the door is subject to a force applied to the door knob as shown. The force ***F*** has a magnitude of 100 N and direction coordinate angles $\theta_x = 110^o$, and $\theta_z = 25^o$. Determine the tension in cable *ED* and the reactions at *A* and *B* for the door to be in equilibrium. Neglect the thickness of the door, the size of the door knob and the small distance from the door knob to the edge of the door. Express your answers in Cartesian vector format.

/16 marks