FINAL EXAM

April 24, 2013   Time: 08:00 – 11:00 (3 hours)

1. Exam is closed book and worth 50% of final mark.
2. Only the SSE sanctioned, non-programmable, scientific calculator is permitted.
3. There are eight (8) short answer questions and four (4) long-answer questions.
4. Answer all questions directly on the question sheets. For the short answer questions, write your answer in the space provided.
5. **Separate Free Body Diagrams are required on long-answer equilibrium questions to obtain full marks**.
6. For multi-part long-answer questions, **students unable to solve one part should make a reasonable assumption for the values required and continue to solve** subsequent parts of the question.
7. If students require the use of extra paper, they may obtain paper from the instructor in the examination room and may not use their own. ALL work is to be handed in, including rough work completed on extra paper.
8. No electronic devices other than the approved calculator are permitted.

Student's Last Name: _____

Student's First Name: _____

Lecture Section:	Maes (L01)	Grozic (L02)	di Martino (L03)	Lissel (L04)
(Circle one)	TuTh 15:30	TuTh 12:30	TuTh 11:00	TuTh 09:30

EXAMINATION RULES

(1) Students late in arriving will not normally be admitted after 30 minutes of the examination time has passed.
(2) No candidate will be permitted to leave the examination until one-half hour has elapsed after the opening of the examination, nor during the last 15 minutes of the examination. All candidates remaining during the last 15 minutes of the examinations period must remain at their desks until their papers have been collected by an invigilator.
(3) All enquires and requests must be addressed to supervisors only.
(4) **The following is strictly prohibited:**
  (a) Speaking to other candidates or communicating with them under any circumstances whatsoever;
  (b) Bringing into the examination room any textbook, notebook or document not authorized by the examiner;
  (c) Making use of calculators, cameras, cell-phones, computers, head-sets, pagers, PDA's, or any device not authorized by the examiner;
  (d) Leaving answer papers exposed to view;
  (e) Attempting to read other student's examination papers..
  The penalty for violation of these rules is suspension or expulsion or such other penalty as may be determined.
(5) Candidates are requested to write on both sides of the page, unless the examiner has asked that the left hand page be reserved for rough drafts and calculations.
(6) Discarded matter is to be struck out and not removed by mutilation of the examination answer book.
(7) Candidates are cautioned against writing in their answer book any matter extraneous to the actual answering of the question set.
(8) During the examination a candidate must report to a supervisor before leaving the examination room.
(9) Candidates must stop writing when the signal is given. Answer books must be handed to the supervisor-in-charge promptly. Failure to comply with these regulations will be cause for rejection of an answer paper.
(10) If during the course of an examination a student becomes ill or receives word of domestic affliction, the student must report at once to the supervisor, hand in the unfinished paper and request that it be cancelled.

Once an examination has been handed in for marking a student cannot request that the examination be cancelled for whatever reason. Such a request will be denied. Retroactive withdrawals will also not be considered.

Student Last Name: _____   ID#: _____

USEFUL FORMULAE:

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

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

Quadratic Formula: $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Question	Max. mark	Mark
1 to 8	20	
9	10	
10	12	
11	16	
12	10	
Total	68	

Figures modified from:

Q2, Q5, Q8, Q10: "Engineering Mechanics, Statics", 5th Edition in SI Edition, Bedford and Fowler, Prentice Hall, 2008.
Q1, Q6: "Vector Mechanics for Engineers, Statics", 7th Edition, Beer, Johnston and Eisenberg, McGraw Hill, 2004.
Q3, Q4, Q11: ""Engineering Mechanics, Statics" , 12th Edition in SI Units, Hibbeler, Prentice Hall, 2010.
Q7: "Statics and Mechanics of Materials", Riley et al., Wiley, 1996.
Q9: "Engineering Mechanics Statics", Meriam and Kraige, Wiley, 2007.

Q1. A single continuous cable, ACB, is attached at A and B and passes through a frictionless ring at C, where a 1000 N vertical force is applied. Knowing that the lengths of segments AC and AB of cable ACB must be equal, determine the shortest length of cable which can be used to support the force shown if the tension in the cable is not to exceed 725 N.
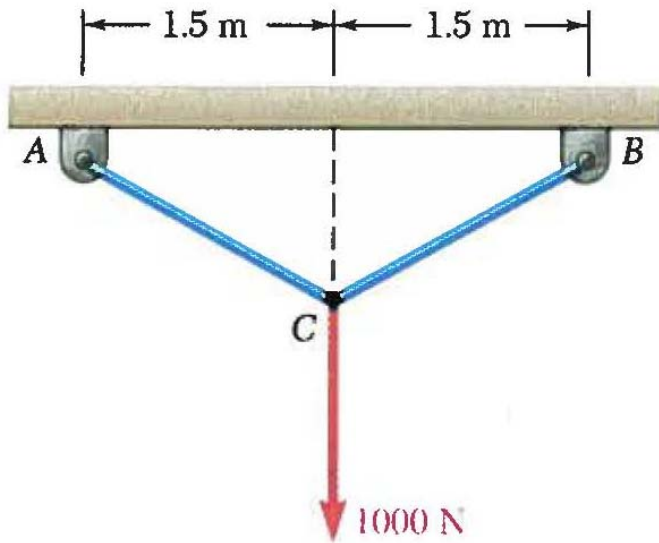
ANSWER: total cable length: _____ **/2 marks**

Q2: The total force exerted on the highway sign by its weight and the most severe anticipated winds is **F** = (2.8**i** – 1.8**j**) kN. Determine the reactions at the fixed support at O. Give your answers in Cartesian vector format.
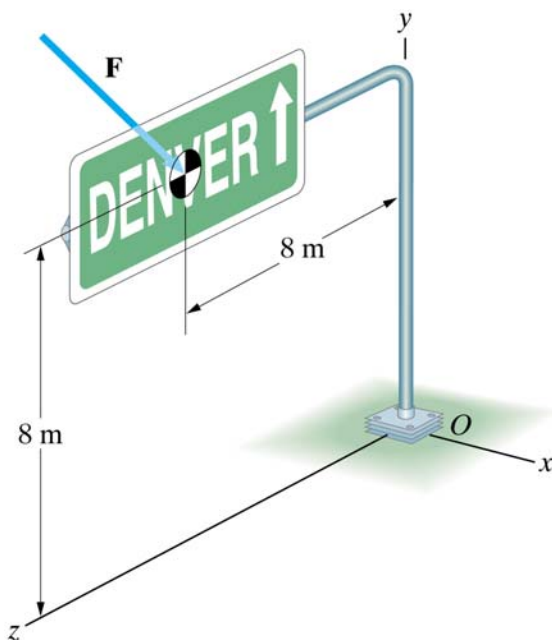
ANSWER: Force reactions = _____ **/1 mark**

   Moment reactions = _____ **/1.5 marks**

Q3. Determine the coefficient of static friction between the floor and the 125 kg crate if a force P = 200 N is required to start sliding the crate across the floor.
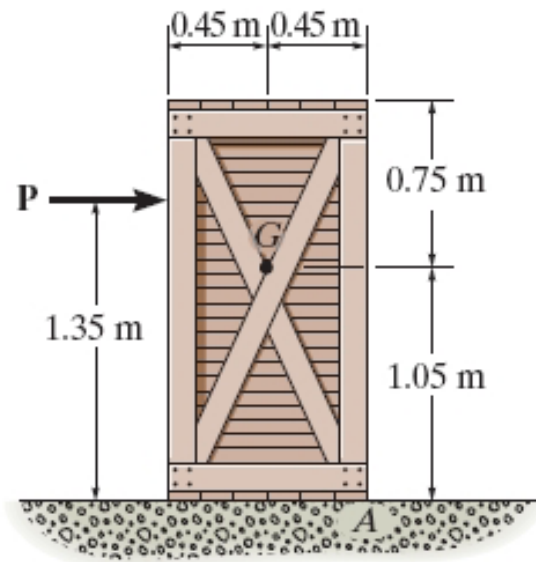
ANSWER: μ_s = _____ **/1.5 marks**

Q4: (a) Determine the minimum coefficient of static friction between the floor and the 125 kg crate such that the force P causes the crate to tip rather than slide.
(b) Determine the magnitude of the force P that would cause the crate to tip.
(c) Determine the reactions at point A when it starts to tip (indicate magnitude and direction in your answers).
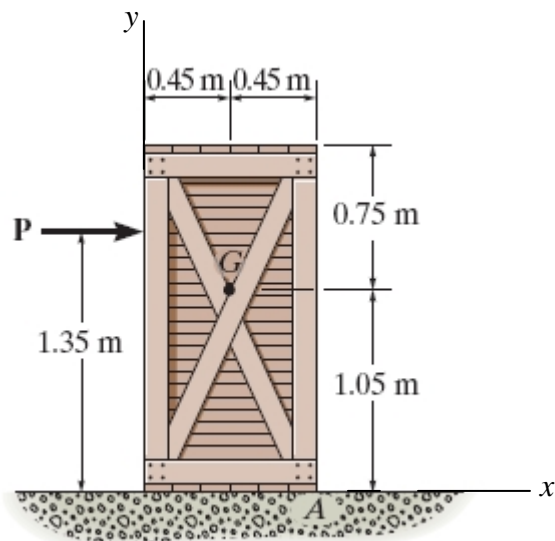
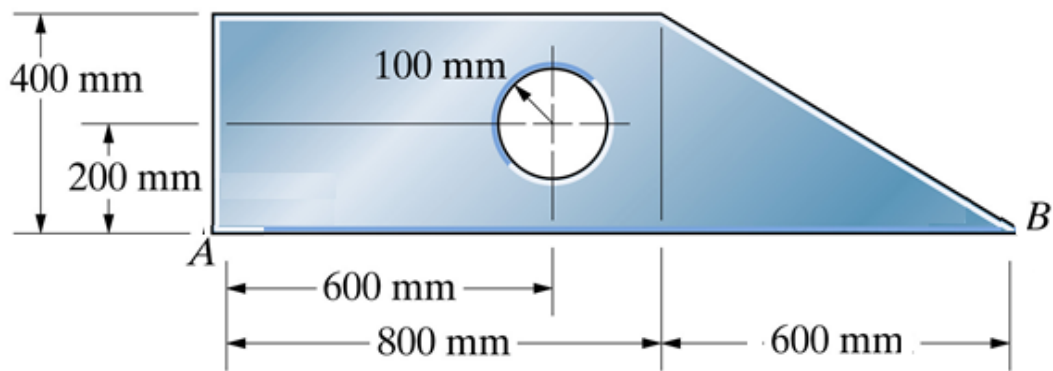ANSWER: (a) μ_s = _____ **/1 mark**

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

(c) A_x = _____ **/1 mark**

A_y = _____ **/1 mark**

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Q5. Determine the location of the centroid of the composite body shown. Specify the coordinates of the centroid measured from point A.

ANSWER: $\overline{x}$ = _____ mm   **/1.5 marks**

          $\overline{y}$ = _____ mm   **/1.5 marks**

Q6. For the beam and loading, determine the internal forces at a point halfway in between points C and D. Indicate magnitude and sign in your answers according to the accepted sign convention for internal forces/moments.
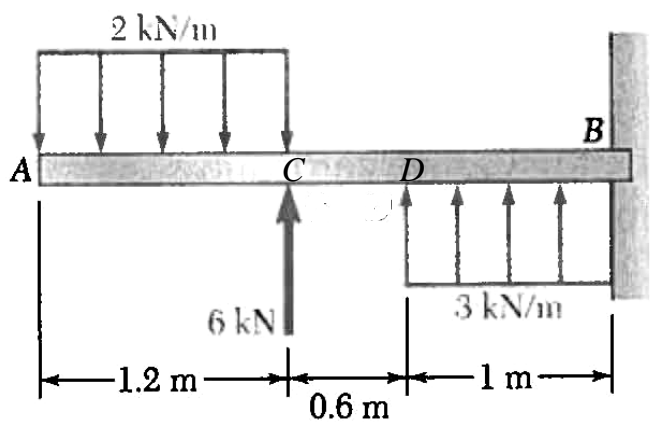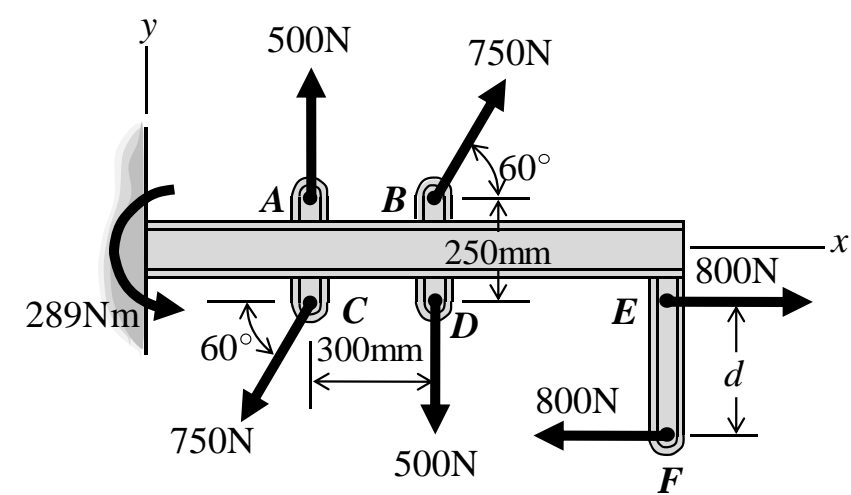

ANSWER: Axial/Normal force = _____ kN   **/1 mark**

          Shear force = _____ kN   **/1 mark**
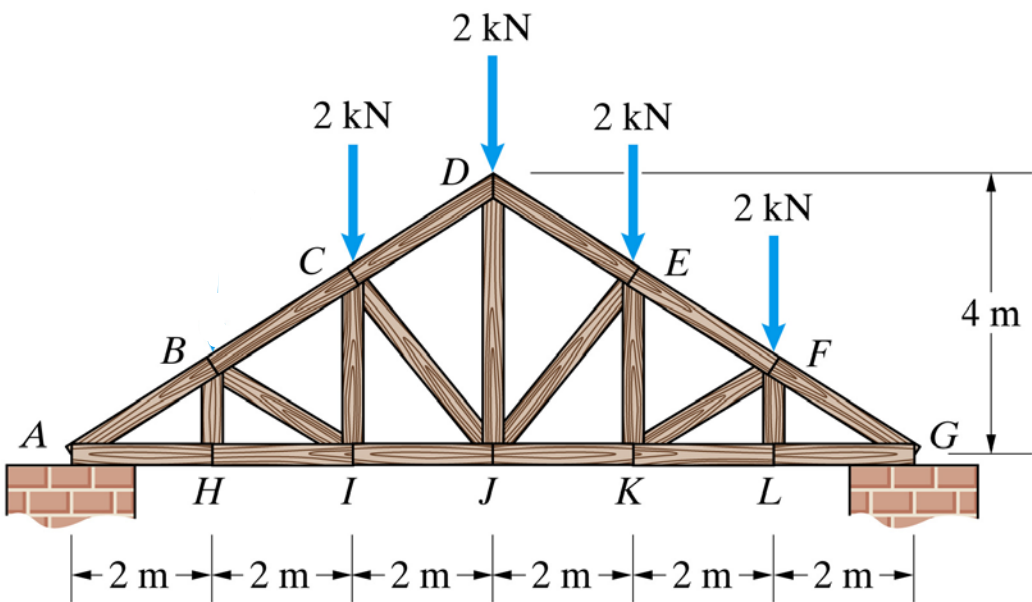
          Moment = _____ kN·m   **/1 mark**

Q7. Determine the distance *d* so that the resultant of the four couples shown is equal to zero.

ANSWER: d = _____   **/2 marks**

Q8: Identify the zero force members in the truss below for the loading shown.


NOTE This question will be marked right minus wrong.

ANSWER: _____   **/2 marks**

Q9. The frame below is made up of 3 members, *AC*, *CD*, and *BDE* connected by pins and is supported by pins/hinges at *A* and *B*. A pulley which supports the 300 kg mass is attached by a pin to the frame at *E*. Determine the reactions at *A* and *B* and the moment *M* which must be applied at *A* to keep the frame in static equilibrium in the position shown. Indicate magnitude and direction in your answers.

/10 marks
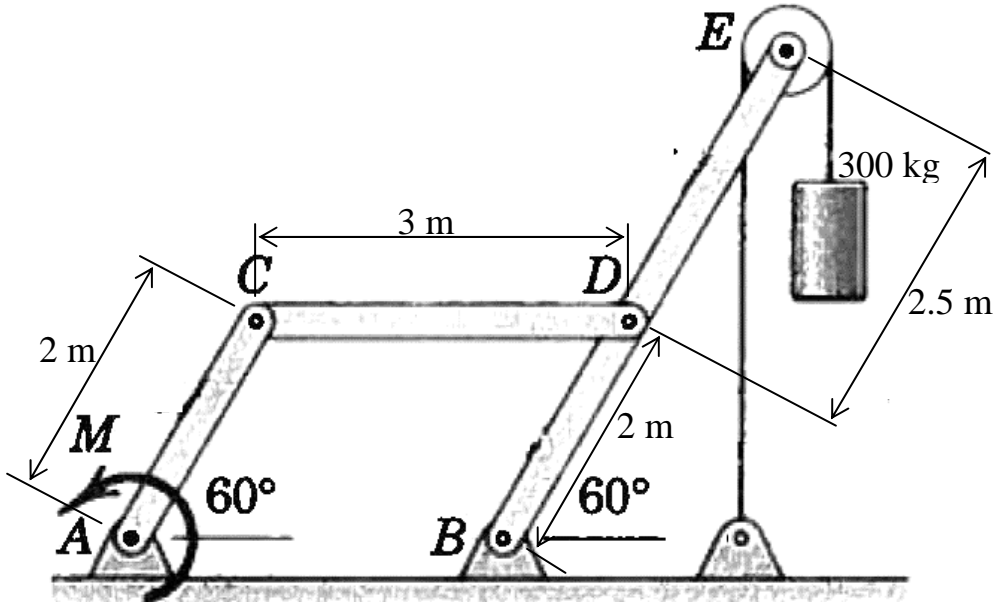
Q10. The suspended sign is a homogeneous, solid, flat plate that has a mass of 130 kg. There are hinge supports at *A* and *B*. Determine the axial forces in members *AD* and *CE* indicating both magnitude and direction (tension or compression) in your answers. NOTE: In the function given for the curved edge of the sign, the *y* axis is positive downward and *x* is in meters.

/12 marks

$$y = 1 + 0.0625x^2$$
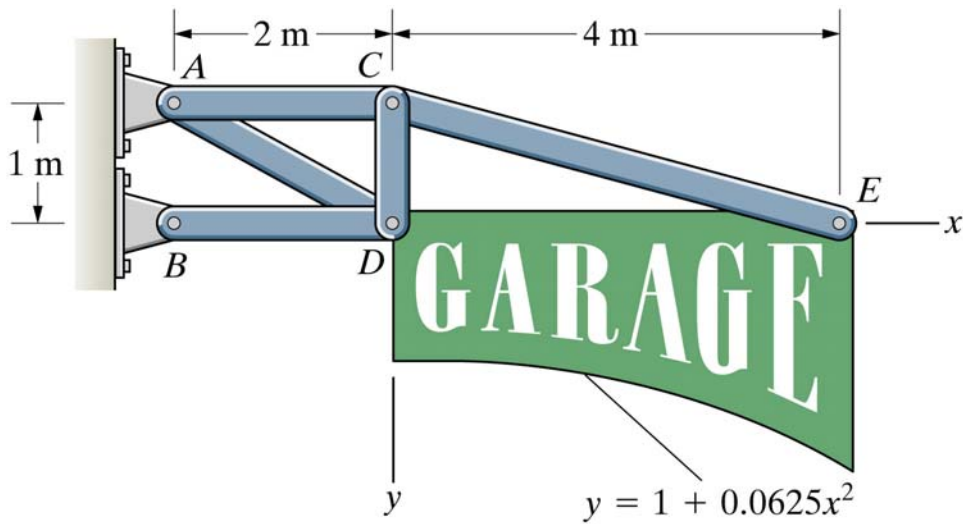
Q11. The compound beam is comprised of 2 beam segments *AB* and *BC*. It is supported by a rocker at *C* and a fixed support at wall *A*. The two beam sections are hinged (pinned) together at *B*. The two members *DE* and *DF* are pinned together at *D* and are pinned to the beam at *E* and *F*. A force, P, is applied at *D* and a uniformly distributed load is applied between *A* and *B*.

(a) Determine the forces in members *DE* and *DF*.   **/2 marks**

(b) Determine the magnitude and direction of the reactions at points *A* and *C*.
                                                            /4 marks

(c) Draw the shear force and bending moment diagrams for the compound beam (*ABC*). Indicate the values for shear force and bending moment at points *A*, *B, E, F* and *C* and any maximums or minimums that may occur in between these points. Show all relevant calculations.   **/10 marks**
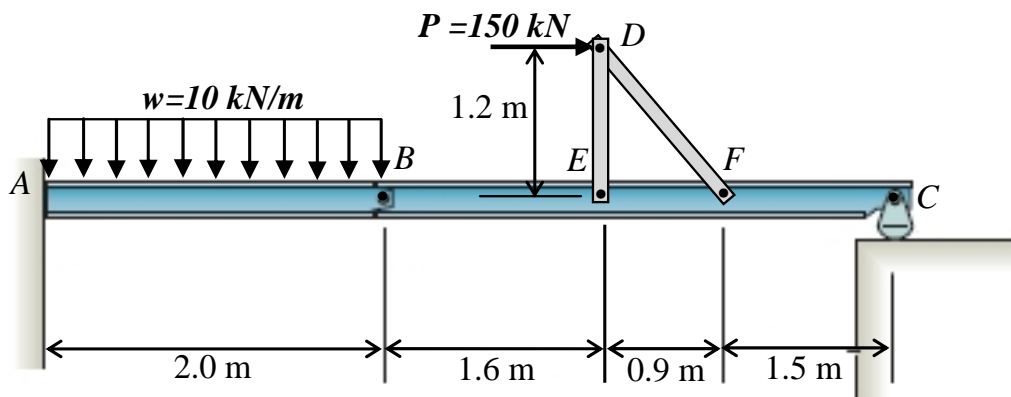
Q12: The crane truss shown is supported by a hinge at joint 1 and a cable at joint 11. Two vertical downward loads having equal magnitude P are applied to the joints numbered 12 and 14. If the internal force in truss member 7-8 (in bold) is observed to be 10 kN in compression, what is the force, T, in the support cable 11-15? **/10 marks**