

RWB SK
A.A.S.H

UNIVERSITY OF CALGARY
Schulich School of Engineering
ENGG 202 – ENGINEERING STATICS

FINAL EXAM

April 25, 2011

Time: 12:00 – 15:00 (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 five (5) comprehensive 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 comprehensive questions to obtain full marks.**
6. For multi-part comprehensive 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 a calculator are permitted.

Student's Last Name: _____

Student's First Name: _____

Lecture Section:	Lissel (L01)	Grozic/Lissel (L02)	Grozic (L03)	Sohrabi (L04)
(Circle one)	TuTh 13:00	TuTh 11:00	TuTh 09:30	TuTh 18:00

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) **Candidates are strictly cautioned against:**
 - (a) Speaking to other candidates or communicating with them under any circumstances whatsoever;
 - (b) Bringing into the examination room any textbook, notebook or memoranda not authorized by the examiner;
 - (c) Making use of calculators and/or portable computing machines not authorized by the instructor;
 - (d) Leaving answer papers exposed to view;
 - (e) Attempting to read another student's examination paper.

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.
- (6) Discarded matter is to be struck out and not removed by mutilation of the examination paper.
- (7) Candidates are cautioned against writing in their examination paper any matter extraneous to the actual answering of the question set.
- (8) A candidate must report to a supervisor before leaving the examination room.
- (9) Answer papers must be handed to the supervisor-in-charge promptly when the signal is given. Failure to comply with this regulation 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 should report at once to the supervisor, hand in the unfinished paper and request that it be cancelled. If physical and/or emotional ill health is the cause, the student must report at once to a physician/counselor so that subsequent application for a deferred examination is supported by a completed Physician/Counselor Statement form. Students can consult professionals at University Health Services or University Counseling Services during normal working hours or consult their physician/counselor in the community.

Should a student write an examination, hand in the paper for marking, and later report extenuating circumstances to support a request for cancellation of the paper and for another examination, such a request will be denied.

Student Last Name: _____

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	Max. mark	Mark
1 to 8	21	
9	13	
10	10	
11	8	
12	11	
13	17	
Total	80	

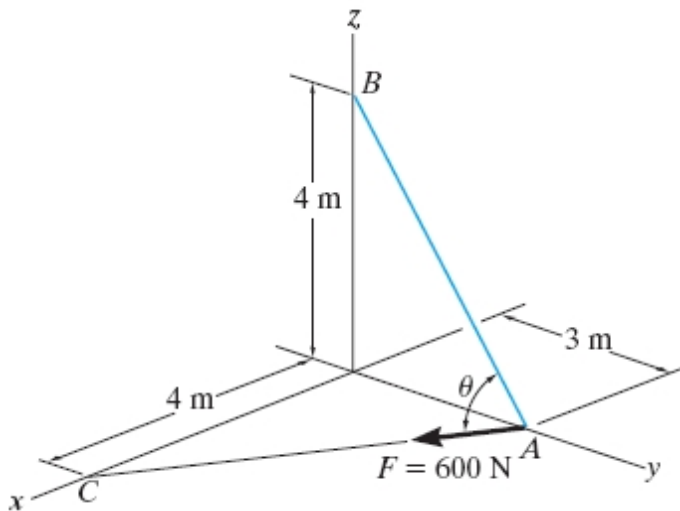
Figures modified from:

Q1, Q4, Q6: “Engineering Mechanics – Statics”, 12th Ed. In SI units, R.C. Hibbeler, Pearson Prentice Hall, Pearson Education Inc., New Jersey, 2010.

Q2, Q3, Q5, Q7, Q8, Q9, Q10, Q13, “Engineering Mechanics, Statics”, 5th Edition in SI Edition, Bedford and Fowler, Prentice Hall, 2008.

Q12: http://wps.pearsoned.co.uk/sg_hibbeler_engmech_statics_12_si_sa/135/34594/8856222.cw/index.html

Q1. The force along line AC has a magnitude of 600 N. (a) What is the force in Cartesian vector format? (b) What is the angle, θ , between line AC and line AB? (c) What is the component of the force \mathbf{F}_{AC} that acts along the line AB? State your answer in Cartesian vector format.

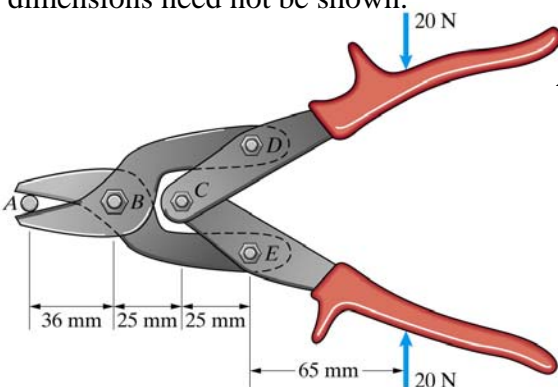


ANSWER: (a) $\mathbf{F}_{AC} =$ _____ N /1 mark

(b) $\theta =$ _____ degrees /1 mark

(c) $\mathbf{F}_{//AB} =$ _____ N /1 mark

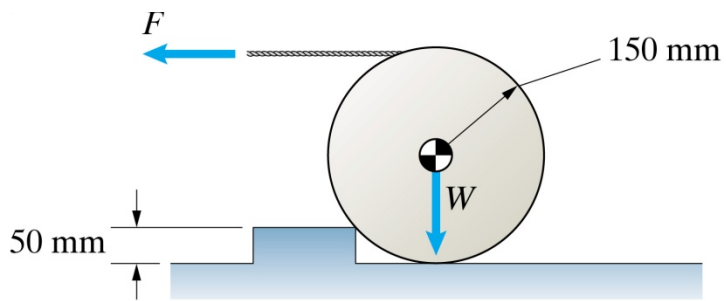
Q2: The wire cutters shown below have 20 N of force exerted on the handles. Draw the free body diagram(s) that would be required to determine the force applied to the wire at A. The dimensions need not be shown.



ANSWER: Draw in the space below

/3 marks

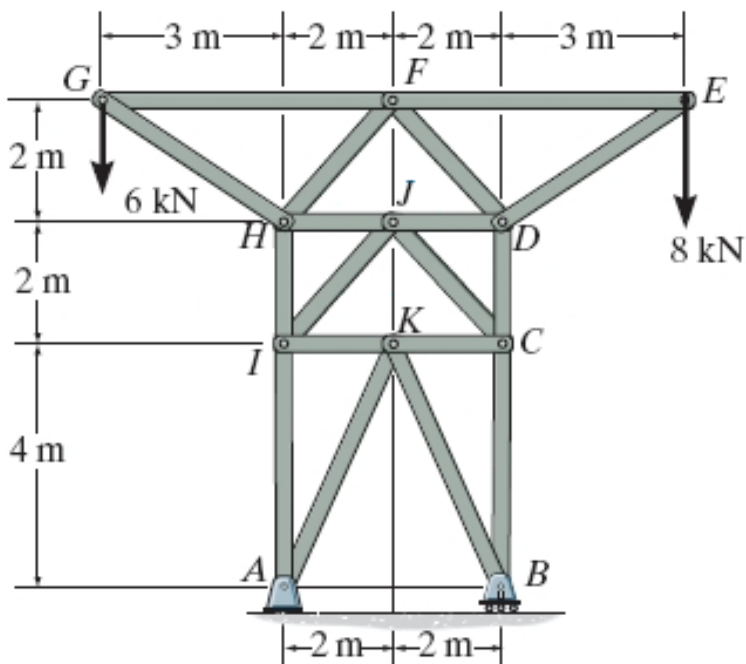
Q3. The weight $W = 40 \text{ N}$ acts at the center of the disk. The surfaces are rough. What horizontal force F is necessary to lift the disk off the floor?



ANSWER: $F =$ _____ N

/2 marks

Q4. The truss shown below is supported by a pin at A and a roller at B. Determine the force in members DC and HI. State if the members are in tension or compression.



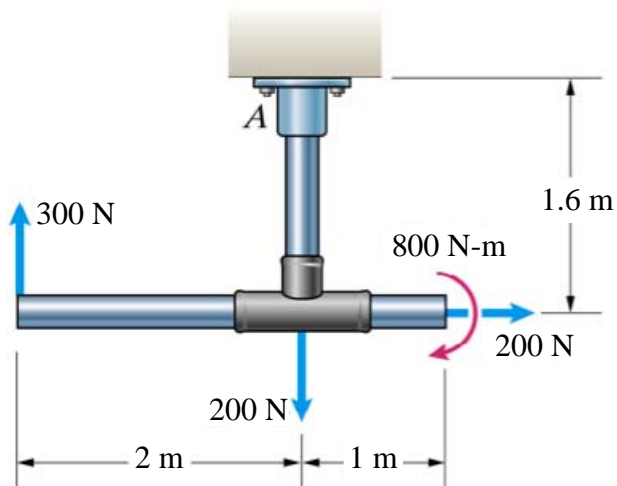
ANSWER: $HI =$ _____ kN

/1.5 marks

$DC =$ _____ kN

/1.5 marks

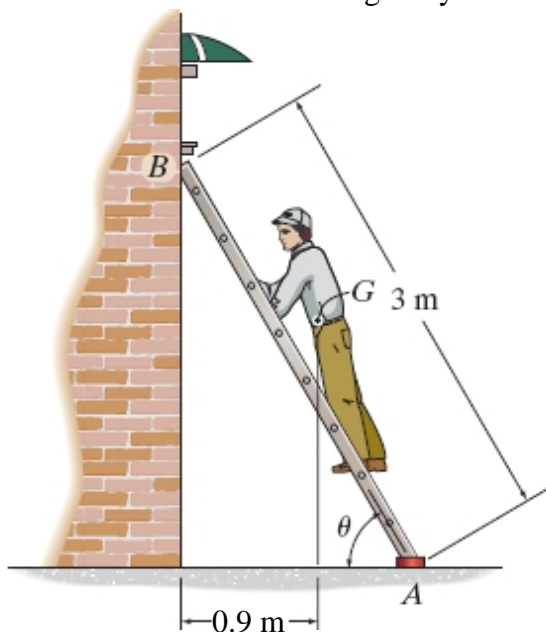
Q5. Replace the force-couple system show below, by an equivalent force, **F** and couple, **M**, system at point A. Specify the magnitude and direction of **F** and **M**.



ANSWER: $F =$ _____ N at _____ degrees /1 mark
Measured from the + x axis

$M =$ _____ N-m _____ /1 mark
CCW or CW?

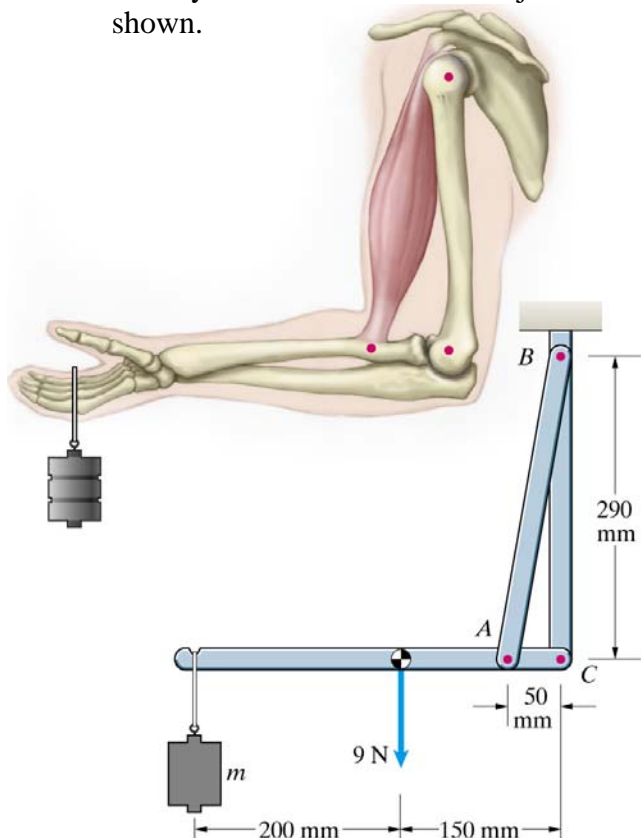
Q6. The 100 kg man climbs up the ladder and stops at the position shown after he senses that the ladder is on the verge of slipping. Determine the coefficient of static friction between the friction pad at A and ground if the inclination of the ladder is $\theta = 55^\circ$ and the wall at B is smooth. The center of gravity for the man is at G. Neglect the weight of the ladder.



ANSWER: $\mu_{sA} =$ _____

/2 marks

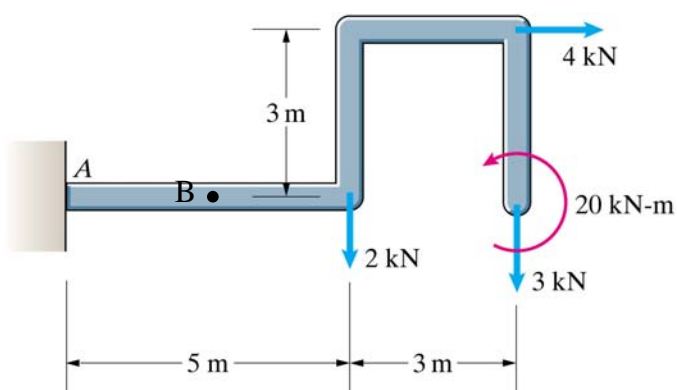
Q7: The bones and biceps muscle of a person's arm are represented by the simple mechanical model shown below. If the weight of the forearm is 9 N, and the mass $m = 2$ kg, determine the tension force in the biceps muscle AB and the magnitude of the force exerted on the upper arm by the forearm at elbow joint C when the forearm is held in the horizontal position shown.



ANSWER: $T_{AB} =$ _____ N /1.5 marks

$|C| =$ _____ N /1.5 marks

Q8: The bar shown below is subject to the forces and couple/moment shown and has a fixed support at A. Determine the magnitude of the internal axial force, shear force, and moment at point B (located at the midpoint of the horizontal segment).



ANSWER: Axial force = _____ kN /1 mark

Shear force = _____ kN /1 mark

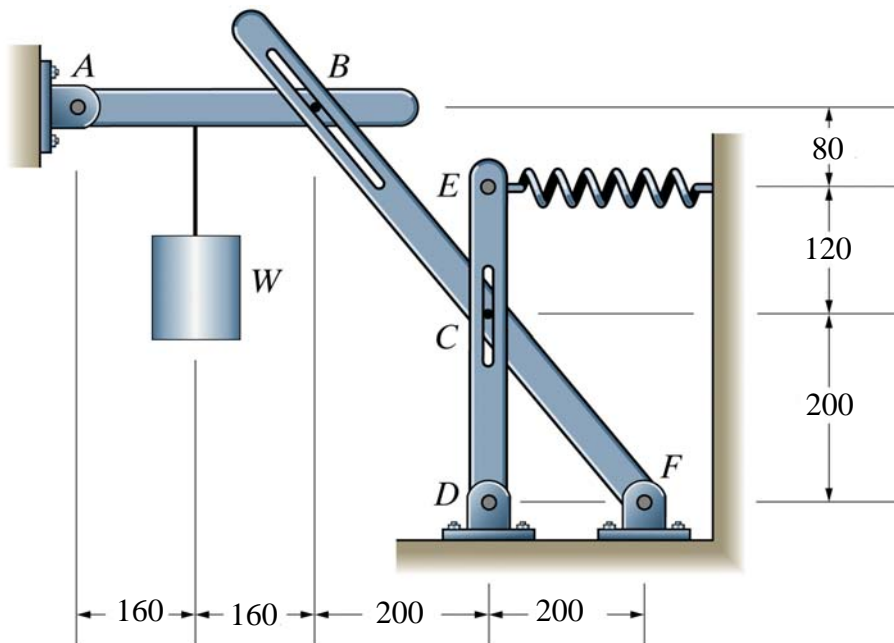
Moment = _____ kN-m /1 mark

Q9. The frame is supported by pins at A, D, and F, and a spring at E. There are pins in frictionless slots at B and C. The weight of the suspended object is $W = 300\text{ N}$. Neglecting the weight of the members, determine:

- (a) The tension force in the spring at E
 (b) The magnitude and direction of the reactions at F.

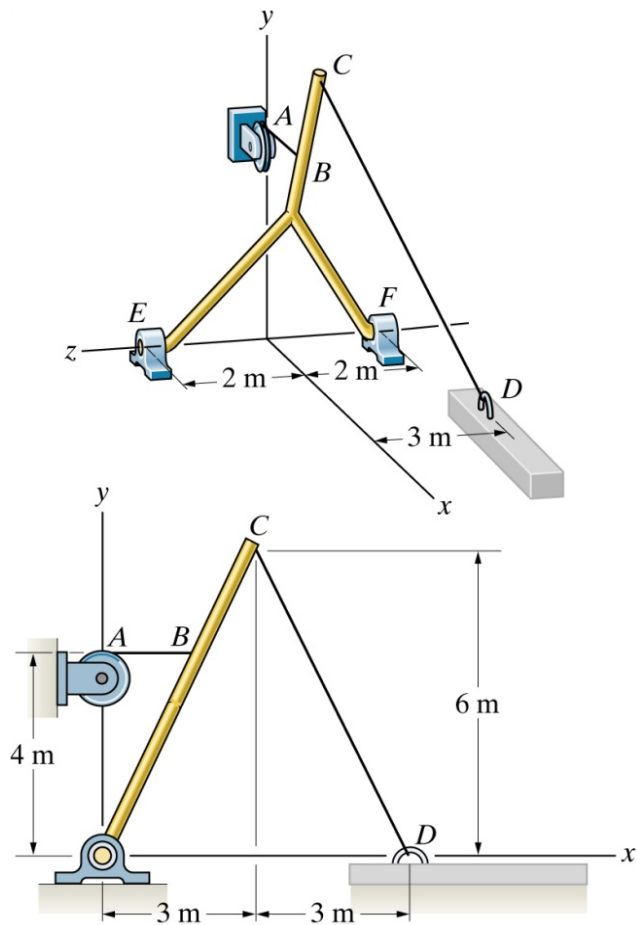
/9 marks
/4 marks

All dimensions in mm.



Q10. The crane's cable CD is attached to a stationary object at D. The crane is supported by the bearings at E and F, and the horizontal cable AB. The bearings at E and F are properly aligned and do not produce couple moments; the bearing at F exerts no axial thrust. The tension in the cable AB is 8 kN. Determine the tension in cable CD.

/10 marks



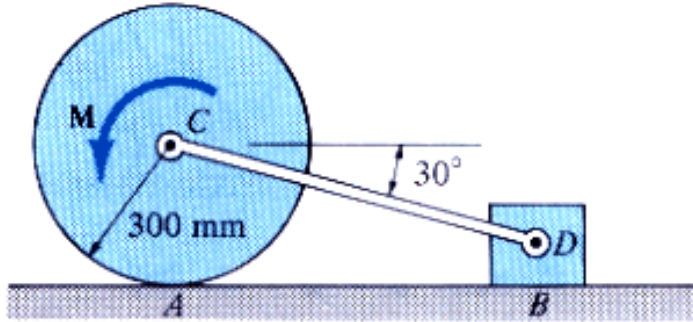
/8 marks

Technical drawing of a mechanical part with the following dimensions:

- Horizontal dimensions (top): 40 mm, 40 mm, 65 mm, 15 mm, 20 mm, 45 mm.
- Vertical dimensions (left): 40 mm, 60 mm.
- Internal vertical dimension: 35 mm.
- Circle radius: 25 mm.
- Base: track.
- Distance from track to right edge: d.

Q12: The disk C has a mass of 15 kg and the block D has a mass of 12 kg. If the coefficients of friction at the points of contact are $\mu_A = 0.5$ and $\mu_B = 0.2$, respectively, determine the smallest couple moment M which can be applied to the disk to cause motion. Neglect the mass of the connecting rod CD. Show by calculation whether the disk slips or rolls at point A.

/11 marks



Q13. A roof structure is represented by the member $ABCD$ and loading shown below. Neglecting the weight of the member:

- Determine the magnitude and direction of the reactions at point A and the magnitude of the force in cable DE . **/5 marks**
- Determine the internal axial force, shear force, and bending moment at point B by sectioning through BD and drawing the Free Body Diagram of segment BD . **/4 marks**
- Draw the shear force and bending moment diagrams for beam ABC . Indicate the values for shear force and bending moment at points A , B , and C . **/8 marks**

