

**FINAL**
Examination Paper

(COVER PAGE)

Session : August 2017

Programme : Foundation in Science (CFSI)

Course : EGR1203: Engineering Mechanics

Date of Examination : 14 December 2017 (Thursday)

Time : 11:00am – 1:00pm Reading Time : Nil

Duration : 2 hours

Special Instructions :

This paper consists of FIVE (5) questions. Answer any FOUR (4) questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided :

Physics Booklet

Examiner(s) :

Dr. Beh Boon Chun

Moderator :

Assoc. Prof. Dr. Khoo Bee Ee

This paper consists of 9 printed pages, including the cover page.

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FOUNDATION IN SCIENCE (CFSI)
 EGR1203: ENGINEERING MECHANICS
 FINAL EXAMINATION: AUGUST 2017 SESSION

Instructions: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Referring to Figure Q1(a),

- (i) Determine the x and y components of each force acting on the gusset plate of a bridge truss. (8 marks)
- (ii) Show that the resultant force is zero. (4 marks)

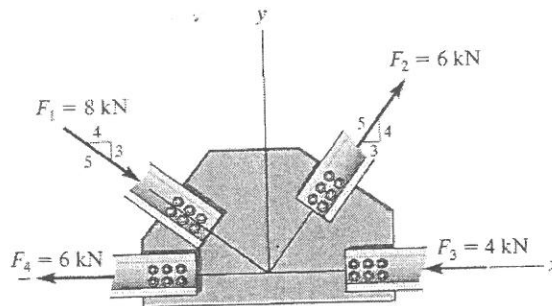


Figure Q1(a)

(b) Referring to Figure Q1(b),

- (i) Express each of the forces in Cartesian vector form. (6 marks)
- (ii) Determine the magnitude and coordinate direction angles of the resultant force. (7 marks)

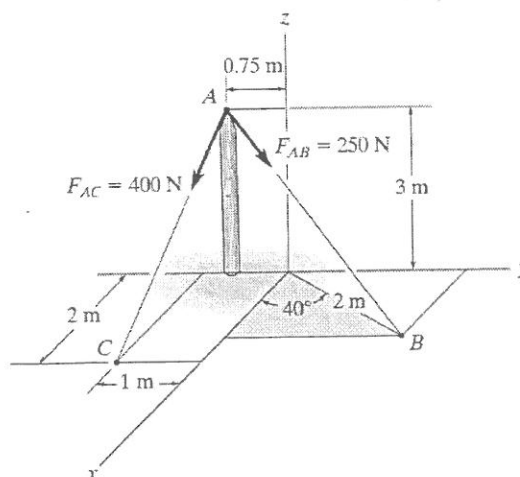


Figure Q1(b)

Question 2

- (a) Determine the moment produced by the force F in Figure Q2(a) about point O . Express the result as a Cartesian vector. (8 marks)

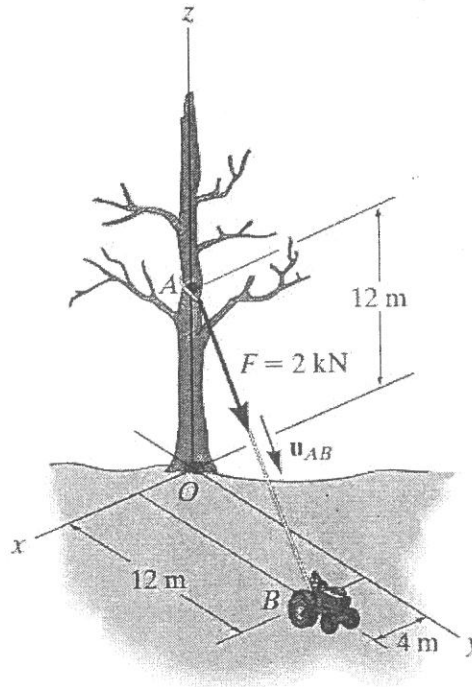


Figure Q2(a)

- (b) Determine the reactions at the supports as shown in Figure Q2(b). (5 marks)

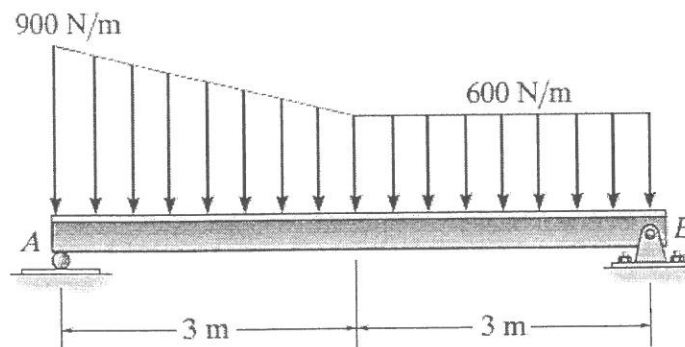


Figure Q2(b)

- (c) Referring to Figure Q2(c),
- (i) Determine the reactions at the pin A and the tension in cord BC. Set $F = 40$ kN. Neglect the thickness of the beam. (6 marks)

- (ii) If rope BC will fail when the tension becomes 50 kN, determine the greatest vertical load F that can be applied to the beam at B. What is the magnitude of the reaction at A for this loading? Neglect the thickness of the beam. (6 marks)

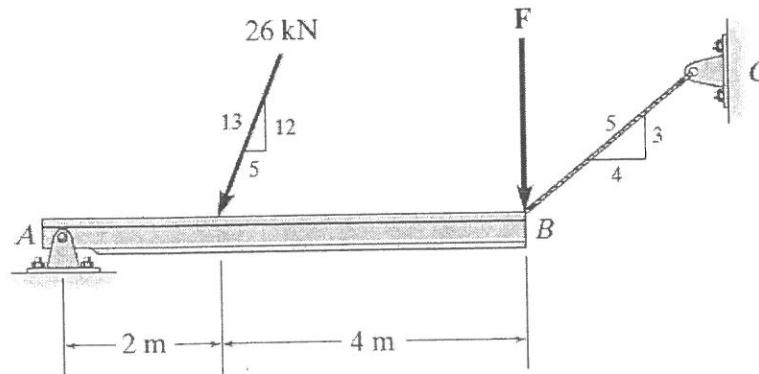


Figure Q2(c)

Question 3

- (a) Determine the forces acting in all the members of the truss shown in Figure Q3(a). (10 marks)

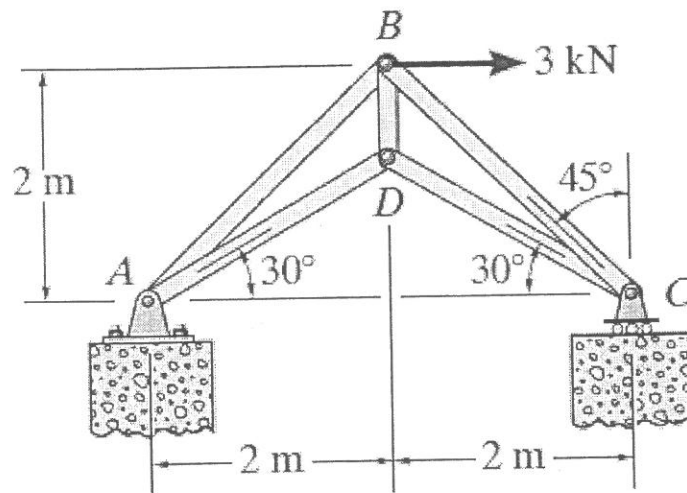


Figure Q3(a)

- (b) Determine the internal normal force, shear force, and moment acting at points D and E of the frame as shown in Figure Q3(b). (8 marks)

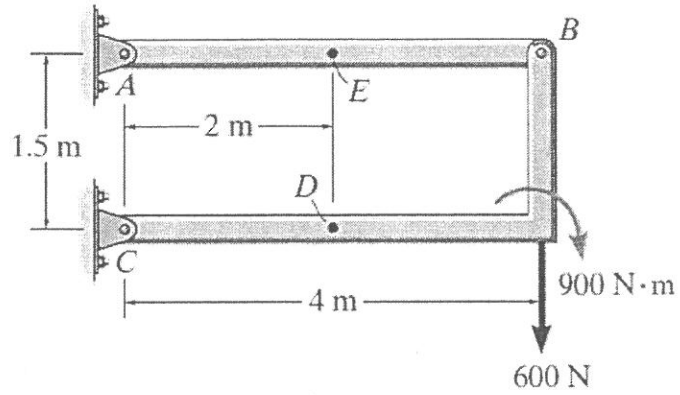


Figure Q3(b)

- (c) Draw the shear and moment diagrams for the beam as shown in Figure Q3(c). (7 marks)

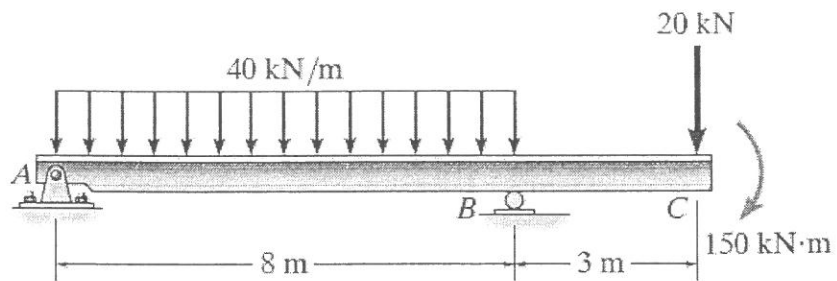


Figure Q3(c)

Question 4

- (a) The mine car and its contents have a total mass of 6 Mg and a center of gravity at G as shown in Figure Q4(a). If the coefficient of static friction between the wheels and the tracks is $\mu_s = 0.4$ when the wheels are locked, find the normal force acting on the front wheels at B and the rear wheels at A when the brakes at both A and B are locked. Does the car move? (8 marks)

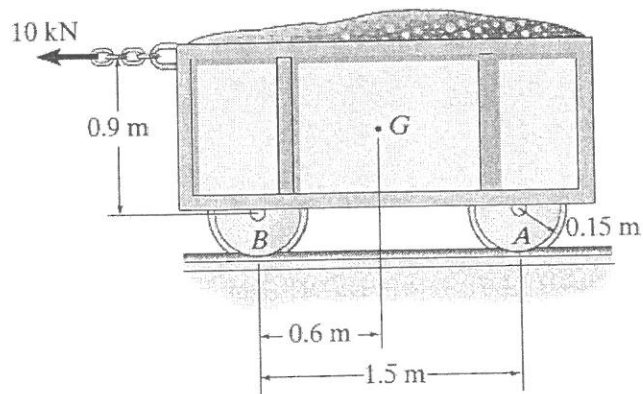


Figure Q4(a)

- (b) A rack is made from roll-formed sheet steel and has the cross section shown in Figure Q4(b). Determine the location (\bar{x}, \bar{y}) of the centroid of the cross section. The dimensions are indicated at the center thickness of each segment. (7 marks)

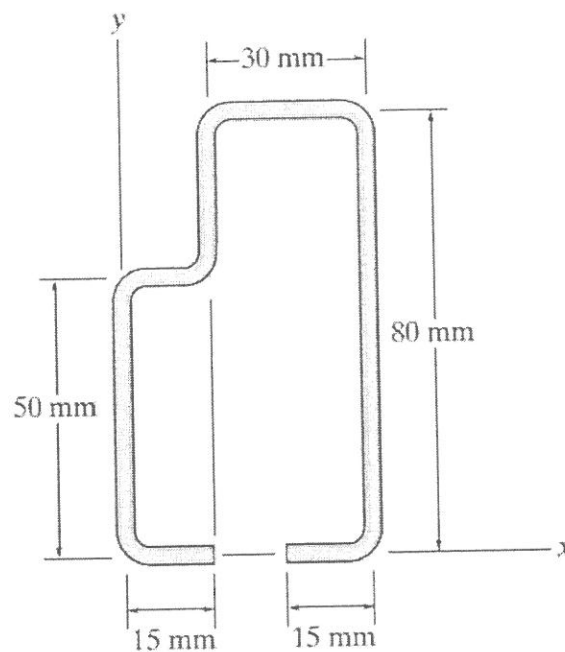


Figure Q4(b)

- (c) Determine the moment of inertia for the shaded area shown in Figure Q4(c) about the x axis. (5 marks)

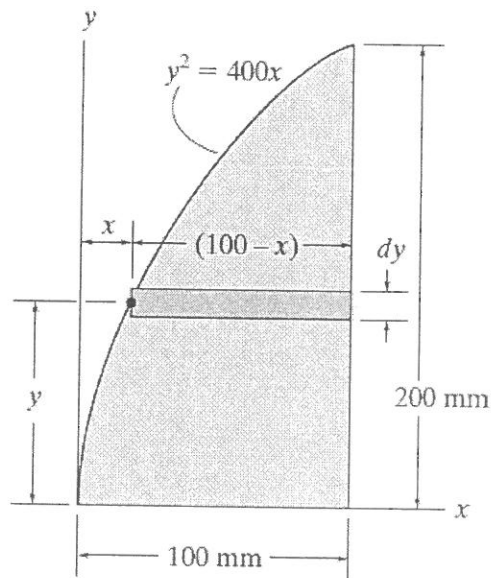


Figure Q4(c)

- (d) Determine the moment of inertia for the rectangular area shown in Figure Q4(d) with respect to
- the centroidal x axis, and (3marks)
 - the axis x' passing through the base of the rectangle. (2 marks)

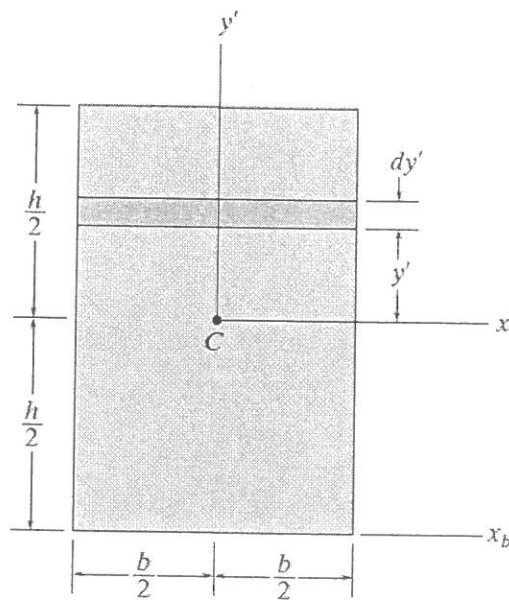


Figure Q4(d)

Question 5

- (a) Determine the speed at which the basketball at A must be thrown at the angle of 30° so that it makes it to the basket at B as shown in Figure Q5(a). (6 marks)

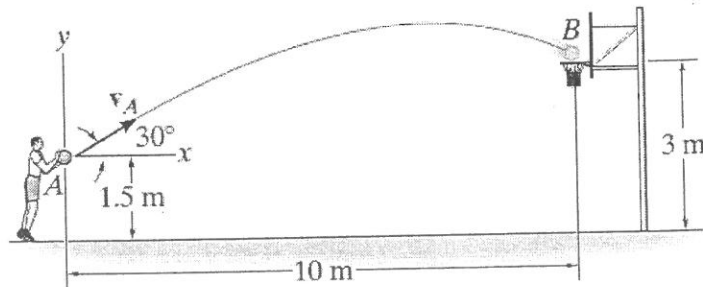


Figure Q5(a)

- (b) The 2-Mg truck is traveling at 15 m/s when the brakes on all its wheels are applied, causing it to skid for a distance of 10 m before coming to rest as shown in Figure Q5(b). Determine the constant horizontal force developed in the coupling C, and the frictional force developed between the tires of the truck and the road during this time. The total mass of the boat and trailer is 1 Mg. (6 marks)

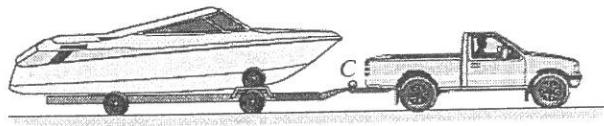


Figure Q5(b)

- (c) The 8-kg block is moving with an initial speed of 5 m/s as shown in Figure Q5(c). If the coefficient of kinetic friction between the block and plane is $\mu_k = 0.25$, determine the compression in the spring when the block momentarily stops. (6 marks)

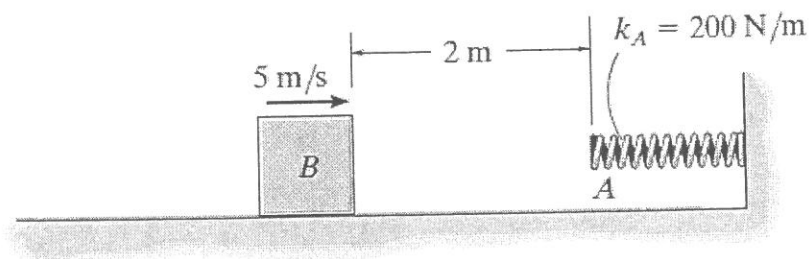


Figure Q5(c)

- (d) The bumper cars A and B in Figure Q5(d) each have a mass of 150 kg and are coasting with the velocities shown before they freely collide head on. If no energy is lost during the collision, determine their velocities after collision. (7 marks)

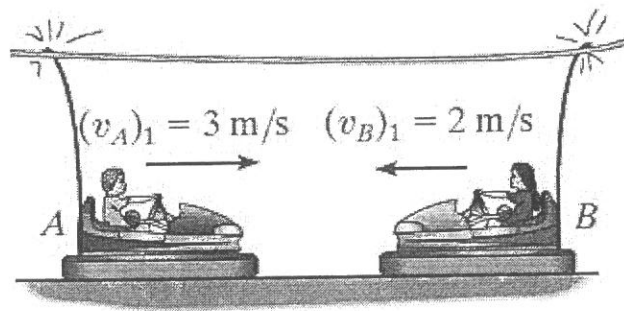


Figure Q5(d)

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