



INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session : August 2018

Programme : Foundation In Science (CFSI)

Course : **EGR1203: ENGINEERING MECHANICS**

Date of Examination : 12 December 2018 (Wednesday)

Time : 8:00AM – 10:00AM 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.

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 consist of 10 printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG
FOUNDATION IN SCIENCE (CFSI)
EGR1203: ENGINEERING MECHANICS
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Question 1

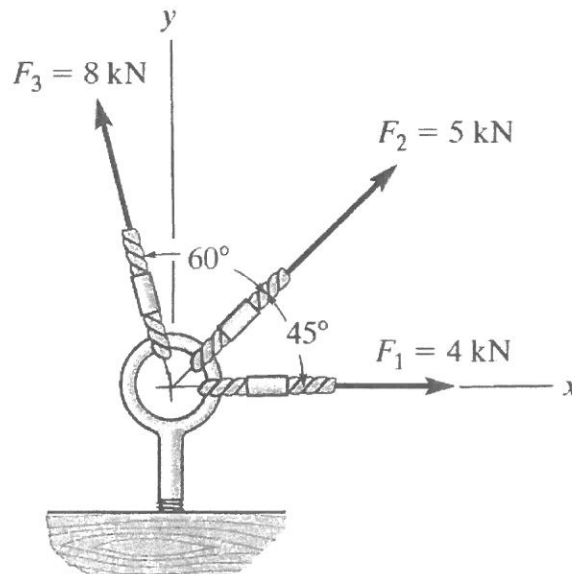


Figure Q1(a)

- a) Determine the magnitude of the resultant force shown in Figure Q1(a) and its direction, measured counterclockwise from the positive x axis.

[7 marks]

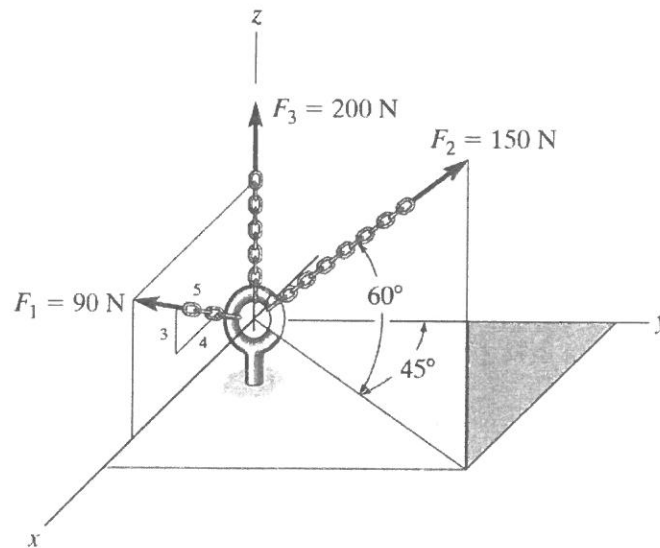


Figure Q1(b)

- b) Express each force (F_1 , F_2 and F_3) shown in Figure Q1(b) in Cartesian vector form and determine the magnitude of the resultant force.

[6 marks]

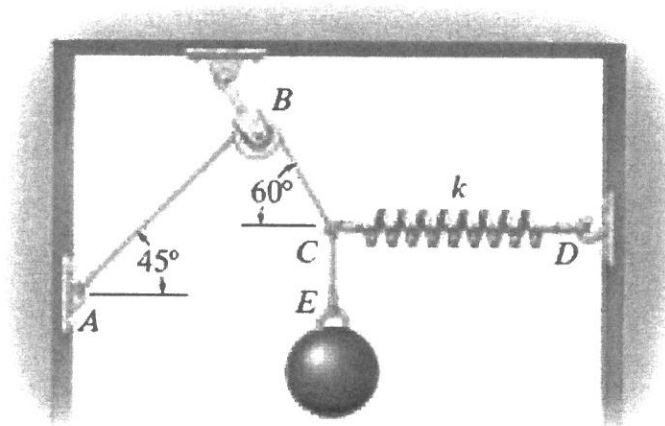


Figure Q1(c)

- c) A sphere has a mass of 6 kg and is supported as shown in Figure Q1(c). Draw a free-body diagram of the sphere, the cord CE and the knot at C. Show all the forces in the diagram.

[5 marks]

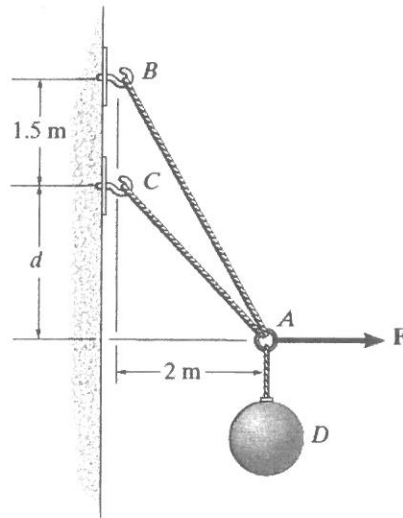


Figure Q1(d)

- d) Determine the forces in cables AC and AB needed to hold the 20 kg ball D in equilibrium as shown in Figure Q1(d). Take $F = 300\text{ N}$ and $d = 1\text{ m}$.

[7 marks]

Question 2

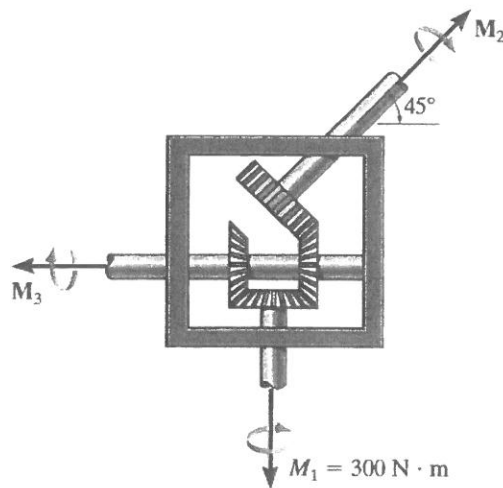


Figure Q2(a)

- a) Determine the required magnitude of the couple moments M_2 and M_3 shown in Figure Q2(a) so that the resultant couple moment is zero.

[4 marks]

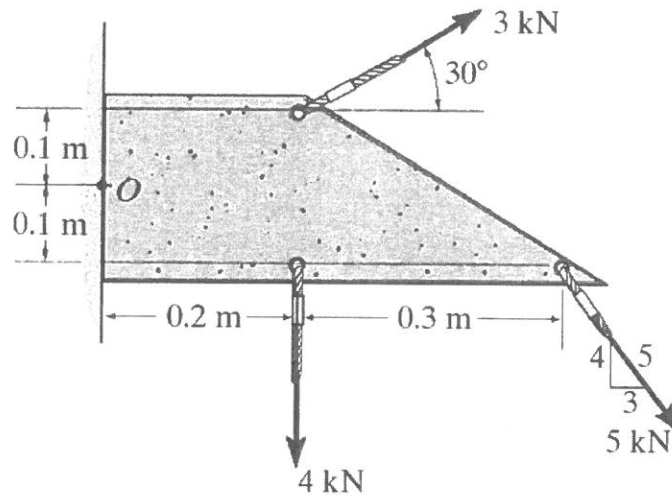


Figure Q2(b)

- b) Replace the force and couple system shown in Figure Q2(b) by an equivalent resultant force and couple moment acting at point O.

[8 marks]

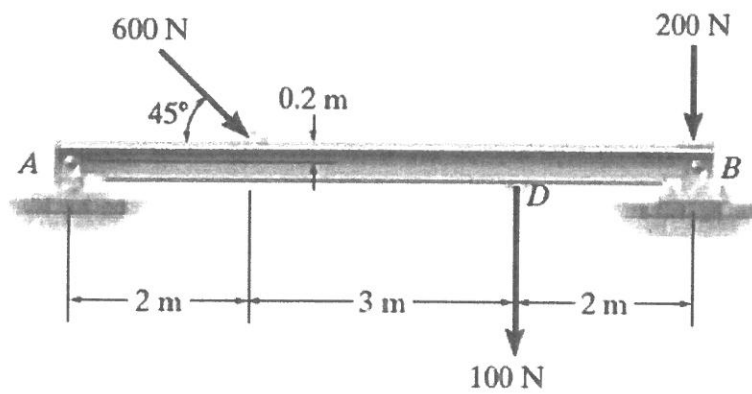


Figure Q2(c)

- c) Determine the horizontal and vertical component of reaction on the beam caused by the pin at B and the rocker at A shown in Figure Q2(c). Neglect the weight of the beam.

[7 marks]

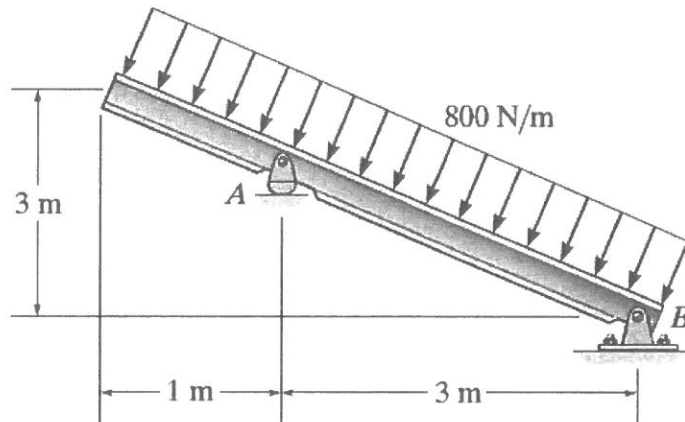


Figure Q2(d)

d) Determine the reactions at the supports A and B shown in Figure Q2(d).

[6 marks]

Question 3

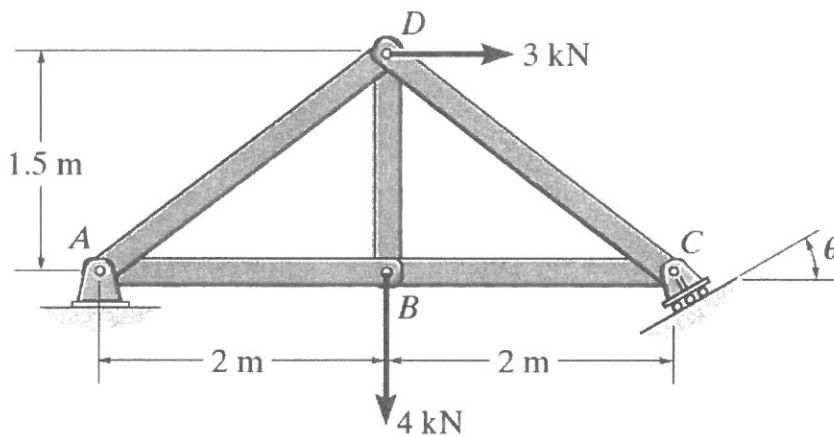


Figure Q3(a)

a) Determine the force in each member of the truss shown in Figure Q3(a) and state if the members are in tension or compression. Set $\theta = 30^\circ$.

[12 marks]

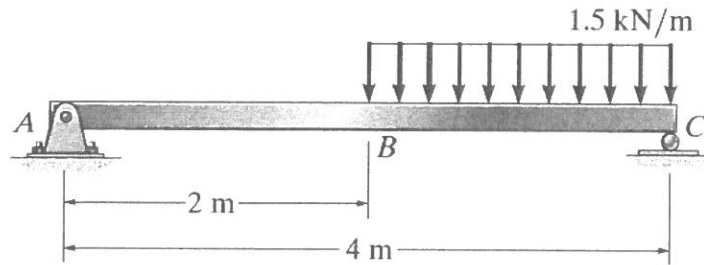


Figure Q3(b)

- b) Draw the shear and moment diagrams for the beam shown in Figure Q3(b)

[13 marks]

Question 4

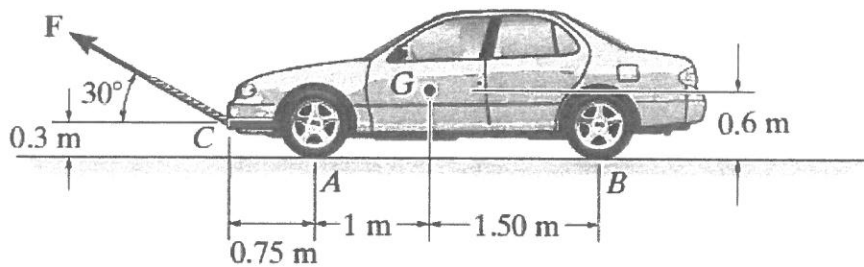


Figure Q4(a)-(b)

- a) The automobile has a mass of $2 Mg$ and center of mass at G. Determine the friction force acts on the wheels and towing force F required to move the car if the back brakes are locked, and the front wheels are free to roll. Take $\mu_s = 0.3$ and refer Figure Q4(a)-(b).

[6 marks]

- b) The automobile has a mass of $2 Mg$ and center of mass at G. Determine the friction force acts on the wheels and towing force F required to move the car. Both the front and rear brakes are locked. Take $\mu_s = 0.3$ and refer Figure Q4(a)-(b).

[7 marks]

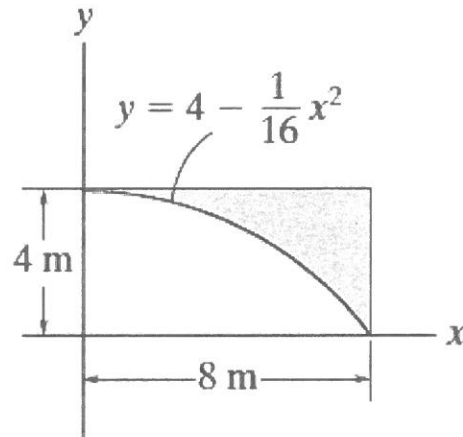


Figure Q4(c)

- c) Locate the centroid (\bar{x}, \bar{y}) of the shaded area shown in Figure Q4(c). [6 marks]

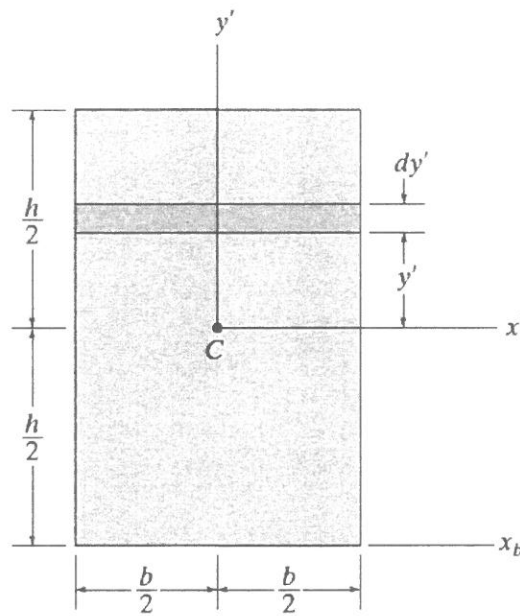


Figure Q4(d)

- d) Determine the moment of inertia for the rectangular area shown in Figure Q4(d) with respect to the centroidal x' axis and the axis x_b passing through the base of the rectangle. [6 marks]

Question 5

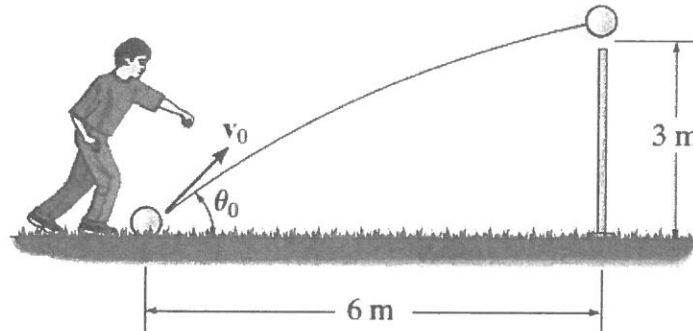


Figure Q5(a)

- a) Determine the minimum initial velocity v_0 and the corresponding angle θ_0 at which the ball must be kicked in order for it to just cross over the 3 m high fence. Refer Figure Q5(a).

[7 marks]

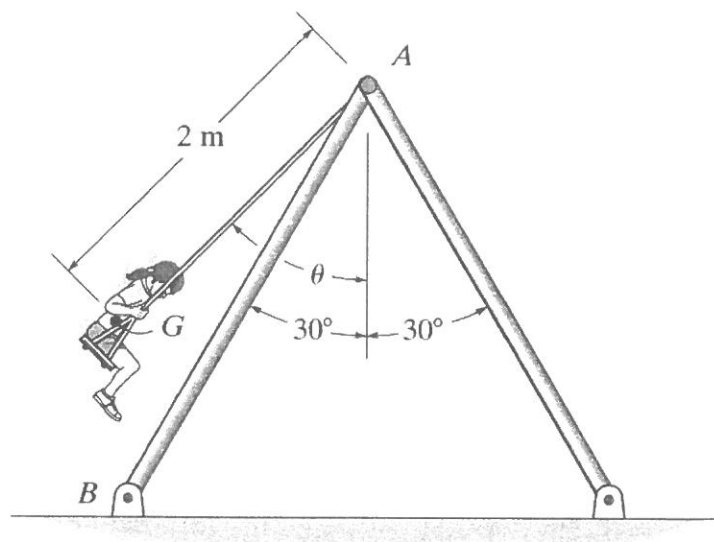


Figure Q5(b)

- b) The girl has a mass of 40 kg and center of mass at G as shown in Figure Q5(b). If she is swinging to a maximum height defined by $\theta = 60^\circ$, determine the force developed along each of the four supporting posts such as AB at the instant $\theta = 0^\circ$. The swing is centrally located between the posts.

[6 marks]

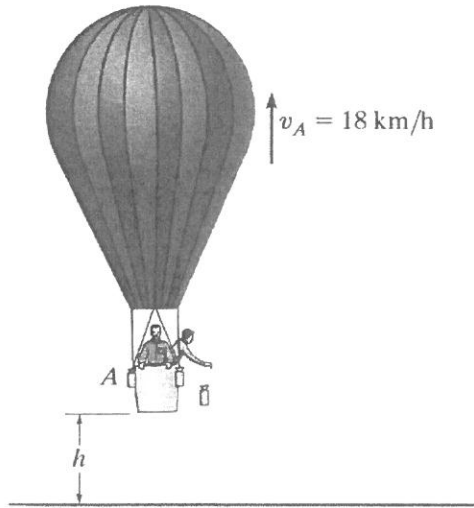


Figure Q5(c)

- c) The balloon shown in Figure Q5(c) has a total mass of 400 kg including the passengers and the ballast. The balloon is rising at a constant velocity of 18 km/h when $h = 10 \text{ m}$. If the man drops the 40 kg sand bag, determine the velocity of the balloon when the bag strikes the ground. Neglect air resistance.

[7 marks]

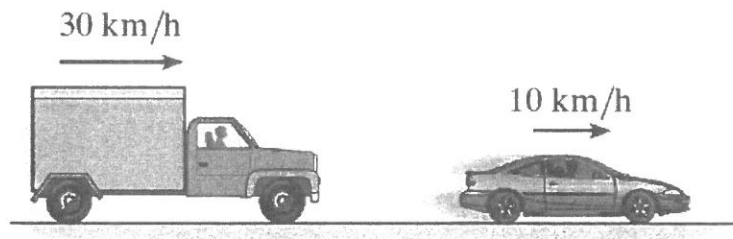


Figure Q5(d)

- d) The 5-Mg truck and 2-Mg car are travelling with the free-rolling velocities shown in Figure Q5(d) just before they collide. After the collision, the car moves with a velocity of 15 km/h to the right relative to the truck. Determine the coefficient of restitution between the truck and car due to the collision.

[5 marks]