

INTI INTERNATIONAL UNIVERSITY
 FOUNDATION IN SCIENCE (CFSI)
 EGR1203: ENGINEERING MECHANICS
 FINAL EXAMINATION: JANUARY 2014 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) If $\phi = 30^\circ$ and the resultant force is to be 6 kN directed along the positive y axis as shown in Figure Q1(a),

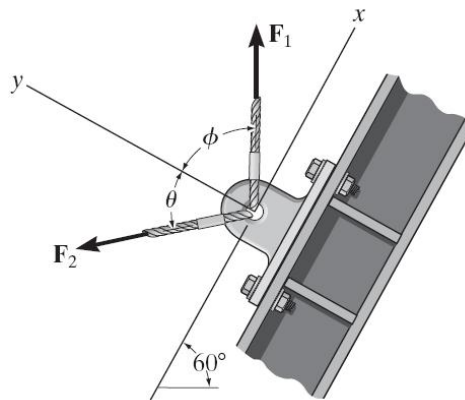


Figure Q1(a)

- (i) determine the magnitudes of \mathbf{F}_1 , \mathbf{F}_2 and the angle θ if \mathbf{F}_2 is required to be a minimum, and (4 marks)
- (ii) draw the parallelogram and label all the forces and angles. (5 marks)
- (b) Referring to Figure Q1(b), determine the magnitude of \mathbf{F}_1 and its direction θ so that the resultant force is directed vertically upward and has a magnitude of 800 N. (6 marks)

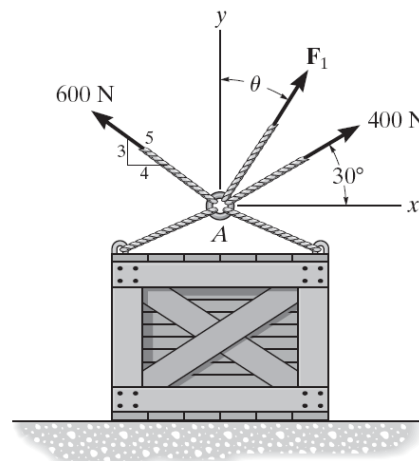


Figure Q1(b)

- (c) The Figure Q1(c) represents a bracket subject to three tensional forces. If the resultant force acting on the bracket is to be directed along the positive x axis and the magnitude of F_1 is required to be a minimum,

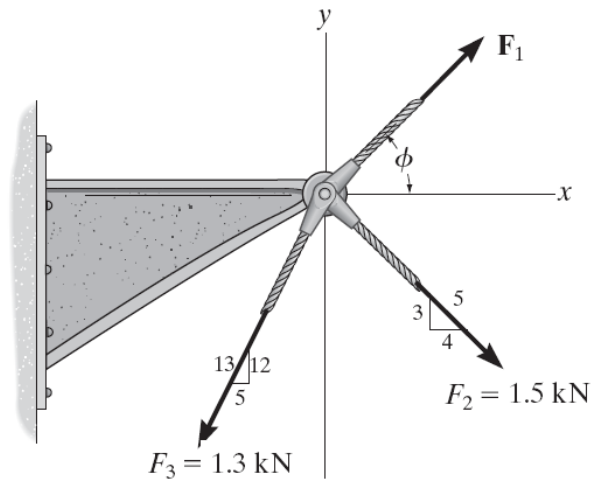


Figure Q1(c)

determine the magnitudes of the resultant force and F_1 .

(10 marks)

Question 2

- (a) Determine the magnitude and coordinate direction angles of the resultant force acting on the bracket as shown in Figure Q2(a).

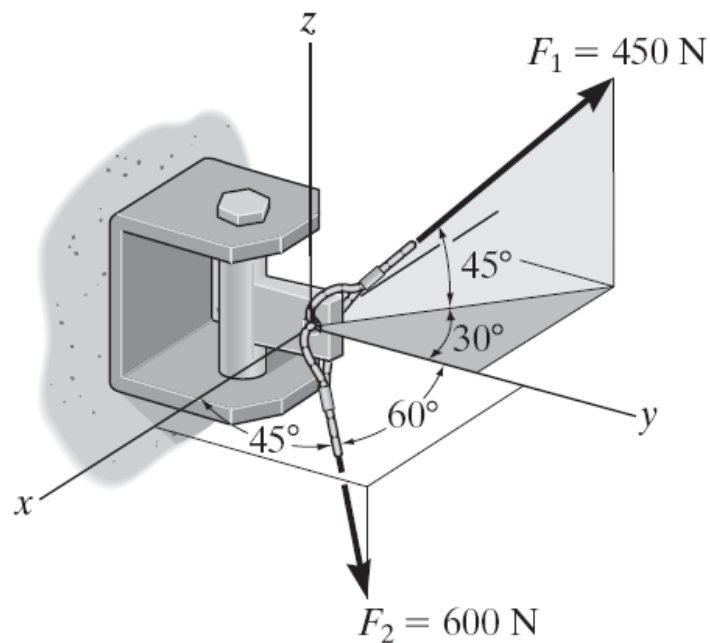


Figure Q2(a)

(15 marks)

- (b) Determine the unstretched length of spring AC if a force $P = 400\text{ N}$ causes the angle $\theta = 60^\circ$ for equilibrium as shown in Figure Q2(b). Cord AB is 0.6 m long. Take $k = 850\text{ N/m}$.

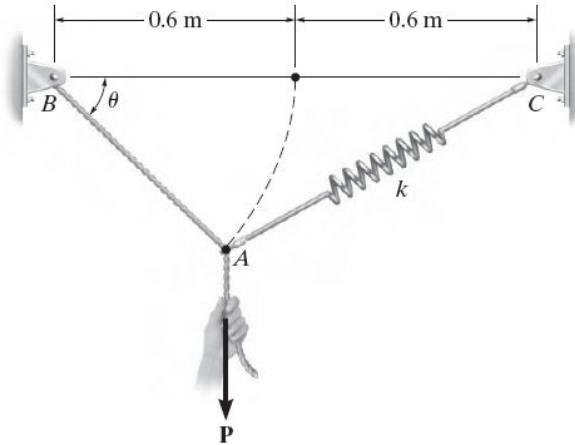


Figure Q2(b)

(10 marks)

Question 3

- (a) The rocker arm BD of an automobile engine is supported by a nonrotating shaft at C as in Figure Q3(a). Note that the points B , C and D lie on a horizontal line and that both the pushrod and valve stem exert forces along their axes. If the design value of the force exerted by the pushrod AB on the rocker arm is 80 kN ,

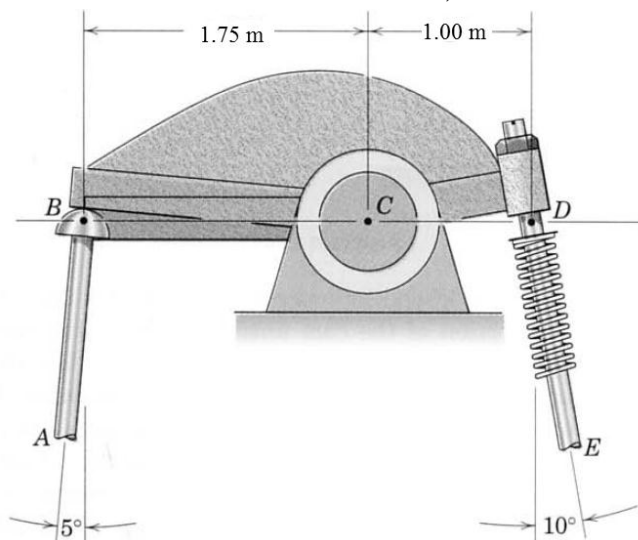


Figure Q3(a)

- (i) determine the force which the valve stem DE must exert at D in order for the combined moment about C to be zero. (2 marks)
- (ii) Compute the resultant of these two forces exerted on the rocker arm. (3 marks)

- (b) Referring to Figure Q3(b), a force F of magnitude 50 N is exerted on the automobile parking brake lever at the position $x = 250$ mm.

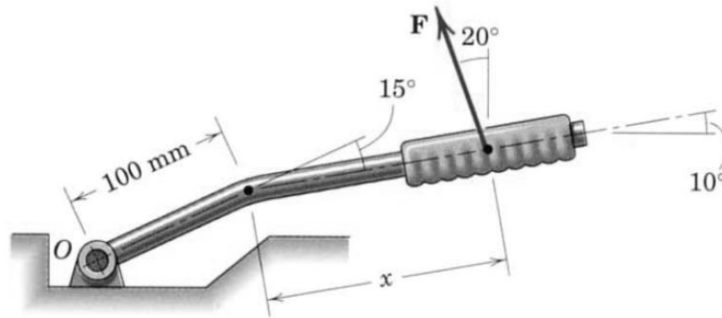


Figure Q3(b)

Replace the force by an equivalent force-couple system at the pivot point O .

(4 marks)

- (c) Solve for the forces in all members of the truss which supports the load L as shown in Figure Q3(c) using the method of joint and state if the members are in tension or compression. All members are of the same length.

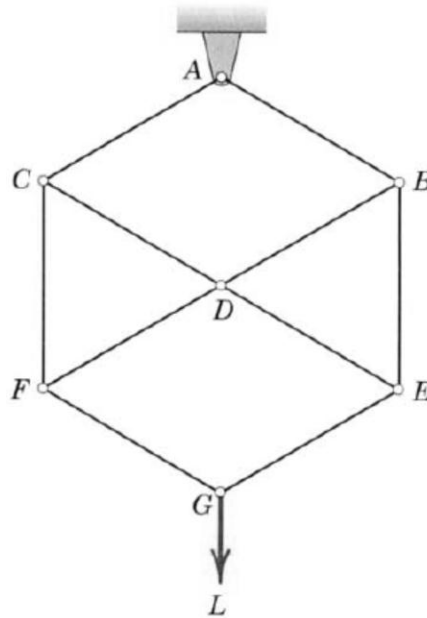


Figure Q3(c)

(16 marks)

Question 4

- (a) The system of parallel forces acts on the top of the *Warren truss* as shown in Figure Q4(a).

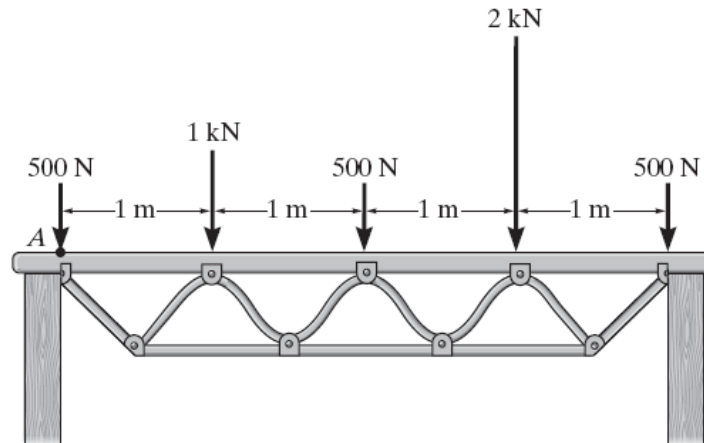


Figure Q4(a)

Determine the equivalent resultant force of the system and specify its location measured from point A.

(4 marks)

- (b) The internal drag truss for the wing of a light airplane is subjected to the forces shown in Figure Q4(b).

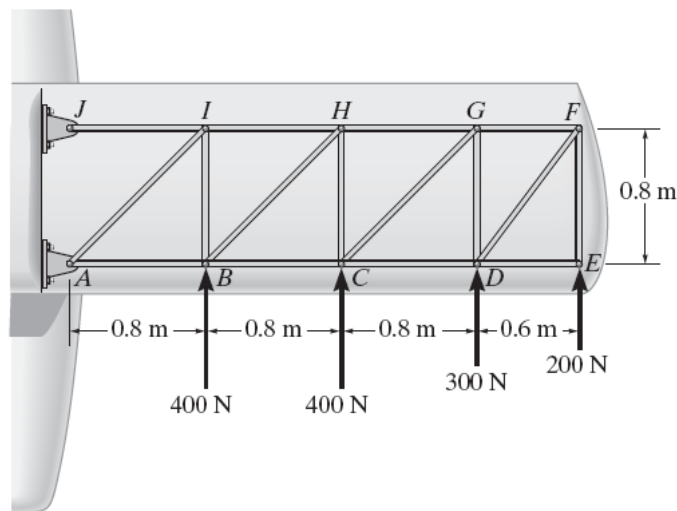


Figure Q4(b)

Determine the force in members BC , BH , and HC , and state if the members are in tension or compression.

(8 marks)

- (c) A car starts from rest and moves with a constant acceleration of 15 m/s^2 until it achieves a velocity of 25 m/s . It then travels with constant velocity for 60 seconds. Determine the average speed and the total distance traveled.

(8 marks)

- (d) The man pushes on the 30 kg crate with a force \mathbf{F} . The force is always directed down at 30° from the horizontal as shown in Figure Q4(d), and its magnitude is increased until the crate begins to slide. Determine the crate's initial acceleration if the coefficient of static friction is $\mu_s = 0.6$ and the coefficient of kinetic friction is $\mu_k = 0.3$.

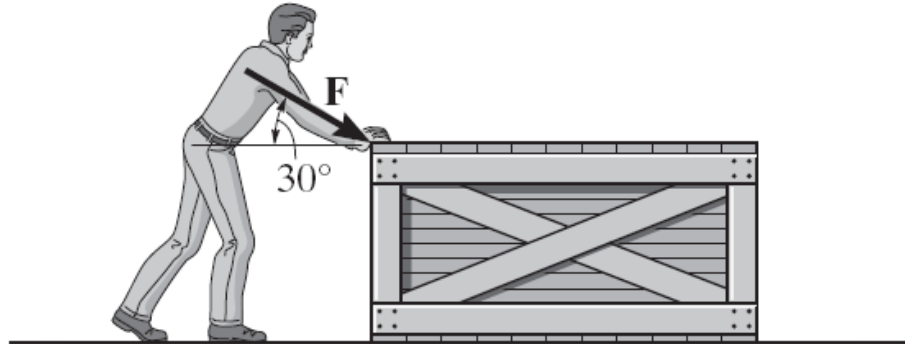


Figure Q4(d)

(5 marks)

Question 5

- (a) A two-stage missile is fired vertically from rest with the acceleration shown in Figure Q5(a). In 15 s the first stage A burns out and the second stage B ignites.

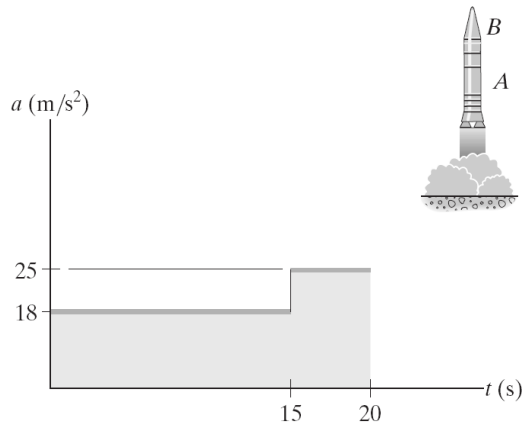


Figure Q5(a)

Plot the $s-t$ and $v-t$ graphs which describe the two-stage motion of the missile for $0 \leq t \leq 20$ s.

(15 marks)

- (b) The baseball player A hits the baseball with $v_A = 12 \text{ m/s}$ and $\theta_A = 60^\circ$ as shown in Figure Q5(b). When the ball is directly above of player B he begins to run under it.

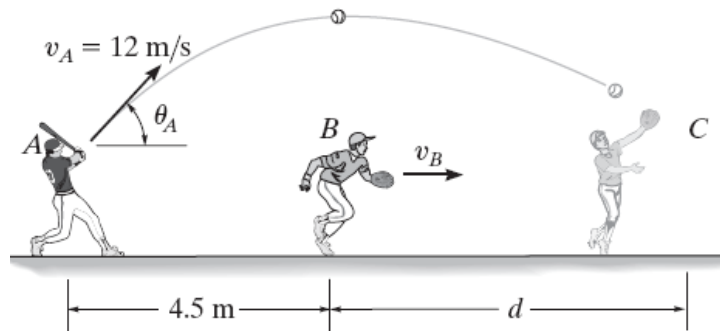


Figure Q5(b)

- (i) Determine the constant speed v_B and, (2 marks)
- (ii) Determine the distance d at which B must run in order to make the catch at the same elevation at which the ball was hit. (4 marks)
- (c) The casting has a mass of 3 Mg . Suspended in a vertical position and initially at rest, as shown in Figure Q5(c), it is given an upward speed of 200 mm/s in 0.3 s using a crane hook H .

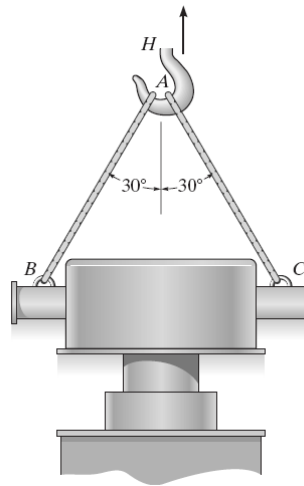


Figure Q5(c)

Determine the tension in cables AC and AB during this time interval if the acceleration is constant.

(4 marks)

--THE END--

EGR1203(F)/JAN2013/TKY/150414