



# STAMFORD COLLEGE SCHOOL OF ENGINEERING

## FOUNDATION STUDIES IN ENGINEERING

### KE 002: MECHANICS

**Date: 6 / 9 / 2007 (Thursday)**

**Time: 10:00 a.m. – 12:10 p.m.**

**Duration: 2 hours + 10 minutes reading time**

#### **Instructions to Candidates:**

- Instructions:
1. 6 questions set.
  2. Answer 4 questions.
  3. Maximum marks attainable: 100

Please ensure that this examination paper contains SIX questions on THREE printed pages before you start the examination.

Books, papers or any other written materials are not allowed to be brought into the examination hall. A candidate who violates the examination rules of Stamford College or commits a malpractice will be disqualified from the examination.

Write your Examination Index Number on each page of your answer booklet.

**Question 1**

- (a) A light horizontal beam of length 2 m rests with its ends A and B on a smooth support. The beam carries masses of 5 kg and 2 kg at distances of 60 cm and 150 cm from A, respectively.  
Find the reaction at each support. (5 marks)

- (b) Figure Q1(b) shows a uniform ladder AB of weight W, with its lower end on a horizontal floor and its top against a smooth vertical wall. The ladder is in equilibrium under the forces shown.

Prove the following expressions:

- (i)  $R = 2W \tan \theta$  (5 marks)  
 (ii)  $\tan \theta \tan \phi = \frac{3}{4}$  (5 marks)

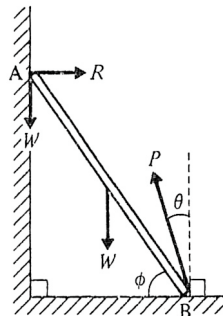


Figure Q1(b)

- (c) Figure Q1(c) shows a uniform ladder resting-in equilibrium with its top end against a smooth vertical wall and its base on a smooth inclined plane. The plane makes an angle of  $\theta$  with the horizontal and the ladder makes an angle of  $\phi$  with the wall.  
Prove that  $\tan \phi = 2 \tan \theta$ . (10 marks)

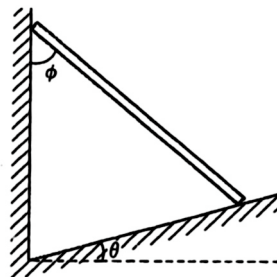


Figure Q1(c)

(Total= 25 marks)

**Question 2**

A particle P of mass  $2m$  resting on a rough plane inclined at  $30^\circ$  to the horizontal. The frictional force is equal to one-half of the normal reaction. P is attached to one end of a light inelastic string which passes over a smooth pulley fixed at the top of the plane and carries a particle Q of mass  $3m$  hanging freely at the other end. Find in terms of  $g$ :

- (a) the normal reaction between P and the plane , (7 marks)
- (b) the acceleration of P, and (8 marks)
- (c) the force exerted by the string on the pulley. (10 marks)

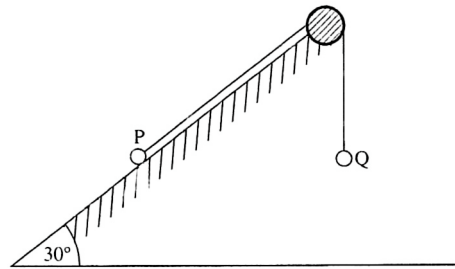


Figure Q2

(Total= 25 marks)

**Question 3**

A boy throws a ball vertically upwards from a seven-metre-high roof.

- (a) If, after 2 seconds, he catches the ball on its way down again, with what speed was it thrown? (8 marks)
- (b) What is the velocity of the ball when it is caught? (8 marks)
- (c) If the boy fails to catch the ball, with what speed will it hit the ground? (9 marks)

(Total= 25 marks)

**Question 4**

Find the centre of mass of the uniform lamina OABCDEF shown in Figure Q4.

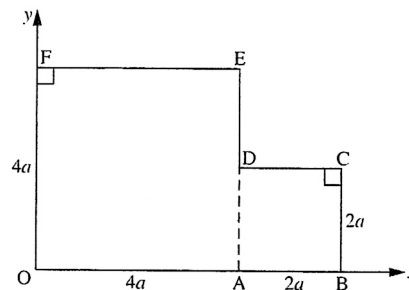


Figure Q4

(Total= 25 marks)

**Question 5**

A uniform ladder of mass 30 kg and length 5 m rests against a smooth vertical wall with its lower end on rough ground, coefficient of friction  $2/5$ . The ladder is inclined at  $60^\circ$  to the horizontal. Find the distance a man of mass 80 kg can ascend the ladder without it slipping.

(Total= 25 marks)

**Question 6**

A lift of mass 800 kg is operated by a cable as shown in Figure Q6. A passenger of mass 70 kg is standing in the lift. Find:

- (a) the force exerted by the passenger on the floor of the lift when the lift is accelerating
- (i) upwards at  $0.5 \text{ m/s}^2$  (6 marks)
  - (ii) downwards at  $0.5 \text{ m/s}^2$  (6 marks)
- (b) the tension in the cable when the lift is accelerating
- (i) upwards at  $0.5 \text{ m/s}^2$  (6 marks)
  - (ii) downwards at  $0.5 \text{ m/s}^2$  (7 marks)



Figure Q6

(Total= 25 marks)

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