



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

BRIDGING HIGHER DIPLOMA IN BUILDING & CIVIL ENGINEERING

AMA 2409 : APPLIED MATHEMATICS

END OF SEMESTER EXAMINATION

SERIES: AUGUST/SEPTEMBER 2011

TIME: 3 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Pocket Calculator*

This paper consists of **FIVE** questions in **TWO** sections A & B

Answer questions **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are shown

This paper consists of **THREE** printed pages

SECTION A (COMPULSORY – 30 MARKS)

Question 1

- a) A stone is thrown horizontally, from the top of a building 10m high, with a velocity of 20ms^{-1} . Find how far from the building the stone falls on the ground ($g = 9.8\text{ms}^{-2}$) (6 marks)
- b) An object of mass 5kg is acted on by coplanar forces 6, 8 and 3N at bearings 030° , 150° and 270° respectively. Find the acceleration of the object and its direction (10 marks)
- c) A uniform ladder 5.0m long has a mass of 20kg and rests with its upper end against a smooth vertical wall and with its lower end on rough horizontal ground. The ladder is inclined at 60° with the horizontal. A man of mass 60kg is sitting on the ladder 3m above the ground. Find:
- The magnitude and direction of the force exerted at the bottom of the ladder.
 - The coefficient of friction between the ground and the ladder ($g=10\text{ms}^{-2}$) (14 marks)

SECTION B (Attempt any TWO questions. Each question from this section carry 20 Marks)

Question 2

- a) A man of mass 70kg is ascending up in a lift of mass 300kg. The lift is decelerating at 1.2ms^{-2} . Neglecting resistance to motion. Find:
- The tension in the lift cable
 - The normal contact force between the man and the lift floor ($g = 9.8\text{ms}^{-2}$) (7 marks)
- b) A body of mass 3kg lies on a rough horizontal surface and is connected by a light string over a smooth pulley to another body also of mass 3kg which hangs freely vertically. The frictional resistance to motion is 8N. Find the tension in the string and the acceleration of the bodies when the system is released ($g = 10\text{ms}^{-2}$) (8 marks)
- c) A car of mass 1,000kg is towing a kart of mass 600kg. Find the braking force of the car and force in the tow-bar when slowing down at 0.4ms^{-2} (5 marks)

Question 3

- a) A body of mass 6kg lies on a rough surface inclined at 30° with the horizontal. The body is connected by a light string over a smooth pulley at the top of the slope to another body of mass 3kg which lies on a rough horizontal surface, with frictional resistance to motion equal to 5N. If the acceleration of the system is 1.2ms^{-2} , find the coefficient of dynamic friction for the surfaces in contact ($g = 10\text{ms}^{-2}$) (10 marks)

- b) A vehicle of mass $1.2 \times 10^3 \text{kg}$ starts from rest and acceleration uniformly to a speed of 50kmh^{-1} in a distance of 80m . Find:
- The average driving force
 - The time taken to cover the given distance
- (10 marks)

Question 4

- a) A stone is thrown from ground level with a velocity of 30ms^{-1} at 60° with the horizontal. Calculate:
- Its horizontal range
 - The maximum height reached
 - Its height 1.5 seconds after being thrown ($g = 10 \text{ms}^{-2}$)
- (12 marks)
- b) A simple pendulum has a length 80cm and amplitude 4.0cm . Find the maximum acceleration and velocity of the bob. (8 marks)

Question 5

- a) Find the forces in the members of the pin-jointed structure shown in figure 1, stating whether each force is compressive or tensile (13 marks)

$$10^3 \text{N}$$

- b) A body of mass 4kg is moving with velocity $\begin{pmatrix} 40 \\ 0 \end{pmatrix} \text{ms}^{-1}$ when it is acted upon by a force $\begin{pmatrix} -30 \\ 50 \end{pmatrix} \text{N}$. Find the magnitude and direction of the velocity 2 seconds after the force begun to act (7 marks)