



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

(A Centre of Excellence)

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

DIPLOMA IN BUILDING & CIVIL ENGINEERING

DIPLOMA IN ARCHITECTURE

AMA 2109: APPLIED MATHEMATICS

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2012

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

This paper consists of **FIVE** questions. Answer question **ONE** and any other **TWO** questions
Maximum marks for each part of a question are as shown

This paper consists of **FOUR** printed pages

Question One (20 Marks)

- a) Describe the following terms.
i) Surface Tension
ii) Scalar Quantity (2 marks)
- b) List **FIVE** effects of a force. (5 marks)
- c) A man has mass of 70kg, calculate:
i) His weight on earth ($g=10\text{N/kg}$) (2 marks)
ii) His weight on the moon ($g=1.7\text{N/kg}$) (2 marks)
iii) Give **FOUR** examples of vector and scalar quantities. (4 marks)
- d) Find the weight of the metre rule below. (5 marks)

Figure 1

Question Two (20 marks)

- a) Give **THREE** examples of simple Harmonic motion. (5 marks)
- b) Show that the displacement function of simple Harmonic motion is given by:
$$Y = r \sin wt$$
(4 marks)
- c) In passing through a wooden block 8cm thick the velocity of a bullet reduces from 700m/s to 300m/s.
If the mass of the bullet is log. Find the average resistance to penetrate. (4 marks)
- d) (i) Two masses of 0.5kg and 0.25kg are connected by a light inextensible string which passes over a smooth pulley. If the system is released from rest with the string taught, find the acceleration of each mass and the distance travelled in 1 second from rest. (8 marks)
- (ii) Define the term upthrust. (1 mark)

Question Three (20 marks)

- a) Two blocks of masses m_1 and m_2 are connected by a light string passing over a pulley as shown below.

Figure 2

The blocks are at rest on an inclined frictionless surface and the effects of the pulley are negligible. Which way and how do the blocks move in 0.75seconds after being released? **(10 marks)**

- b) State the **THREE** laws of friction. **(3 marks)**
- c) A Wagon of mass 250kg is pulled by a horizontal cable a long a straight level track against a resisting force of 150N. The Wagon starts from rest. After 10 seconds, it had covered a distance of 60m. Find the tension in the cable. **(5 marks)**

Figure 3

- d) List **TWO** types of forces. **(2 marks)**

Question Four (20 marks)

$$\mu = \tan \theta$$

- a) Show that the coefficient of sliding friction for a rough inclined plane is given by **(6 marks)**
- b) A 60kg ice skater is standing at rest on a frozen lake. The friction between his skates and the surface of ice is legible. If he throws a 2kg block horizontally with a velocity of 12m/s. What is his recoil velocity? **(4 marks)**
- c) (i) Two cars approaching each other along streets that meet at a right angle collide at the intersection and after the crash they stick together. If one car has a mass of 1400kg and an initial velocity of 11.5m/s and the other has a mass of 1750kg and an initial speed of 15.5m/s. What will be their speed and direction immediately after impact? **(8 marks)**
- (ii) Differentiate between static frictional forces and kinetic frictional forces. **(2 marks)**

Question Five (20 marks)

- a) A dingy of mass 90kg is moved across a horizontal bench at a steady speed of 2ms^{-1} . One of the crew pulls with a force of P Newton's, the other pushes with a force of $(P+15)$ Newtons. The frictional force resisting the motion is 105N. Find p . **(3 marks)**
- b) A block of mass M on an inclined plane is joined to a mass m by a cord over a pulley as shown below.

Figure 4

The block slides on a frictionless surface and the effects of the pulley are negligible. What is the magnitude and direction of the acceleration of the block if the surface is inclined at 20° and $m = \frac{1}{2}M$

- c) (i) Give **TWO** examples of circular motion. **(2 marks)**
- (ii) Determine the centripetal acceleration of the moon as it circles the earth and compare that acceleration with the acceleration of bodies falling on the earth surface. The period the moon's orbit is 27.3 days and the distance of the moon from the earth is $3.84 \times 10^8\text{m}$ **(5 marks)**
- d) Define the term simple Harmonic motion. **(2 marks)**