



# TECHNICAL UNIVERSITY OF MOMBASA

## FACULTY OF ENGINEERING AND TECHNOLOGY

### DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

#### UNIVERSITY EXAMINATION FOR:

#### DIPLOMA IN MECHANICAL ENGINEERING YEAR I SEMESTER II

#### EME 2106 : MECHANICAL SCIENCE II

#### END OF SEMESTER EXAMINATION

**SERIES:** APRIL 2016

**TIME:** 2 HOURS

**DATE:** Pick Date May 2016

#### Instructions to Candidates

You should have the following for this examination

*-Answer Booklet, examination pass and student ID*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.

**Do not write on the question paper.**

#### Question ONE

- State FOUR laws of friction. (4 marks)
- Using first principles, show that for a body moving down the plane, pull  $P$  parallel to the plane is given by:-  
 $F = \mu R_N$  for limiting friction and hence  $P + F = W \sin \theta$  when resolved parallel to the plane. (6 marks)
- A force of 540N acting parallel to a plane inclined at  $20^\circ$  to the horizontal is required to just move a body of mass 61.3kg up the plane. Calculate:- (10 marks)
  - The coefficient of friction between the surfaces.
  - The force parallel to the plane required to drag the body down the plane at a steady speed.
  - If the surface is lubricated, calculate the value of  $\mu$  to make the body move down under its own  $W$ .

#### Question TWO

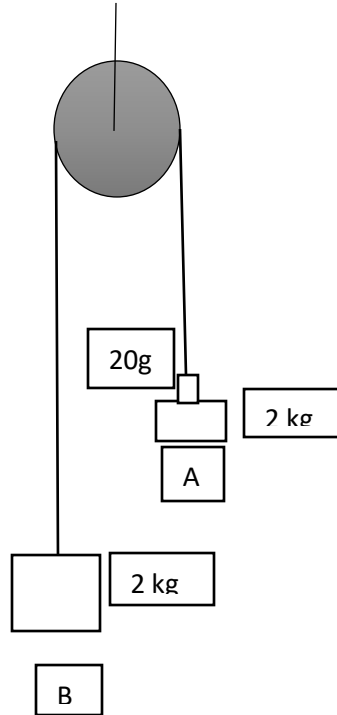
- Define the following terms with reference to applied mechanics:- (4 marks)
  - Work done
  - Tractive resistance
  - Power

iv. Energy

- b. Show that the energy lost due to kinetic energy is given by:- (4 marks)

$$E_k = \frac{1}{2}mv^2$$

- c. The diagram shows two masses 2kg each connected by a light inelastic cord passing over a light frictionless pulley. If an additional mass of 20g is placed on one of the hanging masses, the masses move from rest at constant acceleration. Calculate the distance through which mass will have moved after 6 seconds. (12 marks)



### Question THREE

- a. Define the following terms with reference to simple machines;- (3 marks)
- Mechanical Advantage
  - Velocity Ratio
  - Efficiency
- b. State and explain the condition for reversibility of a machine. (2 marks)
- c. Show using a well labelled diagram, a simple pulley block with a velocity ratio of 5. (3 marks)
- d. The following corresponding values of the load L and effort F were obtained during an experiment with a certain Weston pulley block having a velocity ratio of 24.

Load, L in kg	5	10	15	20	25
Effort, F in N	10	14	18.5	22.5	27.5

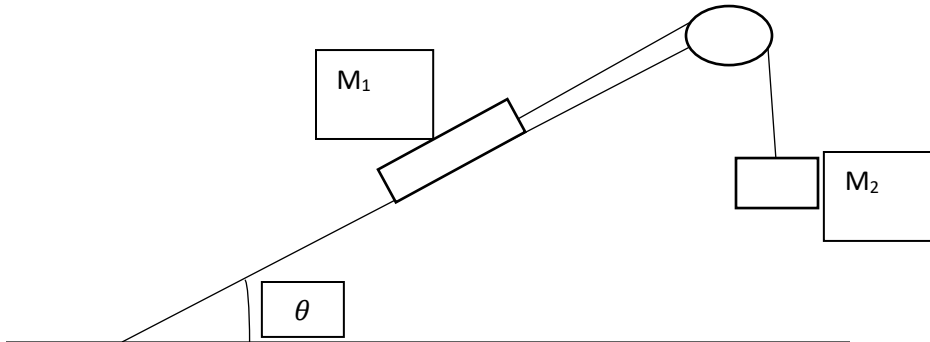
Draw Effort x Load graph and the % efficiency x Load graph on the same side of the graph paper to the same scale and on it determine:-

- The Law of the machine
- Efficiency of the machine when a load of 23 kg is being lifted.

- iii. The load that can be lifted with an efficiency of 35%. (12 marks)

#### Question FOUR

- a. Define the following terms as used in dynamics:- (4 marks)
- Momentum
  - Impulsive forces
- b. State THREE Newton's Laws of motion. (3 marks)
- c. The diagram below shows a mass  $m_1$  kg connected by a mass  $m_2$  kg by means of a light inelastic cord. When the system is released from rest,  $m_2$  accelerates downwards. Calculate the acceleration of the system if the coefficient of friction is  $\mu$ . (13 marks)



#### Question FIVE

- a. Define the following terms as used in strength of materials. (3 marks)
- Strain
  - Stress
  - Intensity of direct stress
- b. State Hooke's law. (2 marks)
- c. A specimen of low carbon steel (En 3B) was subjected to a tensile test to destruction and the following results and details were obtained.

Maximum Load = 34.04kN  
Yield Load = 31.39kN  
Limit of proportionality load = 22.08kN  
Gauge Length = 50mm  
Final distance between gauge lengths = 58mm  
Original cross sectional area = 64mm<sup>2</sup>  
Diameter at fracture = 6mm

Calculate:-

- The tensile strength
- The yield stress
- The limit of proportionality stress and

- iv. The percentage elongation and reduction area (8 marks)
- d. A copper wire 1.6mm diameter, 4m long extends 1.7mm when carrying a mass of 98N. Calculate:-
- i. The stress and strain in the wire at this load
  - ii. The modulus of elasticity of copper
  - iii. The factor of safety if the ultimate tensile strength of copper is  $220\text{N/mm}^2$  (7 marks)