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

a. State FOUR laws of friction. (4 marks)

b. 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)

c. A force of 540N acting parallel to a plane inclined at 20^o to the horizontal is required to just move a body of mass 61.3kg up the plane. Calculate:- (10 marks)

   i. The coefficient of friction between the surfaces.

   ii. The force parallel to the plane required to drag the body down the plane at a steady speed.

   iii. If the surface is lubricated is lubricated, calculate the value of μ to make the body move down under its own W.

Question TWO

a. Define the following terms with reference to applied mechanics:- (4 marks)

   i. Work done

   ii. Tractive resistance

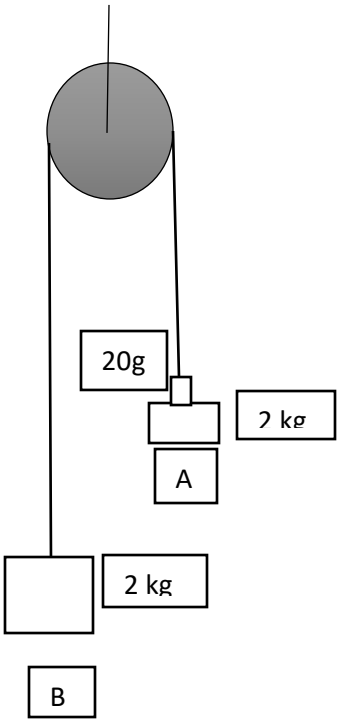
   iii. Power

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 alight inelastic cord passing over a light frictionless pulley. If 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)
   i. Mechanical Advantage
   ii. Velocity Ratio
   iii. 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

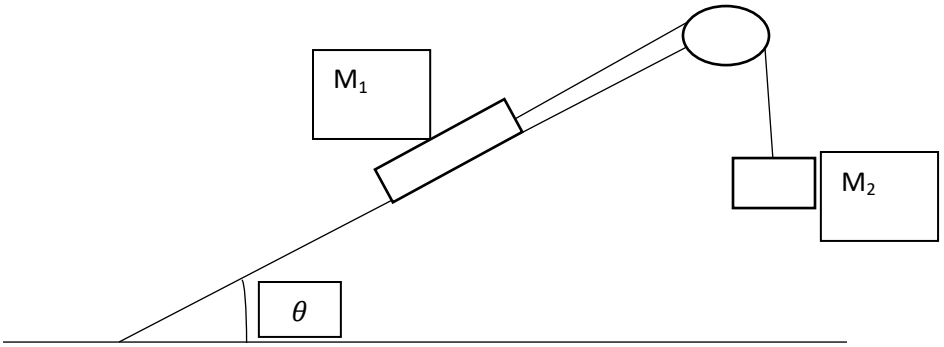
Draw Effort x Load graph and the % efficiency x Load graph on the same side of the graph paper to the same scale and on it determine:-

   i. The Law of the machine
   ii. 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)
   i. Momentum
   ii. 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 μ. (13 marks)



Question FIVE

a. Define the following terms as used in strength of materials.
   i. Strain
   ii. Stress
   iii. Intensity of direct stress (3 marks)
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^2
   Diameter at fracture = 6mm

Calculate:-

   i. The tensile strength
   ii. The yield stress
   iii. 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 $220N/mm^2$ (7 marks)