THE TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

DEE2

EME 2130 MECHNANICAL SCIENCE

SERIES: APRIL/ MAY 2016

TIME: 2 HOURS

Instructions to candidates

You should have the following for this examination:-

- Answer booklet
- Scientific calculator
- Drawings instruments

The paper consists of FIVE Questions. Answer any THREE questions

Question One

(a) Define the following terms:-

(i) Work

(ii) Energy

(iii) Power

(iv) Kinetic energy

(4 marks)

(b) State the principle of conservation of energy

(2 marks)

(c) A body having a mass of 80N rests on a horizontal surface. Assuming the coefficient of friction is 0.25, calculate the force applied to the body at an upward angle of 30° with the horizontal, to just:-

(i) Pull the body over the surface

(ii) Push the body over the surface,

with constant velocity in each case

(14 marks)

Question Two

(a) Define the following terms:-

(i) Moment

(ii) Couple

(iii) Torque

(3 marks)

(b) The compound lever shown below is made up of two levers AE and CE, pinned at a common point E. AE carries a 30KN load at B and rests on a knife edge at A. CE carries a 40KN load at C and rests at a knife edge at D. Calculate the vertical force required at the pin E to hold the two levers horizontal.

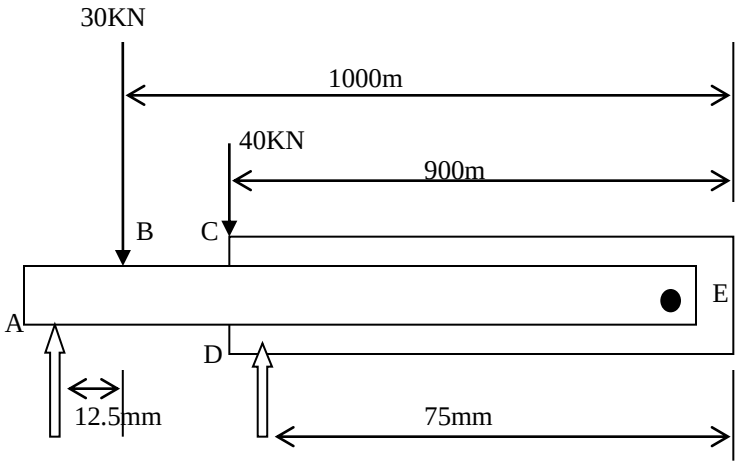

Figure 1

(8 marks)

(c) Calculate the magnitude and direction of the reaction at the pivot point A of the lever shown in the diagram. The lever is in equilibrium.

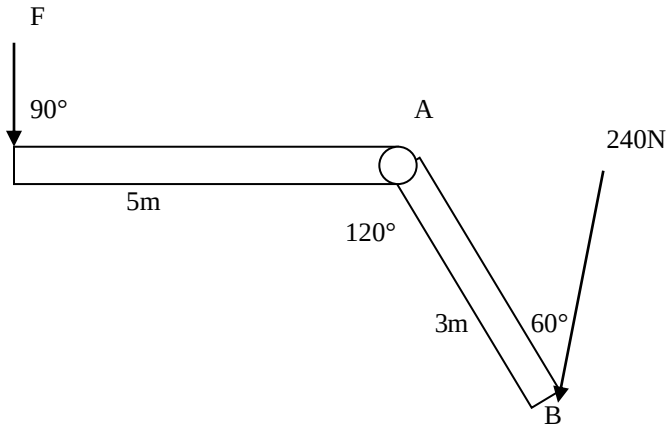

Figure 2

(9 marks)

Question Three

(a) Define the following terms:-

(i) Stress

(ii) Strain

(iii) Modulus of elasticity

(3 marks)

(b) The following results were obtained for a gauge length of 60mm in a tensile test on a specimen of black mild steel of 12mm diameter.

Load, W (KN)	5	10	15	20	25	30	35	40
Extension $x10^{-3}$ mm	14	27.2	41	54	67.6	81.2	96	112

When tested to destruction:-

Maximum load = 65KN
Load at fracture = 50KN
Diameter at fracture = 7.5mm
Total extension gauge length = 17mm

Calculate:-

(i) Young's Modulus

(ii) Specific modulus

(iii) Ultimate tensile stress

(iv) Breaking stress

(v) Stress at fracture

(vi) Percentage elongation

Hint: Relative density of steel = 7.8

(13 marks)

(c) Discuss your results in 3(b) above in relation to:-

(i) Failure, a factor of safety

(ii) Ductility

(iii) Resilience and toughness

(iv) Brittle materials

(4 marks)

Question Four

(a) Define the following terms:-

(i) Pressure

(ii) Density

(iii) Specific gravity

(iv) Specific weight

(v) Centre of pressure

(5 marks)

(b) A fuel tank contains oil of specific gravity 0.7. In one vertical side is cut a circular opening 1.8m diameter closed by a trap door hinged at the lower end B and held by a bolt at the upper edge A. If the fuel level is 1.8m above the top edge of the opening, calculate:-

(i) The total force on the door,

(ii) The force F in the bolt

(iii) The force on the hinge.

Density of water = $1Mg/m^3$

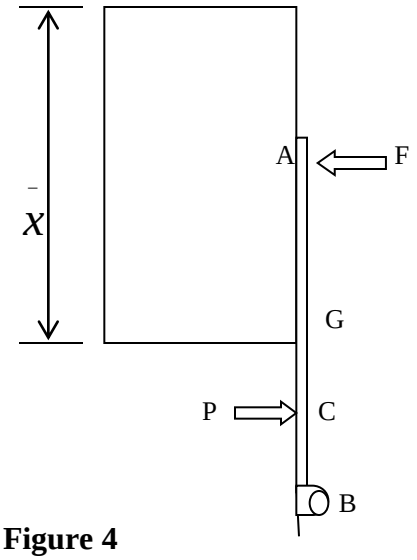

Figure 4

(15 marks)

Question Five

(a) During three consecutive seconds it is observed that a particle moves with constant acceleration through distances of 240m, 486m and 5m. Calculate:-

(i) The acceleration and velocity at the beginning and end of the period of the observation

(ii) The distance traversed during the third second of observation and the total distance covered in six seconds.

(10 marks)

(b) A pulley A, diameter 800mm is accelerated by means of a belt drive from 60r/min to 240r/min during which it turns through 360 revolutions. This pulley is attached by means of a belt to a driven pulley B, with a diameter 200mm. Calculate:-

(i) The angular acceleration of the belt if there is no slip

(ii) The initial and final velocity of pulley B in r/min and rad/s respectively.

(10 marks)