NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRY TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

ENGINEERING MECHANICS I: STATICS

TCW 1101

Examination Paper

NOVEMBER 2016

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Eng. K. Mushunje

INSTRUCTIONS

1. Answer FOUR questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
TOTAL	**100**

QUESTION 1

a) The nature of a force system can be described by its position in space or the way it is acting on a body. The following terms are used to describe force systems:

i) Concurrent and non-concurrent force system;

ii) Planar and non-planar system of forces.

Explain what is meant by each of the terms above and give examples of each. [12]

b) A plate shown in Figure 1.1 below is subjected to four forces and one couple.

i. Determine the magnitude and location of the resultant of these forces on the plate.

ii. Show an alternative point of application for the 40 N - force that will have the same effect of the plate as the one shown in Figure 1.1. (show by means of a diagram and give brief explain) [13]

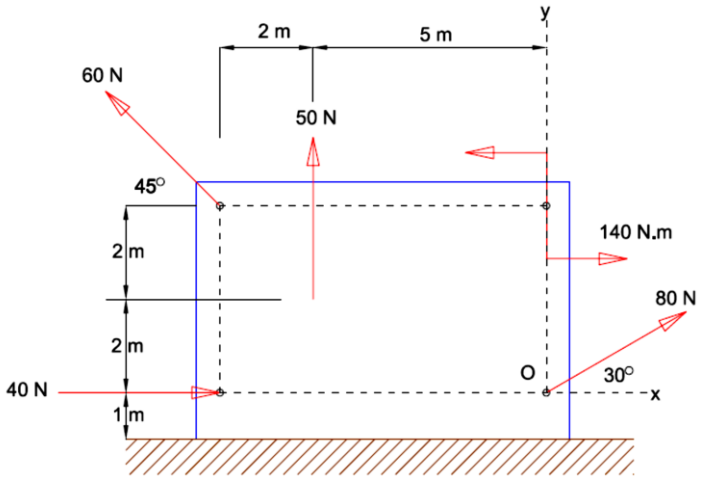

Figure 1.1

QUESTION 2

a) What is the significance of the knowledge of the type and magnitude stresses in engineering materials. [5]

b) A specimen of steel 20 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.25 mm under a load of 80 kN and the load at elastic limit is 102 kN. The maximum load is 130 kN. The total extension at fracture is 56 mm and diameter at neck is 15 mm. [10]

Find

(i) The stress at elastic limit.

(ii) Young's modulus.

(iii) Percentage elongation.

(iv) Percentage reduction in area.

(v) Ultimate tensile stress.

c) A bar of length 1000 mm and diameter 30 mm is centrally bored for 400 mm, the bore diameter being 10 mm as shown in Figure 2.1. Under a load of 30 kN, if the extension of the bar is 0.222 mm, what is the modulus of elasticity of the bar? [10]

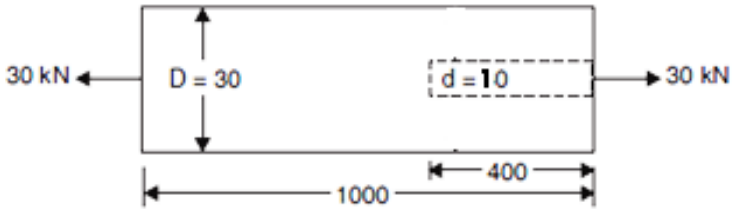

Figure 2.1

QUESTION 3

a) List and explain the assumptions in truss analysis. [6]

b) A truss can either be redundant, deficient or perfect. Using diagrams where necessary explain how you would classify a truss into these three categories. [4]

c) Determine the forces in each member in the truss shown in Figure 3.1 and show the nature of the force. [15]

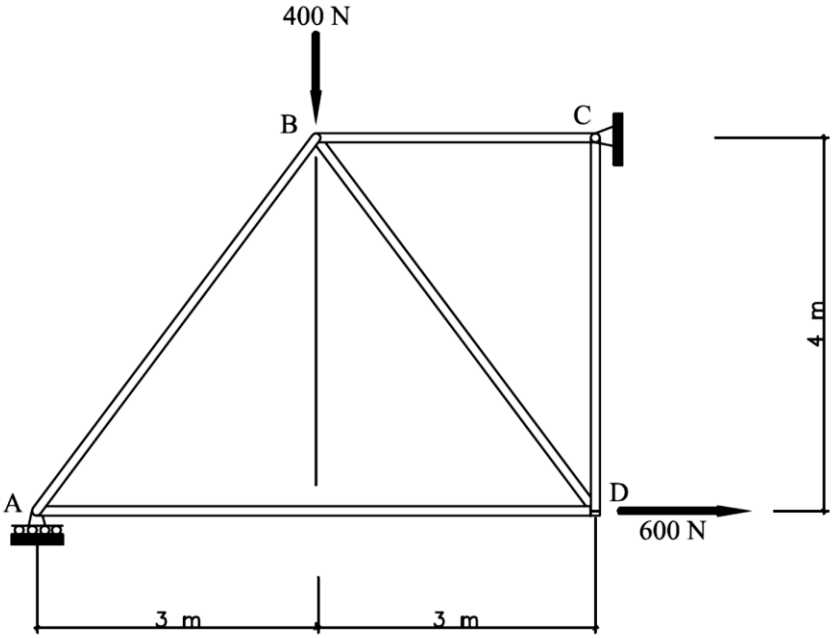

Figure 3.1

d)

QUESTION 4

a) State Coulomb's laws of dry friction. [6]

b) Blocks A(3kg) and B(9kg) shown in Figure 4.1 are connected to weightless links. Determine the largest vertical force P that can be applied at the pin C without causing any movement. The coefficient of static friction between the blocks and the contacting surfaces is $\mu = 0.3$. [10]

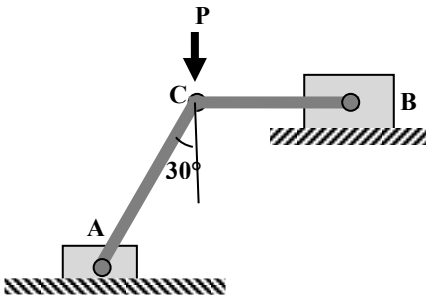

Figure 4.1

c) What is meant by the term angle of repose? What should be the value of θ in Figure 4.2 which will make the motion of 900 N block down the plane to impend? The coefficient of friction for all contact surfaces is 1/3. [9]

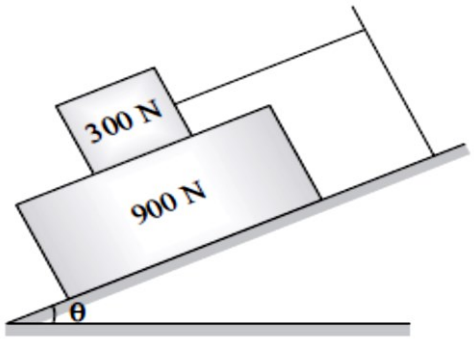

Figure 4.2

QUESTION 5

a) Determine the centroid of the wire shown in Figure 5.1. [10]

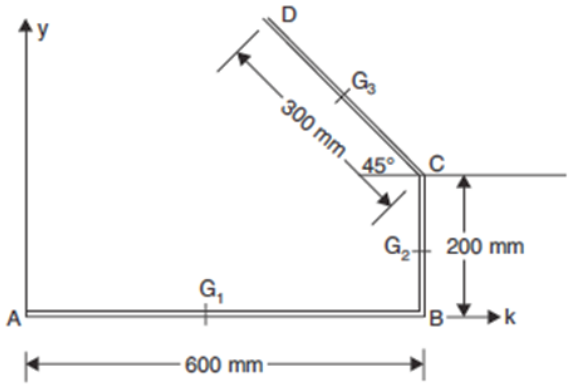

Figure 5.1

b) Determine the moment of inertia of the section shown in Figure 5.2 about an axis passing through the centroid and parallel to the top most fibre of the section. Also determine moment of inertia about the axis of symmetry. [15]

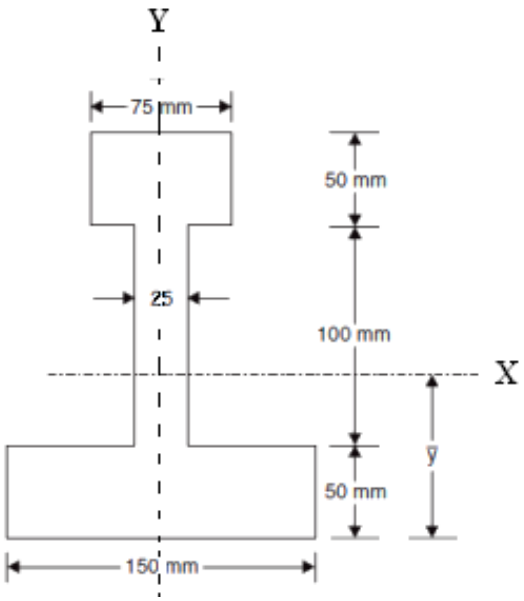

Figure 5.2