**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

**FACULTY OF SCIENCE AND ENGINEERING**

**AEH105**

**Department of Engineering and Physics**

**Bachelor of Science (Honours) Degree in Agricultural Engineering**

**Engineering Mechanics**

**3 HOURS (100 Marks)**



**INSTRUCTIONS**

1. The paper contents 6 questions
2. Answer any **FOUR** questions. Each carries **25 marks**

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**Question 1**

Fig. Q1 represents a box acting on it 4 four forces (A=60 kgf; B= 500N; C= 0,3kN and D = 35 kgf). Accordingly determine:

a) The resultant force acting on the body? [9 marks]
b) The direction of the resultant force? [9 marks]
c) The sense of the resultant force? [7 marks]

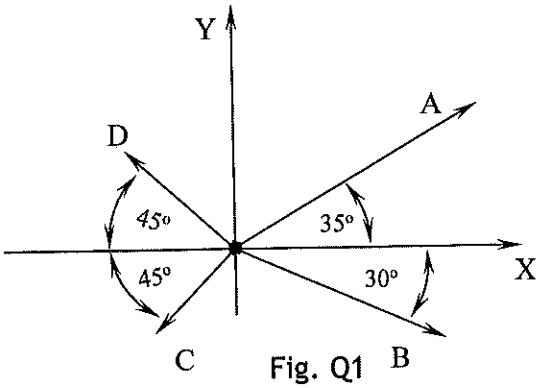


Fig. Q1

**Question 2**

To the lever (Fig.Q2) of the brake system of a machine, a vertical force of 500 N is applied at point A.

a) Calculate the moment of the force about O. [6 marks]
b) Determine magnitude and direction of the horizontal force applied at C that produces the same moment with respect to O. [6 marks]

c) Determine the smallest force that when applied at C produces the same moment about O. [6 marks]

d) Calculate the value that the force $F$ would have if it were applied at B, in such a way that it produces the same moment $M_O$? [7 marks]

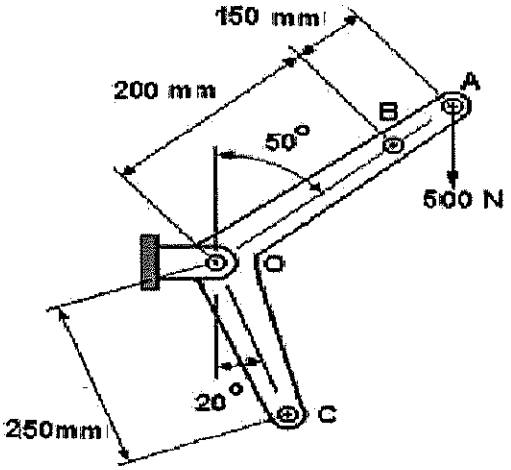


Fig. Q2

**Question 3**

A crane with a weight of 1500 kgf is designed to lift a 2000 N maximum. It is supported by a rocker A and pin B. The centre of gravity of the crane is located at G (see Fig. Q3).

a) Make the free body diagram in each analyse. [4 marks]

b) Determine the reaction forces A and B in Y direction. [7 marks]

c) Calculate the reaction force A in X direction. [6 marks]

d) Using the node's method, determine the internal forces in AB, BC y AC. [8 marks]

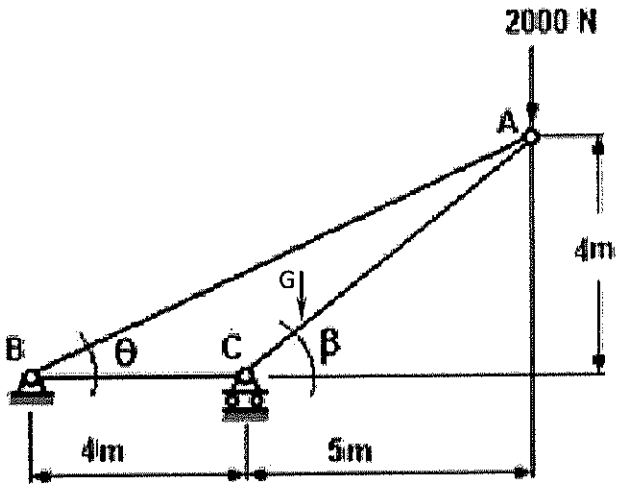


Fig. Q3

## Question 4

With the reference to Fig. Q4.

a) Determine the coordinates of the gravity centre. [15 marks]

b) Locate the coordinates of the centre of gravity in a cardinal system (X,Y) [10 marks]

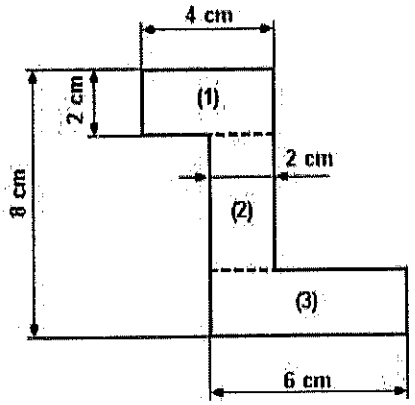


Fig. Q4

Location of the centroid coordinates of Fig. Q4.

| Figure | x | Y | A | XA | YA |
|---|---|---|---|---|---|
| 1. | 2 | 7 | 8 | 16 | 56 |
| 2. | 3 | 4 | 8 | 24 | 32 |
| 3. | 5 | 1 | 12 | 60 | 12 |
| | | | **28** | **100** | **100** |

## Question 5

A beam is loaded with three concentrated forces, with 8 kN as it is shown the Fig. Q5.

a) Determine the reaction forces in Y direction at point A. [8 marks]

b) Calculate the reaction forces in Y direction at point B [8 marks]

c) Draw the bending moment graphs. [9 marks]

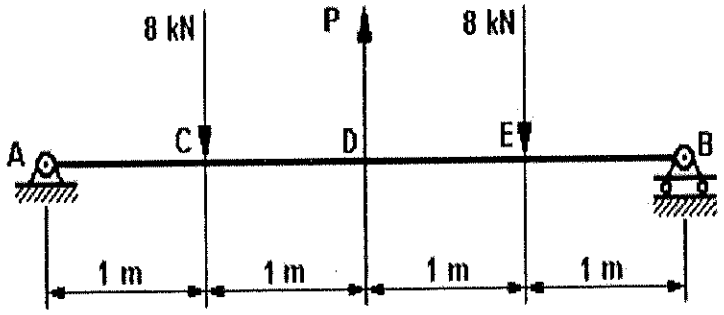


Fig. Q5

**Question 6**

The Crank-slide mechanism (Fig. Q6) is fixed at point A, the crank AB rotate clockwise at a speed of 60 rad/s, while BC has plane movement and C develop translation.

a) Establish the scale coefficient for length and speed. [7 marks]

b) Determine the rotational speed at point B. [8 marks]

c) Calculate the translation speed at point C. [10 marks]

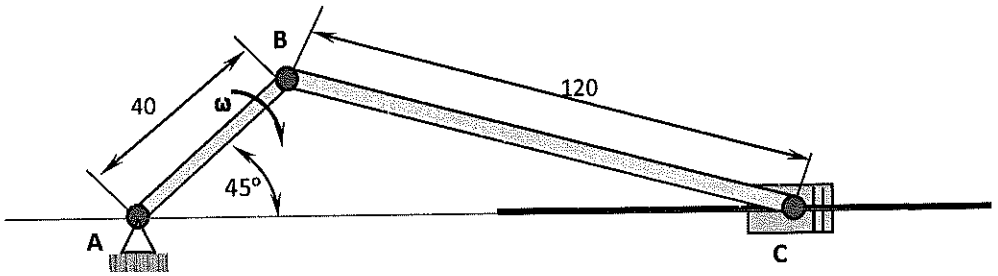


Fig. Q6