



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
SCIENCE AND TECHNOLOGY DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

CIVIL ENGINEERING, WATER RESOURCES ENGINEERING

SUBJECT: Applied Mechanics

PAPER NO: 313/13/S04

DURATION: 3 Hours

OCTOBER/NOVEMBER 2016 EXAMINATION

REQUIREMENTS

Scientific calculator

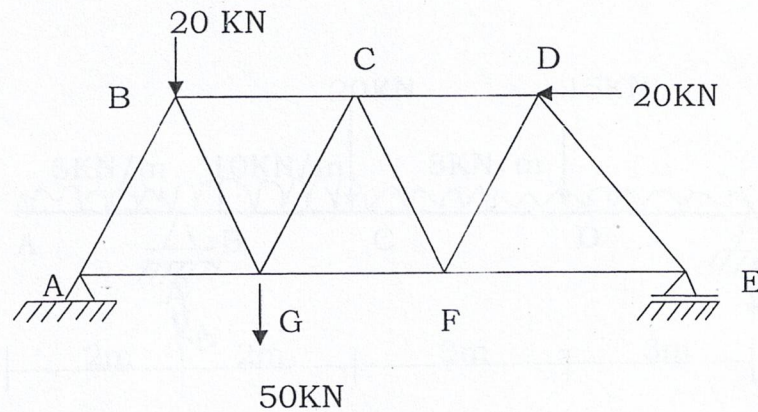
INSTRUCTIONS TO CANDIDATE

Answer any FIVE (5) questions.

This paper consists of 5 printed pages.

QUESTION 1

- a) For the framed structure shown in Fig Q1 (a) determine:



All members are 3m in length

Fig Q1(a)

- i) The reactions at the supports (3 marks)
 - ii) The force in members BC, GC and GF indicating whether ties/struts (7 marks)
- b) Determine the magnitude and direction of the resultant force for the system of force shown in Fig Q1 (b) (10 marks)

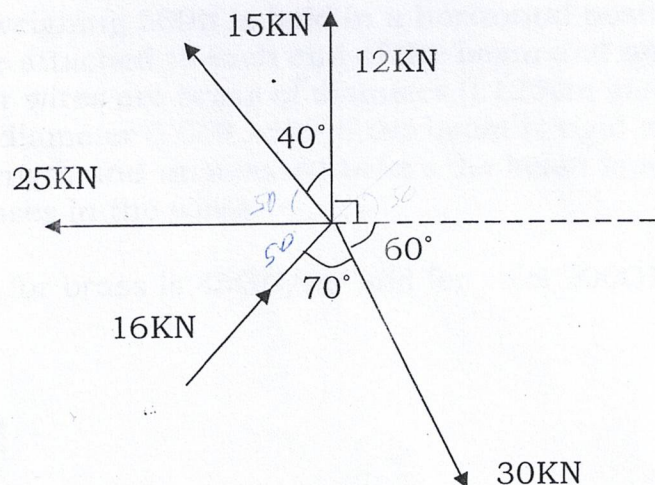


Fig Q1(b)

QUESTION 2

A beam ABCDE is loaded as shown in Fig. Q2.

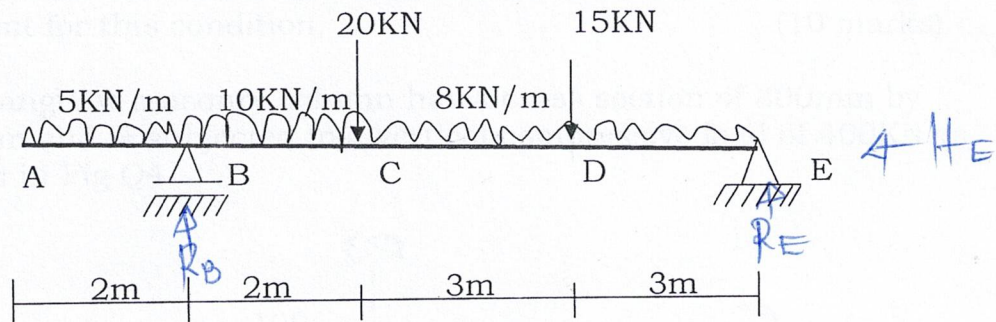


Fig Q2

- Calculate the reactions at the supports. (4 marks)
- Draw the shear force diagram. (4 marks)
- Draw the bending moment diagram. (5 marks)
- Calculate the position and value of the maximum bending moment (4 Marks)
- Calculate the position of the point of contraflexure. (3 marks)

QUESTION 3

A uniform beam weighing 500N is held in a horizontal position by three vertical wires, one attached to each end of the beam and one at the middle. The outer wires are brass of diameter 0.125cm and the central wire is of steel of diameter 0.0625cm. If the beam is rigid and the wires are of the same length and unstressed before the beam is attached, estimate the stresses in the wires.

Young's Modulus for brass is 85 GN/m^2 and for steel 200 GN/m^2 .
(20 marks)

QUESTION 4

- a) A rectangular concrete is 30cm wide and 45cm deep to the steel reinforcement. The direct stresses are limited to 115MN/m^2 in the steel and 6.5MN/m^2 in the concrete, and the modular ratio is 15. What is the area of steel reinforcement required if both steel and concrete are fully stressed? Estimate the permissible bending moment for this condition. (10 marks)
- b) A rectangular masonry column has a cross section of 800mm by 600mm and is subjected to a vertical compressive load of 400kN as shown in Fig Q4.

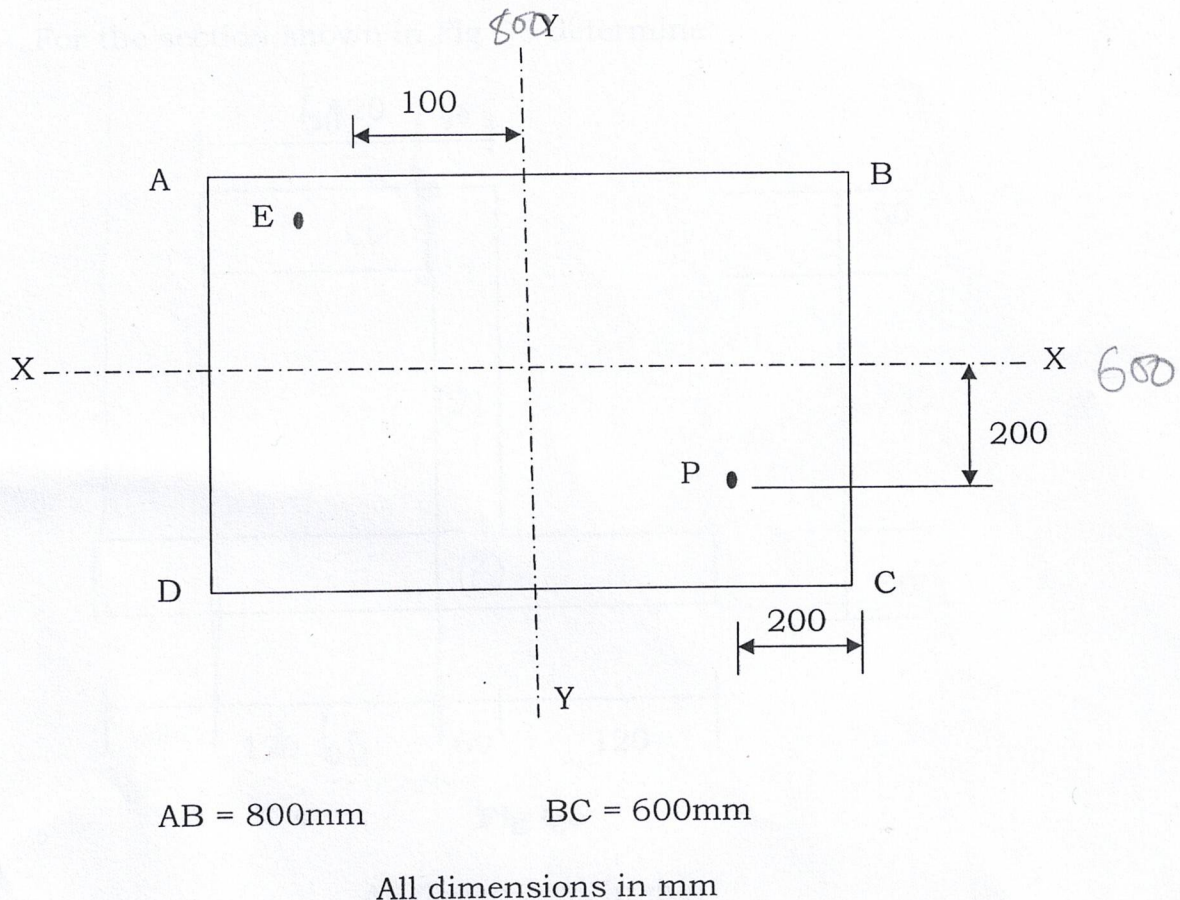


Fig Q4

The load is applied at a point P. Calculate the stresses at points A and B. (10 marks)

QUESTION 5

- a) Calculate the magnitude of an upward force P parallel to the plane that is required to pull a body of 250Kg mass resting on an inclined plane. The incline makes an angle of 20° with the horizontal. Take the coefficient of friction between the body and plane as 0.26. (10 marks)
- b) Determine the horizontal force that is required to prevent the body from sliding down the plane. (10 marks)

QUESTION 6

- a) For the section shown in Fig Q6 determine:

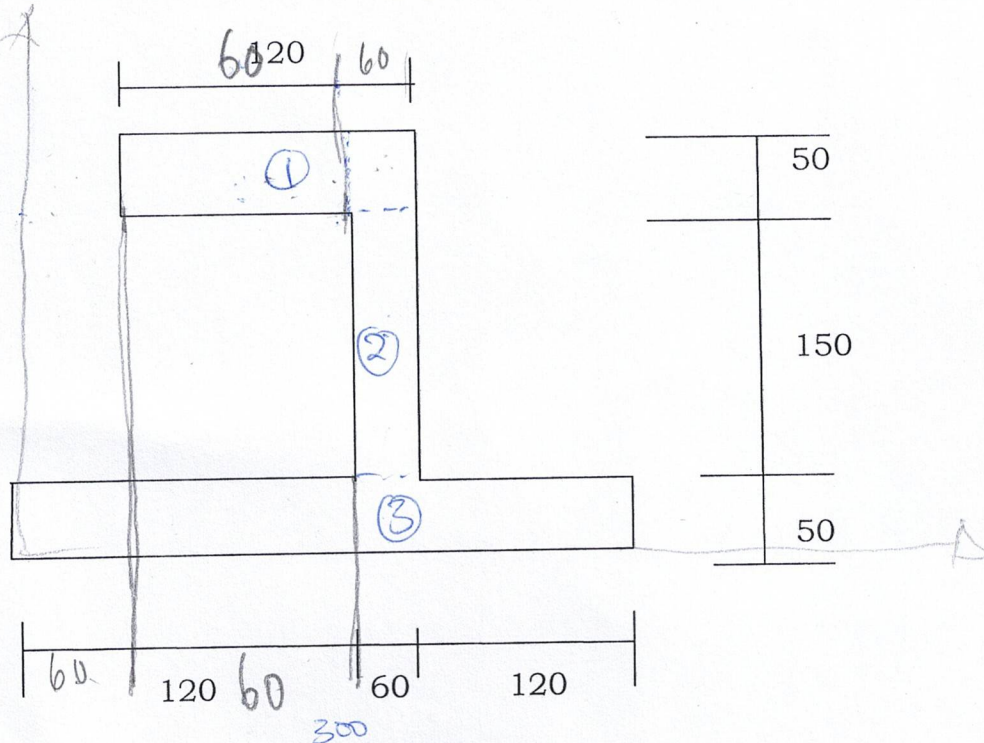


Fig Q6

All dimensions in mm

- i) The position of the centroid
 ii) The second moment of area about the horizontal axis (10 marks)
- b) A car travelling between two points 3km apart completes the trip in 5 minutes for the first 30 seconds the car is moving with uniform acceleration and then maintains a constant speed. The car is then brought to rest in the last 20 seconds:
Calculate
 i) The uniform speed
 ii) The acceleration (10 marks)

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