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**KIBABII UNIVERSITY**  
**UNIVERSITY EXAMINATIONS**  
**2017/2018 ACADEMIC YEAR**

**SECOND YEAR FIRST SEMESTER**

**MAIN EXAMINATIONS**

**FOR THE BACHELOR OF RENEWABLE ENERGY AND BIOFUELS  
TECHNOLOGY**

**COURSE CODE : PRD 221**

**COURSE TITLE : SOLID MECHANICS I**

**DURATION : 2 HOURS**

**DATE : 18<sup>TH</sup> JANUARY 2018**

**TIME : 9 – 11AM**

**INSTRUCTIONS TO CANDIDATES**

- Answer any FIVE Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

**Question One**

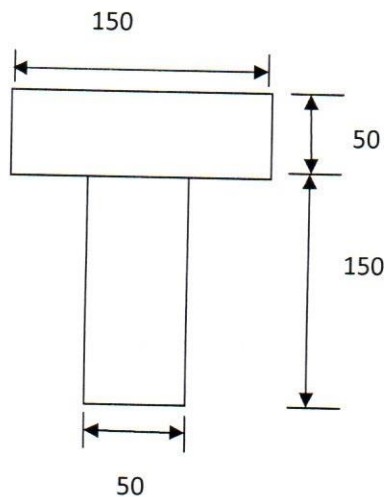
- a) State the theory of simple bending (4marks)
- b) Proof that the maximum stress induced is given by

$$\sigma_{\max} = \frac{E}{R} \times Y \quad (4\text{marks})$$

- c) A steel wire of 5mm diameter is bent into circular shape of 5m radius. Determine the maximum stress induced in the wire. Take  $E = 200 \text{ GPa}$ .(6marks)
- d) A rectangular beam 60mm wide and 150mm deep is simply supported over a span of 4metre.If the beam is subjected to a uniformly distributed load of 4.5 KN/M,Find the maximum bending stress induced in the beam.(6marks)

**Question two**

Two wooden planks  $150\text{MM} \times 50\text{MM}$  each are connected to form a T – section of a beam. If a moment of  $6.4\text{KN} - \text{M}$  is applied a round the horizontal neutral axis, inducing tension below the neutral axis, Find the bending stresses at the extreme fibres of the cross section. (20marks)



**Question Three**

If the tension test is found to taper from  $(D+a)\text{MM}$  diameter to  $(D-a)\text{MM}$  diaMETER, Proof that the error involved in using mean diameter to calculate Youngs modulus is  $(10a/D)^2$  percent. (20mks)

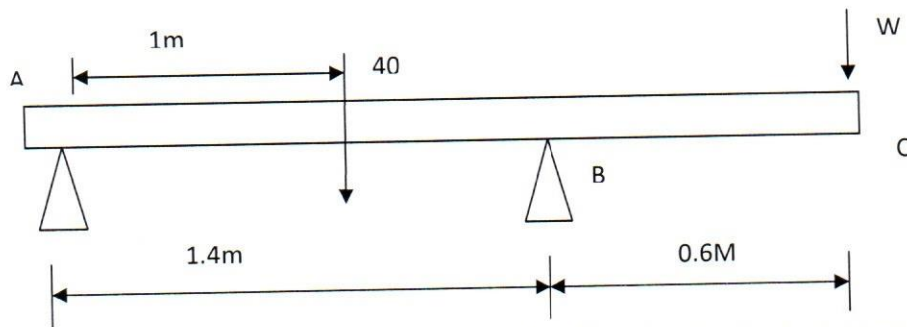
**Question Four**

A steel plate of 20MM thickness tapers uniformly from 100MM to 50MM in a length of 400MM. What is the elongation of the plate if an axial force of 80KN acts on it? Take  $E=200\text{GPa}$ . (20MKS)

**Question Five**

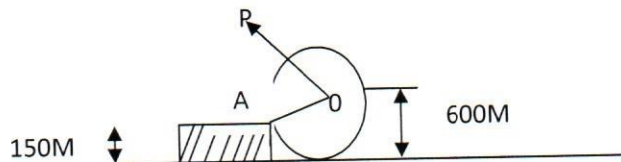
- i) Explain mathematically what is meant by moment of force (3marks)
- ii) State the law of moments (3marks)

- iii) A uniform plank ABC of weight 50N and 2M long is supported at one end A and at a point B which is 1.4m from A as shown in figure below.(7marks)



Find the maximum weight W, that can be placed at C so that the plank does not topple.

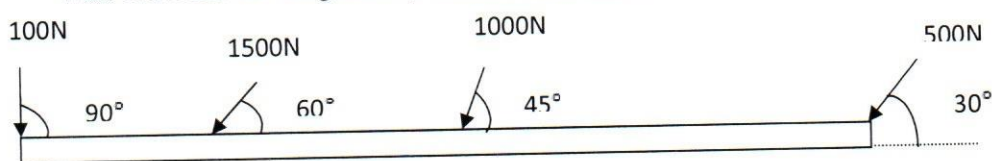
- iv) A uniform wheel of 600 mm diameter, weighing 5KN rests against a rigid rectangular block of 150mm height as shown.



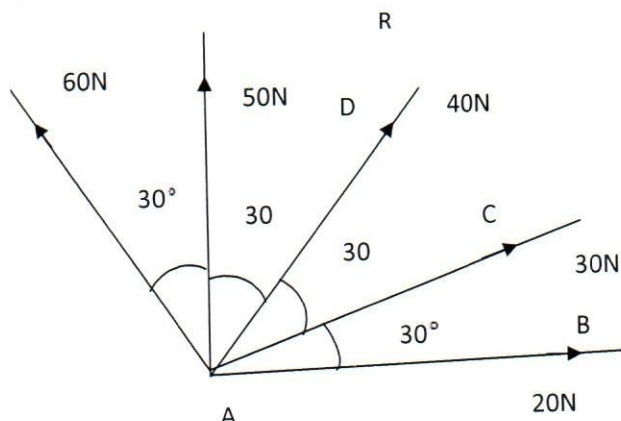
Find the least pull, through the centre of the wheel required just to turn the wheel over the corner A of the block – Also find the reaction of the block. (7marks)

### Question Six

- a) A horizontal line PQRS is 12 M long, Where  $PQ = QR = RS = 4m$ . Forces of 1000, 1500, 1000 and 500N act P, Q, R and S respectively with downward direction. The lines of action of these forces make angles of  $90^\circ, 60^\circ, 45^\circ$  and  $30^\circ$  respectively with PS. Find the magnitude, direction and position of the resultant force.(10MKS)

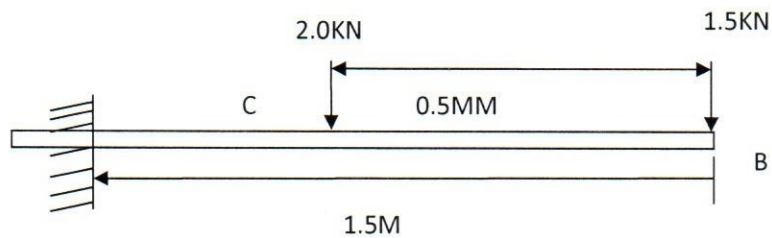


- b) The forces of 20N, 30N, 40N, 50N and 60N are acting at one corner of a regular pentagon towards the other five angular points, in the same plane. Find the magnitude and direction of the resultant force.(10mks)

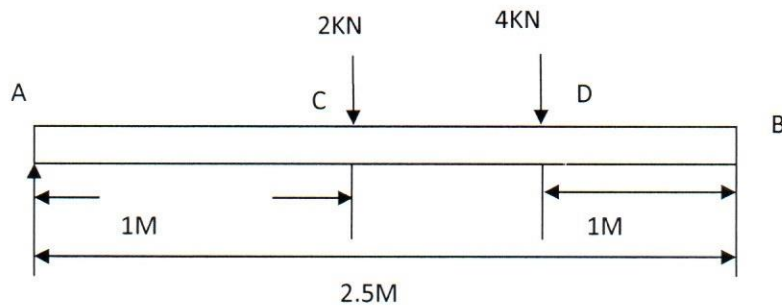


**Question Seven**

- a) Draw shear force and bending moment diagrams for a cantilever beam of span 1.5m carrying point loads as shown.(6marks)
- b) A cantilever beam AB 2m long carries a uniformly distributed load of 1.5 KN/M over a length 1.6m from the free end. Draw shear force and bending moment diagrams for the beam.(6marks)



- c) A simply supported beam AB of span 2.5m is carrying two point loads as shown.(8marks)



Draw the shear force and bending moment diagrams for the beam.