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INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

I SEMESTER B.Sc. (Applied Sciences) EXAMINATION- NOV. 2017

SUBJECT: MECHANICS OF SOLIDS (ICE111)

(BRANCH: Civil)

Friday, 17 November 2017

Time: 3 Hours **Max. Marks: 100**

- *Answer FIVE full questions.*
- *Assume missing data, if any, suitably and indicate them clearly.*

1.a. Define the following terms

a) Coplanar Concurrent force
b) Resultant of force
c) Space diagram
d) Principle of transmissibility

1.b. A system of concurrent coplanar forces shown in **Fig.1** has six forces of which only five are given. If the resultant is a force of magnitude R = 300kN acting vertically upwards along the Vertical, find the unknown sixth force "F6".

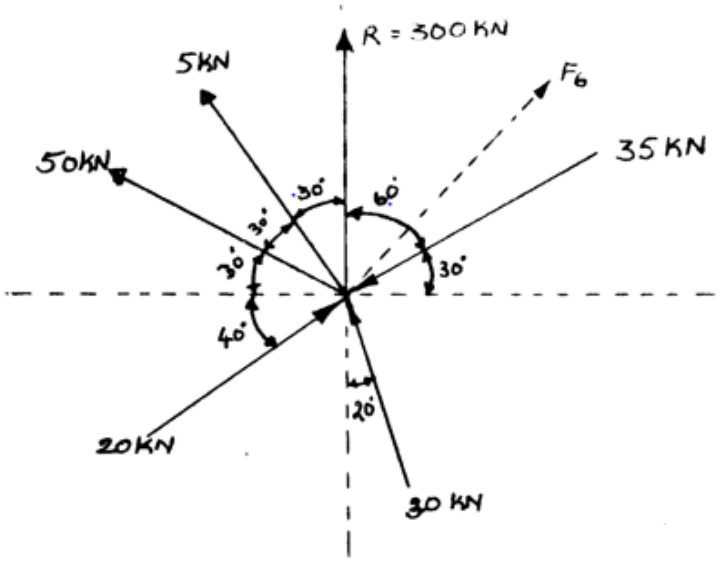

Fig. 1

1.c. Locate the resultant with respect to point A for the **Fig.2** shown below.

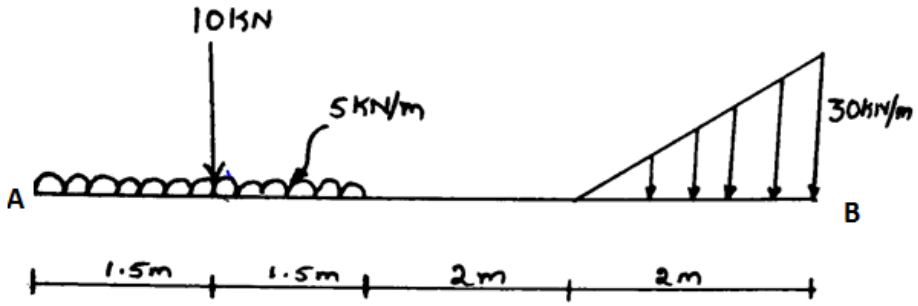

Fig. 2

(4+8+8)

2.a. Determine the support reaction for 'L' Shaped bracket as shown in F**ig. 3**

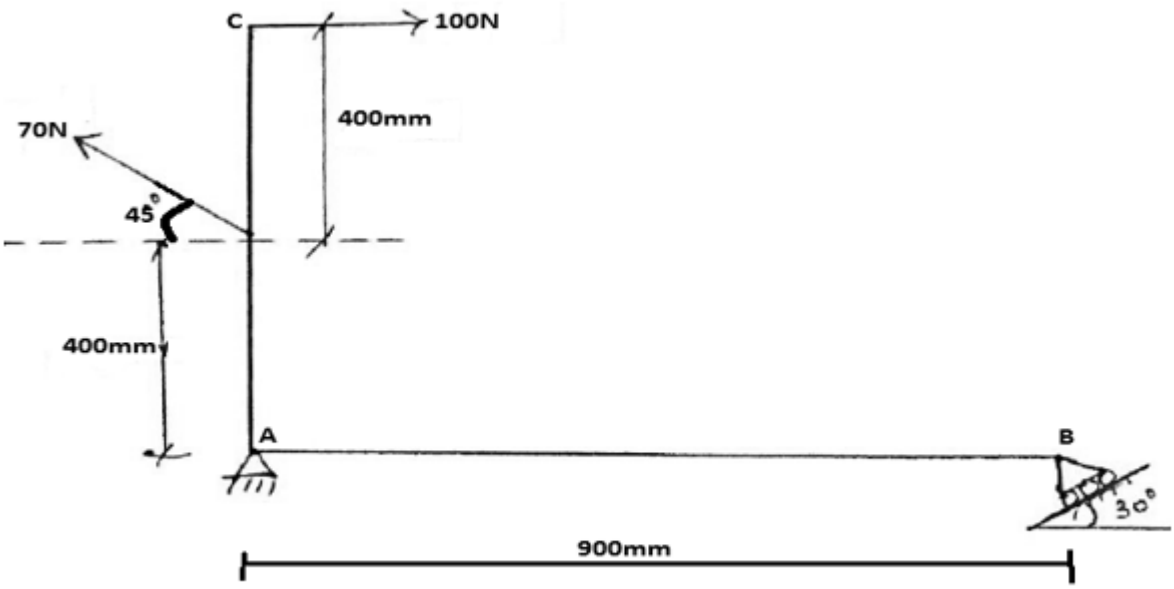

Fig. 3

2.b. For the given **Fig.4**, determine the minimum weight of block B that will keep it at rest while a force P starts blocks A up the incline surface of B. The weight of A is 100 kN and the angle of friction for all surfaces in contact is 15°.

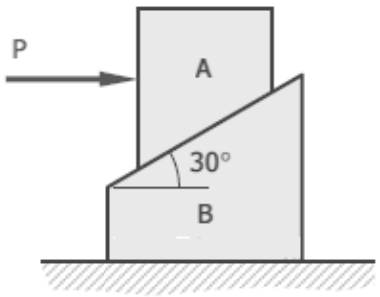

Fig. 4

(10+10)

3.a. Locate the centroid of the shaded area shown in **Fig.5** with respect to axes shown

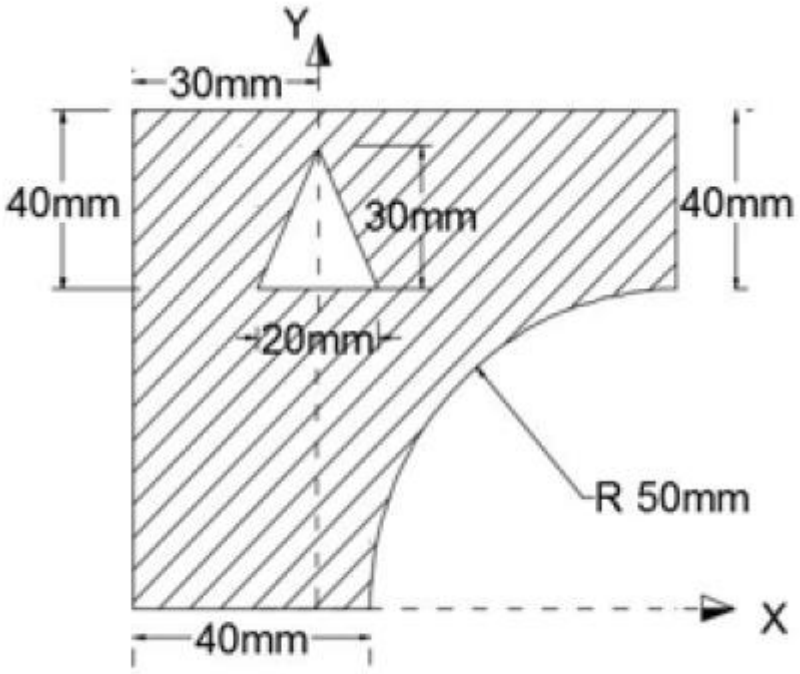

Fig. 5

3.b. Determine the second moment of area and radius of gyration of the hatched of hatched ortion shown in **Fig.6** with respect to given axis A-B.

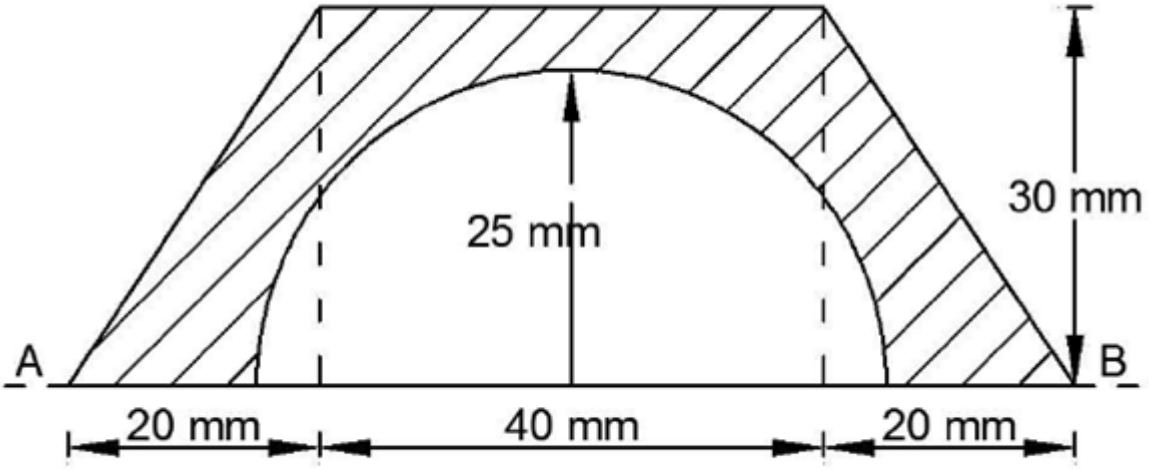

Fig. 6

(8+12)

4.a. A 25mm diameter bar when subjected to a force of 40kN has an extension of 0.08mm on a gauge length of 200mm. if the diametrical reduction is 0.003mm, find the values of E,G,K and Poisson's ratio.

4.b. A bullet having a mass of 100 gm is fired into a freely suspended target having of mass 50 kg. On impact, the target moves with a velocity of 3 m/s along with the bullet in the direction of firing as shown in **Fig.7**. Find the velocity of bullet. Also find the angle of swing due to impact.

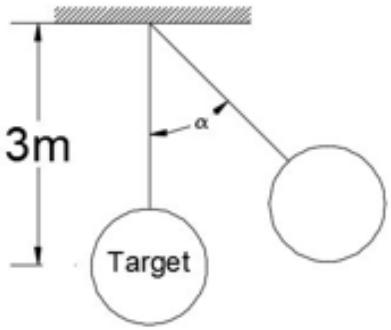

Fig. 7

(10+10)

5.a. Explain the following:
i) D' Alembert's theorem ii) Law of conservation of momentum iii) Kinetics iv) Kinematics

5.b. **.** The baggage truck A has mass 800kg and is used to pull the two cars, each with mass 300kg as shown in **Fig. 8**. The tractive force on the truck is 480N. Using D' Alembert's Principle i) determine the initial acceleration of the truck. ii) What is the acceleration of the truck if the coupling at C suddenly fails? The car wheels are free to roll. Neglect the mass of the wheels.

Fig. 8

5.c. A wagon weighing 600kN starts from rest starts from rest, runs 30 m down a 1 in 100 grade and strike a post. If the rolling resistance of the track is 5 N per kN, find the velocity of the wagon when it strikes the post. (4+10+6)

6.a. What is joint efficiency in case of thin cylinders?
6.b. . A thin cylindrical shell is 4m long and 1m in internal diameter. It is subjected to internal pressure of 1.5 MPa. If the thickness of the sheet is 13mm, find the circumferential stress, longitudinal stress, changes in diameter, length and volume. Take E=200 GPa and μ= 0.3.

6.c. A hollow steel cylinder of 250mm length, 100mm inside diameter and 5mm uniform wall thickness is filled with concrete and compressed between two rigid parallel plates at the end by a load 600kN. Find the compressive stress in each material and total shortening of the cylinder, if the young's modulus of cylinder 200GPa and young's modulus of concrete 25GPa.
(2+6+12)

7.a. Define: i) Normal stress ii) Hooke's law iii) Poisson's Ratio iv) Bulk modulus

7.b. Derive an expression for the total extension of the tapered bar of circular cross section with d_1 and d_2 as diameters with length 'L', when subjected to an axial tensile load of P.

7.c. Determine the deformation of bar of varying cross section shown in **Fig. 9**, take E=200GPa. Neglect the self-weight.

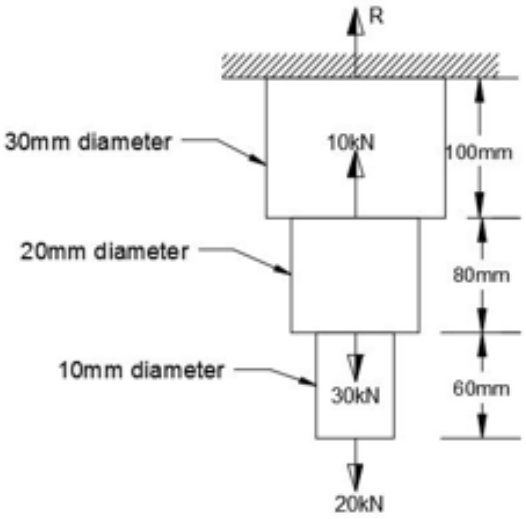

Fig. 9

(4+6+10)

8.a. A rectangular bar 800mm long and 35mm x 60mm in section carries axial load as follows, 150kN (Tensile) on 60mmx35mm faces, 280kN (Compressive) on 60mmx800mm faces and 200kN (Tensile) on 35mmx800mm faces, if Poisson's ratio is 0.25 and E= 200GPa. Calculate

i. Strain along three mutually perpendicular direction.
ii. Change in volume.
iii. Direct stress applied along the length which alone can produce the same longitudinal strain.

8.b. A 15mm diameter steel rod passes centrally through a copper tube of 50mm external diameter and 40mm internal diameter. The tube is held at each end by rigid plate, the length of the rod and tubes are equal. If the temperature of assembly is raised by 60 degree Celcius. Calculate the stress developed in copper and steel. Take E_S =210GPa and Ec = 105GPa, coeffecient of thermal expansion for steel and copper are 12 x 10^{-6} /^{0}C and 17.5 x 10^{-6} /^{0}C respectively.

(12+8)