Model Answer sheet

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Mid Semester Examination – March - 2018

Branch: B. Arch (First Year) **Sem.:- II**

Subject with Subject Code:-Theory of structures – I (AR1020007)

Marks: 20

Date: - 31/03/2018 **Time:- 1 Hr.**

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Instructions:-

1.Read all the questions carefully.
2.Neat sketches must be drawn wherever necessary.
3. Figures to the right indicate full marks.

Attempt any one of the following Questions **(20 Marks)**

(Marks)

Q.1 :

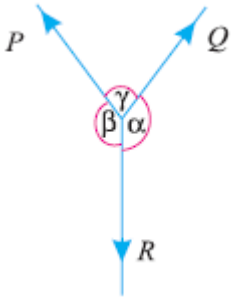
(a) State Varignon's Theorem? (2)

Ans :

If a number of coplanar forces are acting simultaneously on a body , the algebraic sum of the moments of all the forces about any point is equal to the moment of resultant force about the same point.

(b) State Lame's theorem. (2)

It states, "If three coplanar forces acting at a point be in equilibrium, then each force is proportional to the sine of the angle between the other two." Mathematically,

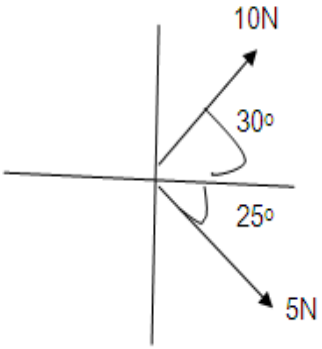


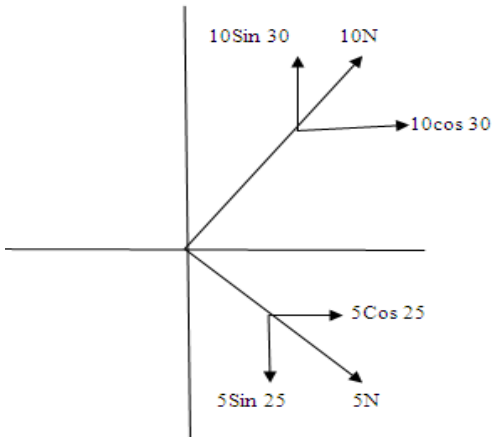
$$\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$$

(c) Determine Magnitude and Direction of Resultant for following Force System shown in fig.1. (6)

Ans:

(1)





(1)

$\sum Fx = 10 \cos 30 + 5\cos 25 = 13.191$ (1)

$\sum Fy = 10\sin 30 - 50\sin 25 = -16.1309$

$R = \sqrt{\sum FX^2 + \sum Fy^2}$ (2)

$R = 20.83$ N

$\Theta =$ 50.72 deg with respect to y-axis (1)

(d) Define centre of gravity (2)

Ans:The point through which the whole weight of the body acts, irrespective of its position, is known as centre of gravity

(e) Find the centroid of an uequal angle section 100 mm × 80 mm × 20 mm,shown in Fig.2. (6)

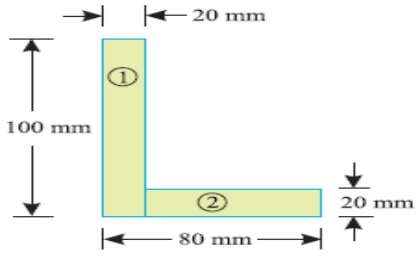
Let left face of the vertical section and bottom face of the horizontal section be axes of reference.

(*i*) *Rectangle* 1

$a_1 = 100 \times 20 = 2000 \text{ mm}^2$

$x_1 = \frac{20}{2} = 10 \text{ mm}$

and $y_1 = \frac{100}{2} = 50 \text{ mm}$ (2)



(*ii*) *Rectangle* 2

$a_2 = (80 - 20) \times 20 = 1200 \text{ mm}^2$

$x_2 = 20 + \frac{60}{2} = 50 \text{ mm}$

and $y_2 = \frac{20}{2} = 10 \text{ mm}$

We know that distance between centre of gravity of the section and left face,

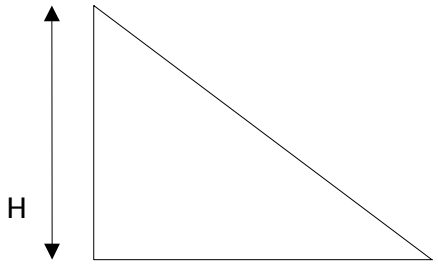
$$\bar{x} = \frac{a_1 x_1 + a_2 x_2}{a_1 + a_2} = \frac{(2000 \times 10) + (1200 \times 50)}{2000 + 1200} = 25 \text{ mm} \quad \text{Ans.}$$ (2)

Similarly, distance between centre of gravity of the section and bottom face,

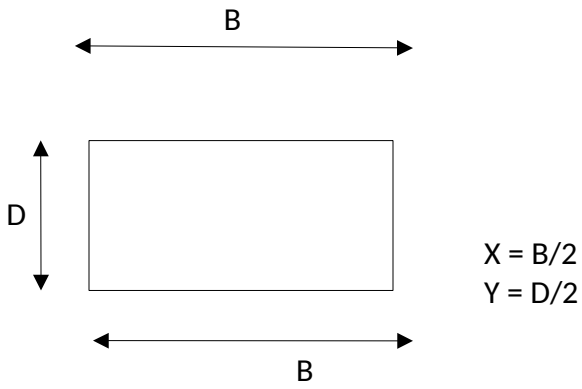
$$\bar{y} = \frac{a_1 y_1 + a_2 y_2}{a_1 + a_2} = \frac{(2000 \times 50) + (1200 \times 10)}{2000 + 1200} = 35 \text{ mm} \quad \text{Ans.}$$

(2)

(f) Write down the Centre of gravity of Right angle triangle and Rectangle with Sketch (2)



X = H/3 From Bottom
Y = B/3 From Right Angle



X = B/2
Y = D/2

OR

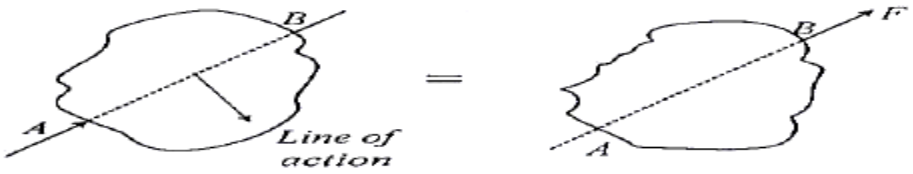
Q.2 :

(a) (2)

State the principal of transmissibility of forces with simple sketch.

Ans:

It states, "If a force acts at any point on a †rigid body, it may also be considered to act at any other point on its line of action, provided this point is rigidly connected with the body."



(b) (2)

Define Coplanar & concurrent forces.

Ans:

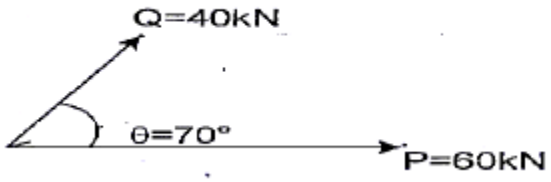
(a) Coplanar forces : If the line of action of all forces lie on same plane, then the forces are said to be coplanar forces.

(b) Concurrent forces : If the line of action of all forces meet at common point, then the forces are said to be concurrent forces.

(c) (6)

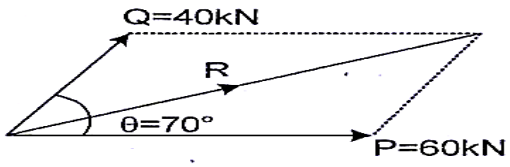
Find the magnitude of the resultant of the two concurrent forces of magnitude 60 kN and

40 kN with an included angle of 70° between them.



Given :

Force, P = 60 kN
Force, Q = 40 kN
Included angle, θ = 70°



To Find :

Resultant, R = ?

Solution :

By parallelogram law of forces,

$$R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$$

$$= \sqrt{60^2 + 40^2 + 2 \times 60 \times 40 \times \cos 70^\circ}$$

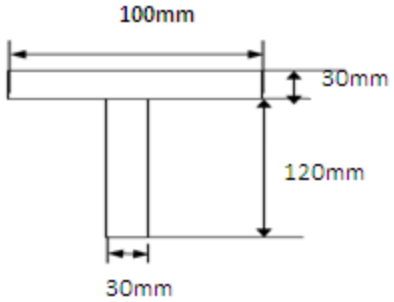
R = 82.7/kN **(Ans)**

(d) Define centre of gravity (2)

Ans: through which the whole weight of the body acts, irrespective of its position, is known as centre of gravity

(e) Locate the centroid of T-section with flange as 150 mm × 50 mm and web as 150 mm × 50 mm , shown in fig.6 (6)

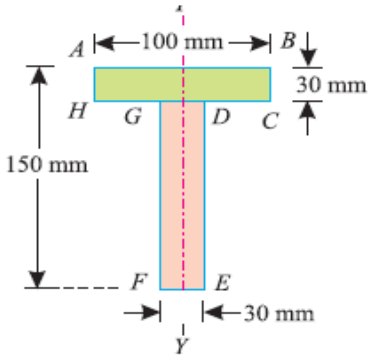
Ans:



(2)

(2)

Let bottom of the web *FE* be the axis of reference.



(*i*) *Rectangle ABCH*

$$a_1 = 100 \times 30 = 3000 \text{ mm}^2$$

and $$y_1 = \left(150 - \frac{30}{2}\right) = 135 \text{ mm}$$

(*ii*) *Rectangle DEFG*

$$a_2 = 120 \times 30 = 3600 \text{ mm}^2$$

and $$y_2 = \frac{120}{2} = 60 \text{ mm}$$

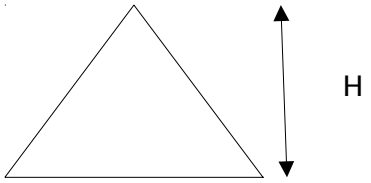
(2)

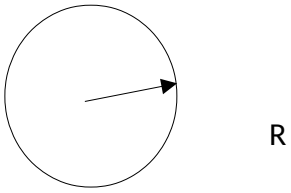
We know that distance between centre of gravity of the section and bottom of the flange *FE*,

$$\bar{y} = \frac{a_1 y_1 + a_2 y_2}{a_1 + a_2} = \frac{(3000 \times 135) + (3600 \times 60)}{3000 + 3600} \text{ mm}$$

$$= 94.1 \text{ mm} \quad \textbf{Ans.}$$

(f) Write down the Centre of gravity of Equilateral triangle and Circle with Sketch (2)





X = B/2
Y = H/2

X = R/2
Y = R /2