

74%

Diagram 1: Triangle ABC
 Side AB = 6.4m, Side BC = 10.5m, Angle B = 47°. Angle A is circled in red with a '2'.

Diagram 2: Triangle BCD
 Side BC = 10.5m, Side CD = 13m, Angle C = 68.11°. Angle B is circled in red with a '3'.

Diagram 3: Triangle ABC (repeated)
 Side AB = 6.4m, Side BC = 10.5m, Angle B = 47°. Angle A is circled in red with a '4'.

Diagram 4: Triangle ABC (repeated)
 Side AB = 6.4m, Side BC = 10.5m, Angle B = 47°. Angle A is circled in red with a '5'.

Calculations:

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

$$\sin A = \frac{\sin 47^\circ}{10.5m} \times 13m$$

$$\sin A = 0.9055$$

$$A = \sin^{-1}(0.9055)$$

$$A = 64.89^\circ$$

Angle D:

$$D = 180 - (64.89 + 47^\circ)$$

$$D = 68.11^\circ$$

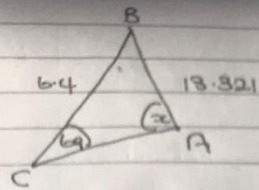
Side C:

$$\frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\frac{10.5m}{\sin 47^\circ} = \frac{c}{\sin 68.11^\circ}$$

$$10.5m \times \sin 68.11^\circ = c$$

$$c = 18.321m$$



$$\frac{\sin 69}{13.321} = \frac{\sin x}{6.4}$$

$$\frac{\sin 69}{13.321} = \frac{\sin x}{6.4}$$

$$\left(\frac{\sin 69}{13.321} \right) \times 6.4 = \sin x$$

$$0.5778 = \sin x$$

$$\sin^{-1}(0.5778) = x$$

$$35.30^\circ = x$$

$$180 - (69 + 35.30) = 75.7^\circ$$

$$\Rightarrow a^2 = b^2 + c^2 - 2bc \cos A$$

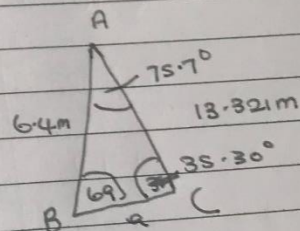
$$a^2 = 13.321^2 + 6.4^2 - 2 \times 13.321 \times 6.4 \cos A$$

$$a^2 = 218.409 - 2 \times 13.321 \times 6.4 \cos A$$

$$a^2 = 176.293$$

$$a = \sqrt{176.293}$$

$$a = 13.277$$



$$\text{Area} = \frac{1}{2} ab \sin C$$

$$= \frac{1}{2} \times 6.4 \times 13.277 \sin C$$

$$= \frac{1}{2} \times 6.4 \times 13.277 \sin 35.30^\circ$$

$$= 24.551 \text{ m}^2$$

69
4

Q1-30

2. The three most common types of beam supports are:

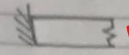
① Pin support / hinge



② Roller support

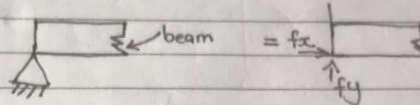


③ fixed Support



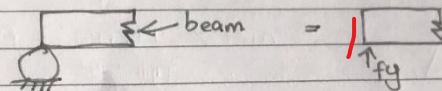
b. Pin support has 2 reaction forces.

f = force, M = moment



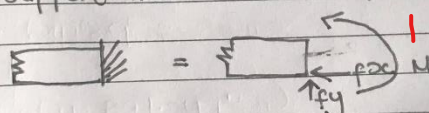
6

Roller support has one reaction force

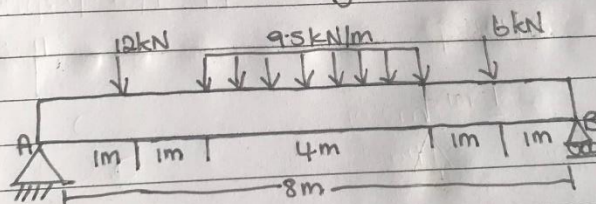


3

Fixed Support has 3 reaction forces



c.

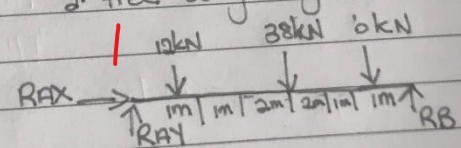


1. Convert UDL to point load

$$= 9.5 \times 4$$

$$= 38N$$

2. Free body diagram



$$\textcircled{2} \sum H = 0 / R_A x = 0 \quad |$$

$$\sum V = 0$$

$$R_A y - 12 \text{ kN} - 38 \text{ kN} - 6 \text{ kN} + R_B = 0$$

$$R_A y - 56 \text{ kN} + R_B = 0$$

$$R_A y + R_B = 0 + 56 \text{ kN}$$

$$R_A y + R_B = 56 \text{ kN} \quad |$$

$$\text{iii. } \sum M_B = (R_A x \times 0) + (R_A y \times 8 \text{ m}) + (-12 \times 7) + (-38 \times 4) + (-6 \times 1) \quad \text{x1)$$

$$= 8 R_A y - 242 = 0$$

$$= 8 R_A y = 0 + 242$$

$$R_A y = \frac{242}{8}$$

$$R_A y = 30.25 \quad |$$

6

$$R_A y + R_B = 56 \text{ kN}$$

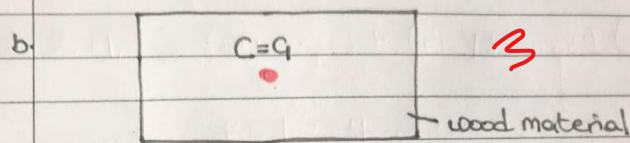
$$30.25 + R_B = 56 \text{ kN}$$

$$R_B = 56 \text{ kN} - 30.25$$

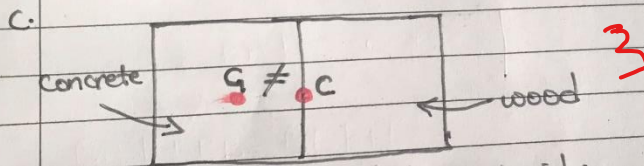
$$R_B = 25.75 \quad |$$

Q15

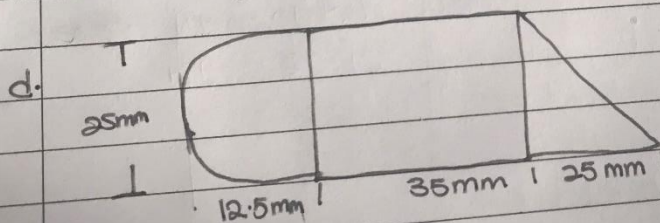
3. the centroid is the geometric centre of a shape, while the centre of gravity is the point of a body where the weight of it acts.
- the size of the shape usually influences the position of the centroid and it can either be within the body or not.
 - once the gravity of a body is assumed to be constant then the centre of gravity is = centroid.



centre of gravity = Centroid as its made up of one material.



centre of gravity & the centroid is not of uniform body



Part ID	Area of Shape (mm ²)	$\bar{x}_1$ (mm)	$A \times \bar{x}_1$ (mm ³)
1	$\frac{\pi \times r^2}{2} = \frac{\pi \times 12.5^2}{2}$ = 245.437	$\bar{x}_1 = \frac{4r}{3\pi} = \frac{4 \times 12.5}{3\pi}$ = 5.805	1802.048
2	$b \times h = 35 \times 25$ = 875	$\bar{x}_1 = 35 \div 2 = 17.5$ $17.5 + 12.5 = 30$	26250
3	$\frac{1}{2} b \times h = 0.5 \times 25 \times 35$ = 312.5	$\bar{x}_1 = 25 \div 3 = 8.3$ $8.3 + 35 + 12.5$ = 55.8	17487.5
Σ	1432.937	-	44989.543

$\bar{x} = \frac{(\Sigma A \times \bar{x}_1)}{\Sigma A} = 31.397 \text{ mm}$

Part ID	Area of shape (mm ²)	y_1 (mm)	$A \times y_1$ (mm ³)
1	245.437	$25 \div 2 = 12.5$	3067.9625
2	875	$25 \div 2 = 15$	13125
3	312.5	$25 \div 3 = 8.3$	2593.75
Σ	1432.937	-	18786.7125

$\bar{y} = \frac{(\Sigma A \times y_1)}{A}$
 $= \frac{18786.7125}{1432.937} = 13.111$

① mm
Q3-2 ↑