

Uganda Certificate of Education

PHYSICS MARKING GUIDE FOR SET 4

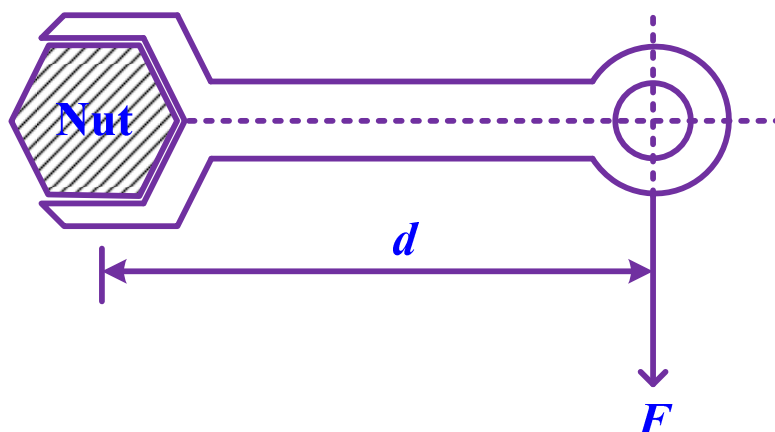
Topic: Moments & Equilibrium

SECTION A

01. B ✓	02. A ✓	03. B ✓	04. D ✓	05. B ✓	06. D ✓	07. B ✓	08. D ✓
09. A ✓	10. D ✓	11. D ✓	12. B ✓	13. B ✓	14. D ✓	15. B ✓	16. C ✓
17. B ✓	18. C ✓	19. B ✓	20. A ✓	21. B ✓	22. B ✓	23. A ✓	24. A ✓
25. D ✓	26. B ✓	27. B ✓	28. A ✓	29. B ✓	30. A ✓		

Working for the mathematical calculations:

Question 1:



$$d = 20 \text{ cm} = \frac{20}{100} \text{ m}, \quad F = 50 \text{ N}$$

$$\text{Moment} = \text{Force} \times \text{Perpendicular distance}$$

$$= 50 \times \frac{20}{100} = \frac{20 \times 50}{100} \text{ N m}$$

Question 9:

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$\begin{aligned}
 P \times 20 &= 2 \times 40 + 2 \times 10 \\
 20P &= 80 + 20 \\
 20P &= 100 \\
 P &= 5 \text{ N}
 \end{aligned}$$

Question 10:

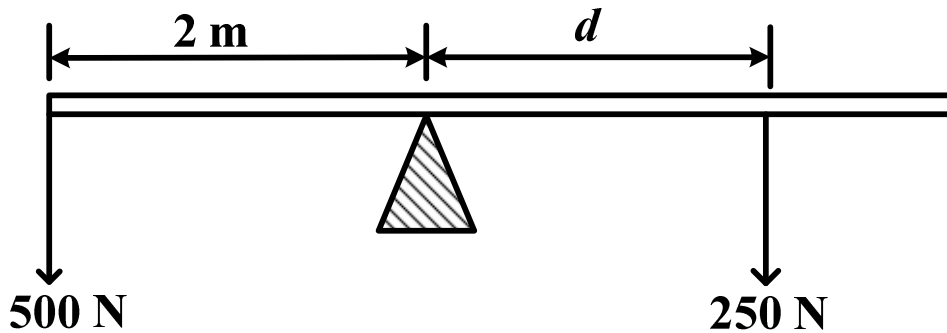
Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$W \times l = R \times x$$

$$W = \frac{Rx}{l}$$

Question 11:



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$250 \times d = 500 \times 2$$

$$250d = 1000$$

$$d = 4 \text{ m}$$

Question 12:

Taking moments about the pivot C,

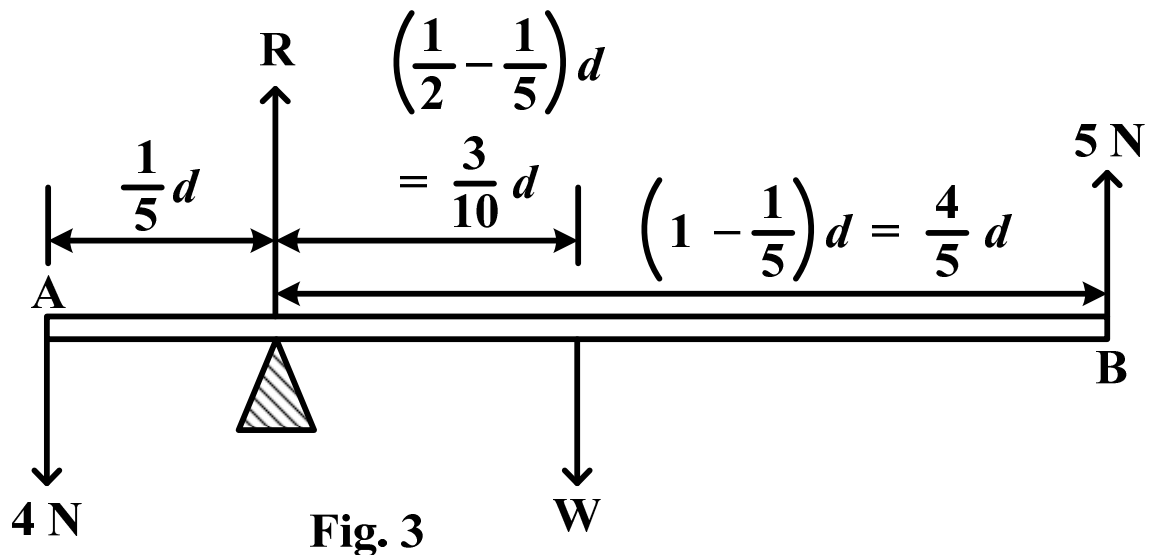
Sum of clockwise moments = Sum of anticlockwise moment

$$Mg \times \left(\frac{50}{2} - 5 \right) = 0.1g \times 5$$

$$20M = 0.5$$

$$M = 0.025 \text{ kg}$$

Question 13:



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$W \times \frac{3}{10}d = 4 \times \frac{1}{5}d + 5 \times \frac{4}{5}d$$

$$0.3W = 0.8 + 4$$

$$0.3W = 4.8$$

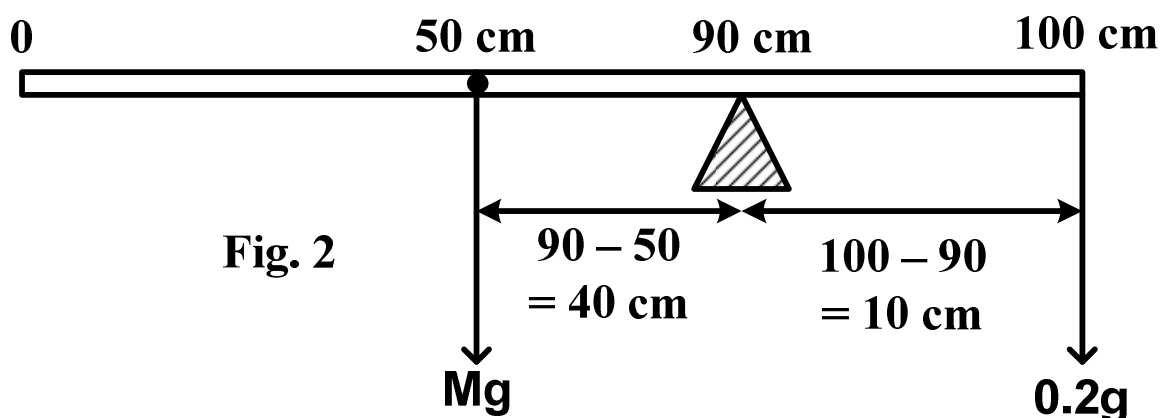
$$W = 16 \text{ N}$$

Sum of upward forces = Sum of downward forces

$$R + 5 = 4 + 16$$

$$R = 20 - 5 = 15 \text{ N}$$

Question 15:



Taking moments about the pivot,

Sum of anticlockwise moments = Sum of clockwise moment

$$Mg \times 40 = 0.2g \times 10$$

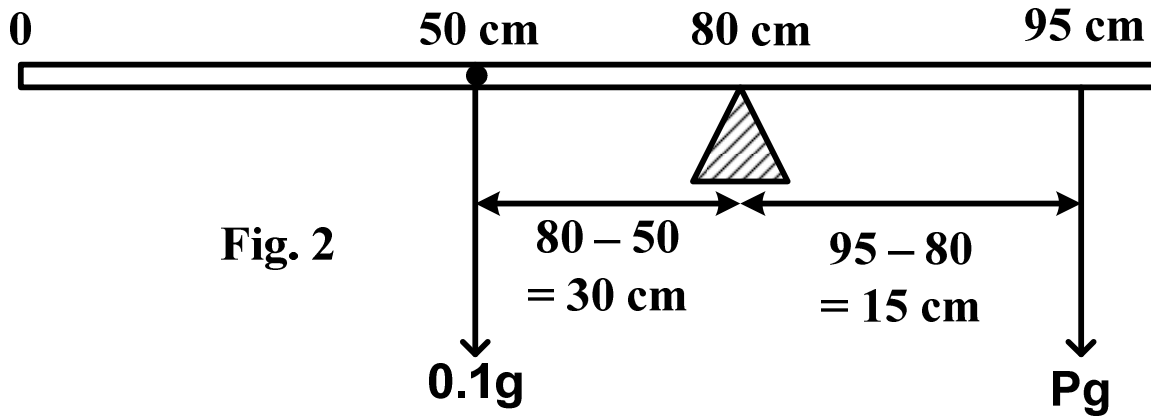
$$40M = 2$$

$$M = \frac{2}{40} = 0.05 \text{ kg}$$

$$M = 0.05 \times 1000 \text{ g}$$

$$M = 50 \text{ g}$$

Question 17:



Taking moments about the pivot,

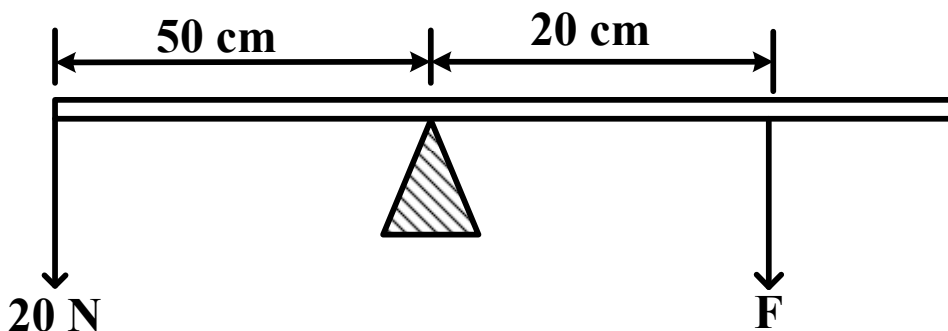
Sum of anticlockwise moments = Sum of clockwise moment

$$0.1g \times 30 = Pg \times 15$$

$$3 = 15P$$

$$P = 0.2 \text{ kg}$$

Question 18:



At equilibrium,

Sum of clockwise moments = Sum of anticlockwise moment

$$20 \times 50 = 20 \times F$$

$$\frac{1000}{20} = \frac{20F}{20}$$

$$F = 50 \text{ N}$$

Question 21:

Taking moments about the pivot,

Sum of anticlockwise moments = Sum of clockwise moment

$$W \times 30 = 60 \times 20$$

$$30W = 1200$$

$$W = 40 \text{ N}$$

Question 22:

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$X \times 6 = 30 \times 2 + 60 \times 4$$

$$6X = 60 + 240$$

$$6X = 300$$

$$X = 50 \text{ N}$$

Question 24:

Taking moments about the pivot,

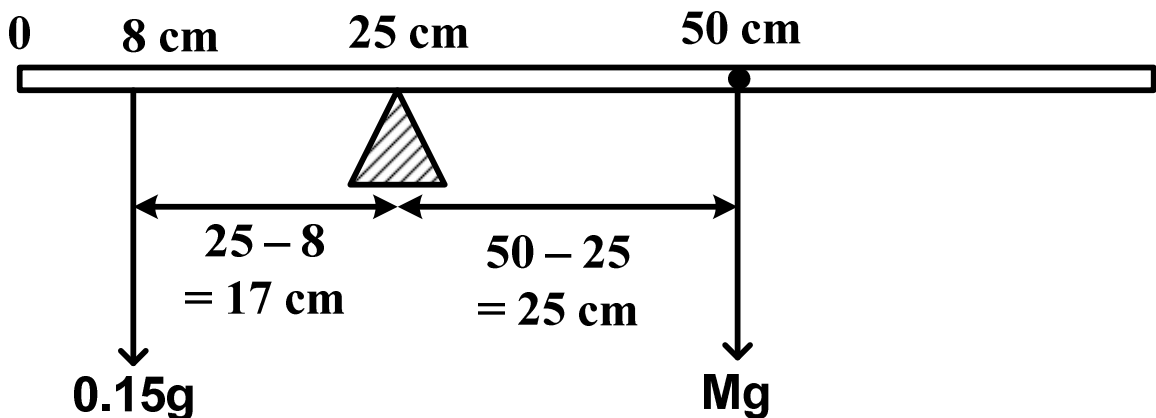
Sum of clockwise moments = Sum of anticlockwise moment

$$W \times 20 = 5 \times 10$$

$$20W = 50$$

$$W = 2.5 \text{ N}$$

Question 25:



Taking moments about the pivot,

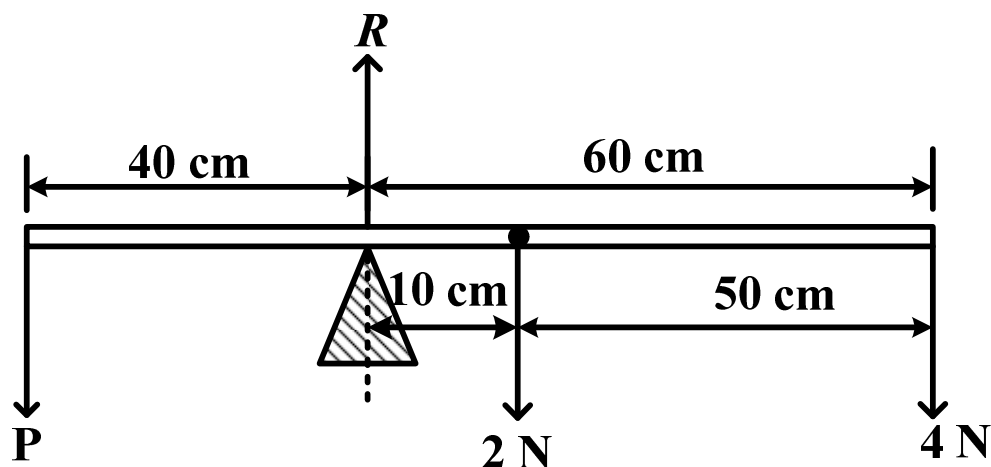
Sum of clockwise moments = Sum of anticlockwise moment

$$Mg \times 25 = 0.15g \times 17$$

$$25M = 2.55$$

$$M = \frac{2.55}{25} = 0.102 \text{ kg}$$

Question 26:



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$2 \times 10 + 4 \times 50 = P \times 40$$

$$20 + 200 = 40P$$

$$220 = 40P$$

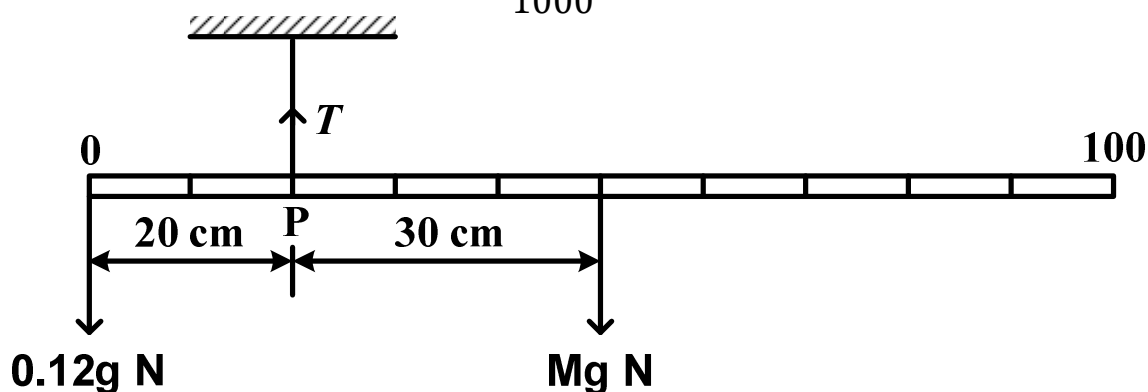
$$\frac{220}{40} = \frac{220}{40}$$

$$P = 5.5 \text{ N}$$

Question 30:

Since the metre rule is uniform, its weight acts at its geometrical centre (at the 50 cm mark)

$$120 \text{ g} = \frac{120}{1000} \text{ kg} = 0.12 \text{ kg}$$



(i). Taking moments about the pivot, P,

Sum of clockwise moments = Sum of anticlockwise moment

$$Mg \times 30 = 0.12g \times 20$$

$$\begin{aligned}30M &= 2.4 \\M &= \frac{2.4}{30} = 0.08 \text{ kg} \\M &= 0.08 \times 1000 \text{ g} \\M &= 80 \text{ g}\end{aligned}$$

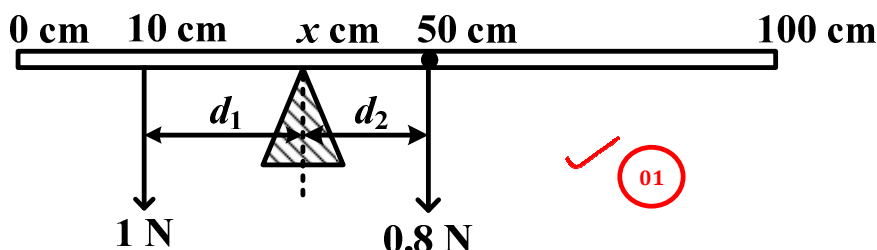
The mass of the metre rule is 80 g.

SECTION B

Question 31:

(a). Overloading vehicles with goods on the roof-rack is dangerous because it raises the centre of gravity of the vehicle; hence making the vehicle unstable. (01)

(b). (i).



(ii).

$$d_1 = (x - 10), \quad d_2 = (50 - x)$$

Taking moments about the pivot,

Sum of anticlockwise moments = Sum of clockwise moment

$$1 \times (x - 10) = 0.8 \times (50 - x)$$

$$x - 10 = 40 - 0.8x$$

$$1.8x = 50$$

$$x = 27.778 \text{ cm}$$

The metre rule will balance at the 27.778 cm mark. (02)

Question 32:

(a). The principle of moments states that when a body is in mechanical equilibrium, the sum of the clockwise moments about a point is equal to the sum of the anti-clockwise moments about the same point. (01)

(b). Total mass = $50 + 10 = 60 \text{ kg}$

Total load = $60 \times 10 = 600 \text{ N}$

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$600 \times 0.5 = E \times 1.5$$

$$300 = 1.5E$$

$$E = 200 \text{ N}$$

(03)

Question 33:

(a). (i). Centre of gravity is a point of application of the resultant force on a body due to the earth's attraction on it. ✓ (01)

(ii). Moment of a force is the product of a force and the perpendicular distance of its line of action from the pivot. ✓ (01)

(b).

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$120 \times 1 = F \times 1$$
$$F = 120 \text{ N} \quad \checkmark \quad (02)$$

Question 34:

(a). (i). [See Qn. 33 a (ii)]

(ii). [See Qn. 32 a]

(b).

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$W \times (50 - 40) = 20 \times (40 - 10)$$
$$10W = 600$$
$$W = 60 \text{ N} \quad \checkmark \quad (02)$$

Question 35:

(a). [See Qn. 32 a]

(b). Let m be the mass of the metre rule.

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$mg \times (60 - 50) = \frac{35}{1000} \times (100 - 60)$$
$$m \times 10 \times 10 = 1.4$$
$$m = 0.014 \text{ kg} \quad \checkmark \quad (03)$$

Question 36:

(a). [See Qn. 32 a]

(b). (i).

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

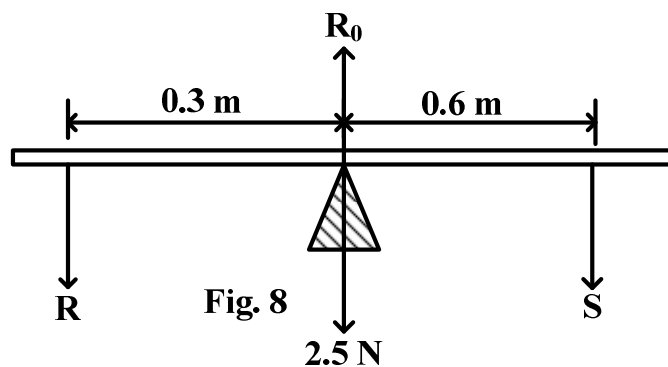
$$S \times 0.6 = 5 \times 0.3$$

$$S = 2.5 \text{ N}$$

02

(ii).

Let R_0 be the reaction at the pivot.



$$R_0 = R + S + 2.5 = 5 + 2.5 + 2.5 = 10 \text{ N}$$

01

Question 37:

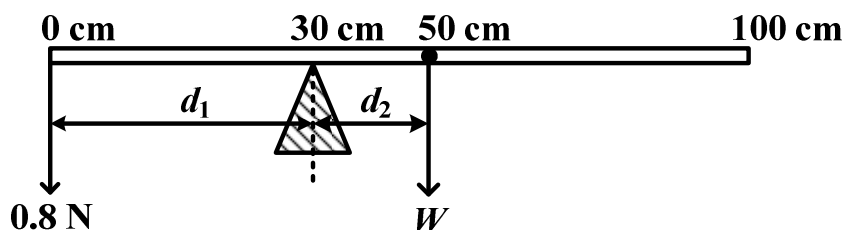
(a).

Moment of a force is the product of a force and the perpendicular distance of its line of action from the pivot. ✓

01

(b).

Let W be the weight of the metre rule.



Taking moments about the pivot,

Sum of anticlockwise moments = Sum of clockwise moment

$$0.8 \times (30 - 0) = W \times (50 - 30)$$

$$24 = 20W$$

$$W = 1.2 \text{ N}$$

03

Question 38:

(a). (i). [See Qn. 32 a]

(ii).

- The sum of the forces in one direction is equal to the sum of forces in the opposite direction. i.e. Sum of upward forces is equal to the sum of downward forces. ✓
- The sum of the clockwise moment about any point is equal to sum of the anti-clockwise moments about the same point. ✓

02

(b).

Centre of gravity is a point of application of the resultant force on a body due to the earth's attraction on it. ✓

01

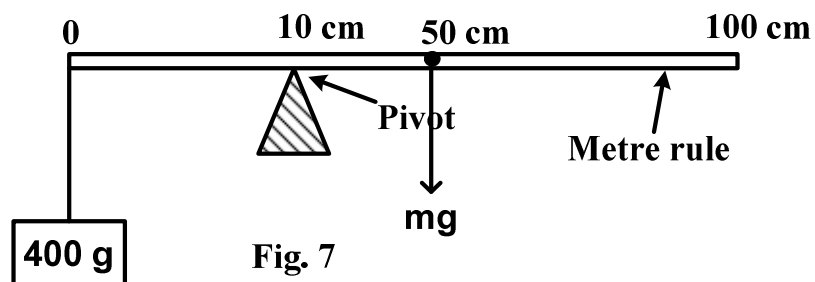
Question 39:

(a). [See 38 a (ii)]

(b). [See 38 b]

(c).

Let m be the mass of the metre rule.



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$mg \times (50 - 10) = \frac{400}{1000} \times (10 - 0)$$

$$m \times 10 \times 40 = 4$$

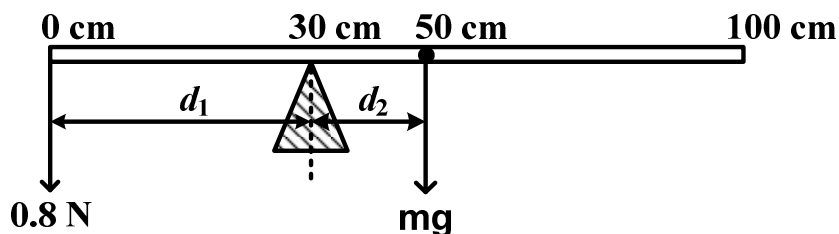
$$m = 0.04 \text{ kg}$$

03

Question 40:

(a). Moment of a force is the product of a force and the perpendicular distance of its line of action from the pivot. ✓ 01

(b). Let m be the mass of the metre rule.



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$mg \times (50 - 30) = 0.8 \times (30 - 0)$$

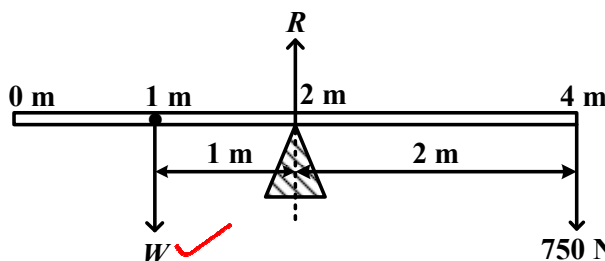
$$m \times 10 \times 20 = 24$$

$$m = 0.12 \text{ kg}$$

03

Question 41:

(a).



(b).

Let W be the weight of the metal bar.

Taking moments about the pivot,

Sum of anticlockwise moments = Sum of clockwise moment

$$W \times 1 = 750 \times 2$$

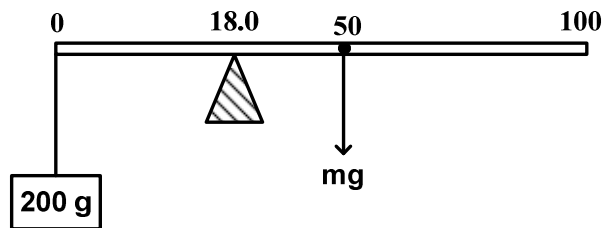
$$W = 1500 \text{ N}$$

03

02

Question 42:

(a). Let m be the mass of the metre rule.



Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$mg \times (50 - 18) = \frac{200}{1000} \times (18 - 0)$$

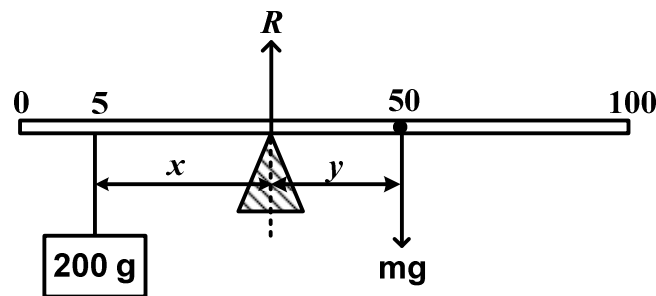
$$m \times 10 \times 32 = 3.6$$

$$m = 0.01125 \text{ kg}$$

02

(b).

Let the knife edge be at a distance x from the 200 g mass.



$$x + y + 5 = 50, \quad \Rightarrow y = 45 - x$$

Taking moments about the pivot,

Sum of clockwise moments = Sum of anticlockwise moment

$$mg \times y = \frac{200}{1000} \times x$$

$$0.01125 \times 10 \times (45 - x) = \frac{200}{1000} \times x$$

$$5.0625 - 0.1125x = 0.2x$$

$$5.0625 = 0.3125x$$

$$x = 16.2 \text{ cm}$$

$$\text{Distance from zero mark} = 16.2 + 5 = 21.2 \text{ cm}$$

03

END



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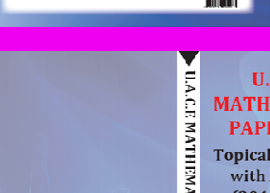


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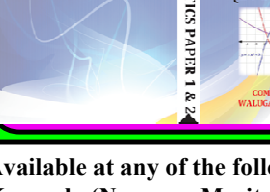
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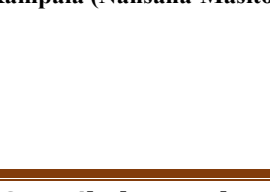


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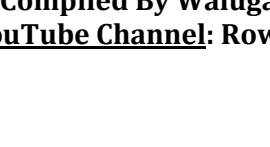
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