Freely Suspended Laminas and Frameworks

Specification: AQA 7367: ME2 (bodies freely suspended) · Edexcel 9FM0: FM2 Centres of mass of plane figures (hanging)

HOMEWORK Consolidation

1 A uniform rectangular lamina ABCD has AB = 16 cm and BC = 6 cm. It is freely suspended from A. Find the angle between AB and the vertical.

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2 A uniform L-shaped lamina has corners O $(0,0)$, A $(10,0)$, B $(10,2)$, C $(2,2)$, D $(2,8)$ and E $(0,8)$. Find its centre of mass. It is freely suspended from E. Find the angle between EO and the vertical.

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3 A uniform rectangle OABC, $0 \le x \le 10$, $0 \le y \le 8$, has the rectangle $6 \le x \le 9$, $4 \le y \le 6$ cut out of it (Lesson 3: G $(355/74, 145/37)$). It is freely suspended from O. Find the angle between OA, along the x-axis, and the vertical.

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4 A uniform triangular lamina has vertices P $(2,1)$, Q $(8,1)$ and R $(5,7)$. It is freely suspended from P. Find the angle between PQ and the vertical.

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5 A uniform semicircular lamina has radius 15 cm, diameter AB and centre O. It is freely suspended from the point P on AB with AP = 6 cm. Find the angle between AB and the vertical.

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6 A uniform wire is bent into a triangular framework OAB with O $(0,0)$, A $(12,0)$ and B $(0,5)$. Find its centre of mass. The framework is freely suspended from B. Find the angle between BO and the vertical.

AQA 7367 ME2 (frameworks) · Edexcel FM2 (frameworks: hanging)

7 Particles of mass 2 kg, 3 kg and 5 kg are fixed at O $(0,0)$, A $(4,0)$ and B $(4,3)$ of a light rigid framework OAB (in m). It is freely suspended from O. Find the angle between OA and the vertical.

AQA 7367 ME1 · ME2 (particles) · Edexcel FM2 (hanging)

8 A uniform rectangular lamina ABCD has AB = 30 cm and BC = 10 cm. It is folded along a line parallel to BC and 6 cm from BC, so the folded part lies flat on the rest (Lesson 3: G is now 13.8 cm from AD). The folded lamina is freely suspended from D. Find the angle between DA and the vertical.

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9 A uniform rectangular lamina ABCD has AB = 10 cm, AD = 4 cm and mass 2 kg. A particle of mass 1 kg is attached at B. The system is freely suspended from the midpoint M of AB. Find the angle between AB and the horizontal, and say which end is lower.

AQA 7367 ME2 · Edexcel FM2 (hanging: unknown mass)

10 A uniform square lamina ABCD has side 6 cm and mass 3 kg. A particle of mass m kg is attached at D. The system is freely suspended from A, and AB makes an angle θ with the vertical, where $\tan\theta = 2$. Find m.

AQA 7367 ME2 · Edexcel FM2 (hanging: unknown mass)

11 *AQA-style*. A uniform rectangular lamina OABC has O $(0,0)$, A $(12,0)$, B $(12,8)$ and C $(0,8)$, in cm. A circular hole of radius 2 cm centred at $(3,4)$ is cut out.

(a) Show that the centre of mass is 6.45 cm from OC, to 3 significant figures. [3 marks]

(b) The lamina is freely suspended from A. Find the angle between AB and the vertical. [2 marks]

(c) The lamina has weight 30 N. It is freely pivoted at A and held with OA horizontal by a horizontal force of magnitude F N acting at B. Find F. [2 marks]

AQA 7367 ME2 (equilibrium: moments) · Edexcel FM2 (hanging) · AQA-style

12 *Edexcel-style*. A uniform lamina is made of a rectangle ABCD, with AB = $2a$ and BC = $4a$, and a semicircle with diameter CD on the other side of CD from AB.

(a) Show that the centre of mass is a distance $\dfrac{4(25+3\pi)a}{3(16+\pi)}$ from AB. [4 marks]

(b) The lamina is freely suspended from A. Find the angle between AB and the vertical. [2 marks]

AQA 7367 ME2 (freely suspended lamina) · Edexcel FM2 (plane figures: hanging) · Edexcel-style