Composite Laminas

Specification: AQA 7367: ME2 · Edexcel 9FM0: FM2 Centres of mass of plane figures (composite laminas, standard results)

HOMEWORK Consolidation

1 A uniform lamina is made of the rectangles $0 \le x \le 8$, $0 \le y \le 2$ and $0 \le x \le 2$, $2 \le y \le 7$. Find its centre of mass.

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2 A uniform rectangle $0 \le x \le 10$, $0 \le y \le 8$ has the rectangle $6 \le x \le 9$, $4 \le y \le 6$ cut out of it. Find the centre of mass of what is left.

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3 A uniform triangular lamina has vertices $(2, 1)$, $(8, 1)$ and $(5, 7)$. Find its centre of mass.

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4 A uniform semicircular lamina has radius 15 cm. Find the distance of its centre of mass from its diameter.

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5 A uniform sector has radius 8 cm and angle $120°$ at its centre O. Find the distance of its centre of mass from O.

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6 A uniform lamina is a rectangle ABCD, with AB = 12 cm and BC = 6 cm, and a semicircle with diameter BC outside the rectangle. Find the distance of the centre of mass from AD.

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7 A uniform lamina is a square OABC of side 6 cm with an isosceles triangle CBD on top, where D is 3 cm above the midpoint of CB. Find the distance of the centre of mass from OA.

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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 that the folded part lies flat on the rest. Find the distance of the centre of mass from AD.

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9 A lamina is made of two squares of side 6 joined along the line $x = 6$: the square $0 \le x \le 6$, $0 \le y \le 6$ has mass σ per unit area and the square $6 \le x \le 12$, $0 \le y \le 6$ has mass 2σ per unit area. Find the centre of mass.

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10 A uniform rectangle $0 \le x \le 10$, $0 \le y \le 4$ has a square hole of side 2 centred at $(p, 2)$. The centre of mass is at $\bar{x} = 4.75$. Find p.

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11 *AQA-style*. A uniform lamina is formed by removing the triangle BCD from the rectangle OABC, where O is the origin, A is $(8, 0)$, B is $(8, 6)$, C is $(0, 6)$ and D is $(4, 3)$, in cm.

(a) Show that the centre of mass of the lamina is at $(4, 7/3)$. [4 marks]

(b) The lamina has mass 1.8 kg. A particle of mass m kg is attached at C. The centre of mass now lies on the line $y = x$. Find m. [3 marks]

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12 *Edexcel-style*. A uniform lamina is made of an isosceles triangle with base AB = $2a$ and height h, and a semicircle with diameter AB on the other side of AB.

(a) Show that the centre of mass is a distance $\dfrac{2(h^2 - 2a^2)}{3(2h + \pi a)}$ from AB, on the side of the triangle. [4 marks]

(b) The centre of mass lies on AB. Find h in terms of a. [2 marks]

AQA 7367 ME2 (formula booklet: triangle, semicircle, sector) · Edexcel FM2 (standard plane figures) · Edexcel-style