Centre of Mass of a System of Particles

Specification: AQA 7367: ME1 · Edexcel 9FM0: FM2 Centres of mass of plane figures (particles)

HOMEWORK Consolidation

1 Particles of mass 5 kg, 3 kg and 2 kg are attached to a light rod AB of length 2 m, at A, 1.2 m from A, and at B. Find the distance of the centre of mass from A.

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2 Particles of mass 2, 3 and 5 kg are at $x = -4$, $x = 1$ and $x = 3$. Find $\bar{x}$.

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3 A uniform rod AB of length 3 m has mass 6 kg. Particles of mass 1 kg and 3 kg are attached at A and B. Find the distance of the centre of mass from A.

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4 Particles of mass 3, 2 and 5 kg are at $(2, 4)$, $(5, -1)$ and $(0, 2)$. Find their centre of mass.

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5 Particles of mass 4, 1 and 5 kg have position vectors $2\mathbf{i} + 5\mathbf{j}$, $-3\mathbf{i}$ and $\mathbf{i} - \mathbf{j}$ metres. Find the position vector of their centre of mass.

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6 Particles of mass 6 kg, 2 kg and m kg are at $x = 0$, $x = 3$ and $x = 8$. Their centre of mass is at $x = 3$. Find m.

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7 Particles of mass 3, 2 and 5 kg are at $(1, 2)$, $(p, 5)$ and $(4, q)$. Their centre of mass is $(3, 1)$. Find p and q.

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8 Particles of mass 4 kg and 6 kg are joined by a light rod of length 2 m. Find the distance of their centre of mass from the 4 kg particle.

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9 A light square lamina OABC has side 30 cm, with O at the origin, A on the positive x-axis and C on the positive y-axis. Particles of mass 2, 1, 3 and 4 kg are at O, A, B and C. Find the centre of mass.

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10 A light rod AB of length 3 m carries particles of mass 2 kg at A, 3 kg at 2 m from A, and 5 kg at B. It rests horizontally on a single support.
(a) Find the distance of the support from A.
(b) Find the reaction at the support.

AQA 7367 ME1 · Edexcel FM2 (centre of mass and moments)

11 *AQA-style*. Particles A, B and C have masses 2 kg, 3 kg and m kg. They are at the points $(1, 1)$, $(5, 2)$ and $(2, 6)$. The centre of mass of the three particles has x-coordinate 3.
(a) Find m. [3 marks]
(b) Find the y-coordinate of the centre of mass. [2 marks]
(c) A fourth particle, of mass 3 kg, is placed at (a, b). The centre of mass of all four particles is $(3, 3)$. Find a and b. [2 marks]

AQA 7367 ME1 · Edexcel FM2 (unknown mass or position) · AQA-style

12 *Edexcel-style*. A uniform rod AB has length $2a$ and mass $3m$. Particles of mass m and $2m$ are attached at A and B.
(a) Show that the centre of mass of the system is a distance $7a/6$ from A. [3 marks]
(b) A further particle of mass km is attached at A. The centre of mass is now at the midpoint of AB. Find k. [3 marks]

AQA 7367 ME1, ME2 · Edexcel FM2 (uniform rod with particles) · Edexcel-style