Uniform and Composite Solids

Specification: AQA 7367: ME2 (uniform bodies, composite bodies, standard results) · Edexcel 9FM0: FM2 Further centres of mass (solids)

HOMEWORK Consolidation

1 A uniform solid cone has height 16 cm. Find the distance of its centre of mass from its vertex.

AQA 7367 ME2 (standard results: formula booklet) · Edexcel FM2 (Further centres of mass: uniform solids)

2 A toy is a uniform solid hemisphere of radius 3 cm with a uniform solid cone of base radius 3 cm and height 6 cm on its plane face (centre O). Find the distance of the centre of mass from O, and from the vertex of the cone.

AQA 7367 ME2 (composite bodies) · Edexcel FM2 (composite solids)

3 A uniform solid is a cylinder of radius 2 cm and length 8 cm with a hemisphere of radius 2 cm on one end. Find the distance of its centre of mass from the plane end of the cylinder.

AQA 7367 ME2 (composite bodies) · Edexcel FM2 (composite solids)

4 A cone (base radius 2 cm, height 6 cm) is drilled out of one end of a uniform solid cylinder (radius 3 cm, height 10 cm), its base in that end face and its axis along the axis. Find the distance of the centre of mass from the other end.

AQA 7367 ME2 (composite bodies: part removed) · Edexcel FM2 (composite solids)

5 A frustum is a uniform solid cone of base radius 6 cm and height 12 cm with the top cone (base radius 3 cm, height 6 cm) removed. Find the distance of its centre of mass from its larger plane face.

AQA 7367 ME2 (composite bodies: part removed) · Edexcel FM2 (composite solids)

6 A closed cone is made of thin uniform card: a conical shell of base radius 6 cm and height 8 cm, and a circular base of radius 6 cm. Find the distance of its centre of mass from the base.

AQA 7367 ME2 (shells and laminas) · Edexcel FM2 (shells)

7 A uniform solid hemisphere of radius 5 cm is freely suspended from a point on the rim of its plane face. Find the angle between its plane face and the vertical.

AQA 7367 ME2 (freely suspended) · Edexcel FM2 (solids: hanging)

8 A uniform solid cone has base radius 4 cm and height 10 cm. It is freely suspended from a point on the rim of its base. Find the angle between its axis and the vertical.

AQA 7367 ME2 (freely suspended) · Edexcel FM2 (solids: hanging)

9 A toy is a uniform solid hemisphere of radius 4 cm with a uniform solid cylinder of radius 4 cm and height h cm on its plane face. It rests with its curved surface on a horizontal floor. Find the greatest value of h for which it returns upright when tilted.

AQA 7367 ME2 (equilibrium: moments) · Edexcel FM2 (solids: resting on a curved surface)

10 A toy is made of a uniform solid cone of base radius 3 cm and height 4 cm and a uniform solid hemisphere of radius 3 cm, joined at their plane faces (centre O). The hemisphere is twice as dense as the cone. Find the distance of the centre of mass from O, and say whether the toy returns upright when tilted on its curved surface.

AQA 7367 ME2 (different densities) · Edexcel FM2 (composite solids)

11 *AQA-style*. A uniform solid cylinder has radius 6 cm and height 10 cm. A hemisphere of radius 4 cm is drilled out of one end, its plane face in that end face and its centre on the axis.

(a) Show that the centre of mass of the remaining solid is $\frac{77}{17}$ cm from the other end. [4 marks]

(b) The solid is freely suspended from a point A on the rim of the end that was not drilled. Find the angle between the axis and the vertical. [2 marks]

(c) Explain why the centre of mass lies on the axis. [1 mark]

AQA 7367 ME2 (composite bodies: part removed) · Edexcel FM2 (composite solids) · AQA-style

12 *Edexcel-style*. A toy is made of a uniform solid hemisphere of radius r and a uniform solid cylinder of radius r and height kr, joined at their plane faces with centre O.

(a) Taking x upwards from O, show that the centre of mass is at $\bar{x} = \frac{3(2k^2 - 1)r}{4(3k + 2)}$ (negative: below O). [4 marks]

(b) The toy rests with its curved surface on a horizontal floor. Find the set of values of k for which it returns upright when tilted. [2 marks]

AQA 7367 ME2 (equilibrium: moments) · Edexcel FM2 (solids: resting on a curved surface) · Edexcel-style