Moments and Couples

Specification: AQA 7367: ME6 (moments and couples; A level only) · Edexcel 9FM0 FM2: not examined

HOMEWORK Consolidation

1 A force of 25 N acts at the end B of a light rod AB of length 1.6 m, at 55° to the rod. Find the magnitude of its moment about A.

AQA 7367 ME6 (moment of a force: F d sin θ)

2 A force $(-2\mathbf{i} + 7\mathbf{j})$ N acts at the point $(3, -2)$. Find its moment about the point P$(1, 1)$.

AQA 7367 ME6 (moment as r × F)

3 A force $(5\mathbf{i} - 12\mathbf{j})$ N acts at the point $(2, 3)$.

(a) Find its moment about O.

(b) Find the perpendicular distance from O to its line of action.

AQA 7367 ME6 (moment as r × F)

4 A rectangular lamina OABC has OA = 5 m and AB = 2 m (O at the origin, A on the positive x-axis, C on the positive y-axis). Forces of 6 N along AO, 4 N along AB and 3 N along CB act on it, in the directions given by the letters.

(a) Find the magnitude of the resultant.

(b) Find the distance from O of the point where its line of action crosses OA.

AQA 7367 ME6 (resultant and its line of action)

5 A square lamina OABC has side 2 m (O at the origin, A on the positive x-axis, C on the positive y-axis). Forces of 4 N along OA, P N along AB, 4 N along BC and Q N along CO act on it. They are equivalent to a couple of moment 18 N m anticlockwise. Find P and Q.

AQA 7367 ME6 (couples)

6 Forces $(-3\mathbf{i} + 4\mathbf{j})$ N, $(5\mathbf{i} + 3\mathbf{j})$ N and $(\mathbf{i} - 3\mathbf{j})$ N act at the points $(-1, 0)$, $(4, -2)$ and $(2, 0)$.

(a) Reduce the system to a single force at O and a couple.

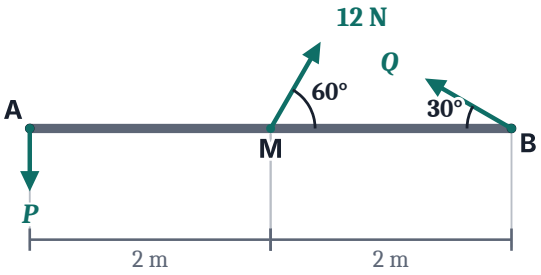
(b) Reduce it to a single force at D$(2, 3)$ and a couple.

(c) Find the equation of the line of action of the single equivalent force.

AQA 7367 ME6 (a force at a point and a couple)

7 A light rod AB has length 4 m; M is its midpoint (AM = MB = 2 m). Forces act as shown: P newtons at A, perpendicular to the rod; 12 N at M, at 60° to the rod; Q newtons at B, at 30° to the rod. They are equivalent to a couple. Find P, Q and the moment of the couple.

AQA 7367 ME6 (couples)



8 A triangular lamina OAB has O$(0, 0)$, A$(4, 0)$ and B$(0, 3)$. Forces of 8 N along OA, 5 N along AB and k N along OB act on it. The line of action of their resultant passes through the midpoint of OA.

(a) Find k.

(b) Find the magnitude of the resultant.

AQA 7367 ME6 (resultant and its line of action)

9 A uniform square lamina OABC of side 2 m and weight 40 N is held in equilibrium in a vertical plane, with OA horizontal and B and C above OA, by a force of magnitude P acting at A in the direction AC and a force at O with horizontal and vertical components S and Q. Find P, S and Q.

AQA 7367 ME6 (equilibrium: unknown forces)

10 Two forces, $F_1 = (3\mathbf{i} + \mathbf{j} - 2\mathbf{k})$ N acting at A$(1, 0, 2)$ and $F_2 = (-3\mathbf{i} - \mathbf{j} + 2\mathbf{k})$ N acting at B$(2, 1, -1)$, form a couple.

(a) Explain why they form a couple.

(b) Find the moment of the couple as a vector, and its magnitude.

AQA 7367 ME6 (vector methods: r × F)

11 *AQA-style*. Three forces, $F_1 = (2\mathbf{i} - 4\mathbf{j})$ N, $F_2 = (2\mathbf{i} + \mathbf{j})$ N and $F_3 = (-4\mathbf{i} + 3\mathbf{j})$ N, act at the points A$(0, 2)$, B$(2, 2)$ and C$(4, 3)$ respectively (metres).

(a) Show that the resultant of the three forces is zero. [1]

(b) Find the moment of the couple and state its sense. [3]

(c) The force F_3 is removed. Find the magnitude of the resultant of F_1 and F_2, and the point where its line of action crosses the x-axis. [3]

AQA 7367 ME6 (couples) · AQA-style

12 *AQA-style*. A rectangular lamina OABC has OA = 4 m and AB = 3 m (O at the origin, A on the positive x-axis, C on the positive y-axis). Forces of 2 N along OA, 5 N along AB and 5 N along the diagonal OB act on it, in the directions given by the letters.

(a) Find the magnitude of the resultant and the angle it makes with OA. [2]

(b) Find the distance from O of the point where its line of action crosses OA. [2]

(c) The system is replaced by a single force at C and a couple. Find the moment of the couple. [2]

AQA 7367 ME6 (resultant and its line of action) · AQA-style