Rigid Bodies in Equilibrium

Specification: AQA 7367: ME6 (rigid bodies in equilibrium; A level only) · Edexcel 9FM0 FM2: not examined

HOMEWORK Consolidation

1 A uniform ladder of length 5 m and weight 250 N rests with its foot on rough horizontal ground and its top against a smooth vertical wall, at $72°$ to the ground.
(a) Find the reaction at the wall.
(b) Find the least possible coefficient of friction.
AQA 7367 ME6 (ladder: smooth wall, rough ground)

2 A uniform ladder rests against a smooth vertical wall with its foot on rough horizontal ground ($\mu = 0.45$). Find the least angle it can make with the ground.
AQA 7367 ME6 (ladder: smooth wall, rough ground)

3 A uniform ladder AB, of length 4 m and mass 12 kg, rests with A on rough horizontal ground ($\mu = 0.25$) and B against a smooth vertical wall, at θ to the ground where $\tan\theta = 3$. A man of mass 72 kg climbs the ladder. How far up the ladder can he climb before it slips?
AQA 7367 ME6 (ladder: how far a person can climb)

4 A uniform ladder AB, of length $2a$, rests with A on rough horizontal ground and B against a rough vertical wall. The coefficient of friction is 0.4 at both. Find the least angle the ladder can make with the ground.
AQA 7367 ME6 (limiting friction at two contacts)

5 A non-uniform ladder AB, of length L and weight W, has its centre of mass at G, where AG = $L/3$. It rests with A on rough horizontal ground ($\mu = 0.25$) and B against a smooth vertical wall. Find the least angle it can make with the ground.
AQA 7367 ME6 (ladder: smooth wall, rough ground)

6 A uniform rod AB, of length 3 m and weight 48 N, has A on rough horizontal ground and rests on a smooth peg at C, where AC = 2.5 m, at $35°$ to the horizontal. The rod is on the point of slipping.
(a) Find the reaction at the peg.
(b) Find the coefficient of friction.
AQA 7367 ME6 (rod on a smooth peg)

7 A smooth hemispherical bowl has radius 0.25 m and its rim horizontal. A uniform rod of length 0.8 m and weight 16 N rests with one end A on the inside of the bowl, touching the rim at C, at θ to the horizontal.
(a) Find the reaction at C.
(b) Find θ.
AQA 7367 ME6 (rod in a smooth hemispherical bowl)

8 A uniform rod AB, of length 2 m and weight 30 N, is freely hinged at A to a vertical wall. A particle of weight 20 N is attached at B. The rod is held horizontal by a light string from B to the point D on the wall, 1.5 m vertically above A.
(a) Find the tension in the string.
(b) Find the magnitude and direction of the force at the hinge.
AQA 7367 ME6 (hinged body held by a string)

9 A uniform triangular lamina ABC has a right angle at A, AB = 0.9 m, AC = 0.6 m and weight 36 N. It is freely hinged at A to a fixed point and held in a vertical plane, with AB horizontal and C vertically above A, by a horizontal light string attached at C.
(a) Find the position of G and the tension.
(b) Find the magnitude and direction of the force at the hinge.
AQA 7367 ME6 (hinged body held by a string)

10 A uniform cylinder of weight 50 N and radius 0.1 m rests with its curved surface on two fixed planes, each inclined at $45°$ to the horizontal, with its axis horizontal. The coefficient of friction at each plane is 0.3. Find the greatest couple that can act on the cylinder, in a plane perpendicular to its axis, without it turning.
AQA 7367 ME6 (couples: the greatest couple before turning)

11 *AQA-style*. A uniform ladder AB, of length 6 m and mass 25 kg, rests with A on rough horizontal ground and B against a rough vertical wall, at $60°$ to the ground. The coefficient of friction is 0.4 at the ground and 0.3 at the wall. A man of mass 75 kg climbs the ladder and it is about to slip when he is x metres from A. Take $g = 9.8$ m s^{-2}.
(a) Find the normal reaction at the ground. [3]
(b) Find x. [4]
AQA 7367 ME6 (limiting friction at two contacts) · AQA-style

12 *AQA-style*. A smooth hemispherical bowl, of radius 0.4 m and centre O, is fixed with its rim horizontal. A uniform rod AB, of length 1.2 m and weight W, rests with A on the inside of the bowl and the rod touching the rim at C, at θ to the horizontal.

(a) Explain why the reaction at A acts through O. [1]

(b) Show that the reaction at C is $0.75W$. [2]

(c) Find θ. [3]

AQA 7367 ME6 (rod in a smooth hemispherical bowl) · AQA-style