STEP II, 2013, Q9 MS

Question 9.

Resolving the forces vertically will establish the first result. For the second part of the question it can be established that all of the frictional forces are equal in magnitude by taking moments about the centre of one of the discs. Resolving forces vertically and horizontally for the discs individually will then lead to simultaneous equations that can be solved for the magnitudes of the reaction and frictional forces.

Since the discs cannot overlap there is a minimum value that θ can take and the value of $\frac{\sin\theta}{1+\cos\theta}$ is increasing as θ increases. This allows the smallest possible value of the frictional force between the discs to be calculated and therefore it can be deduced that no equilibrium is possible if the coefficient of friction is below this minimum value.