

STEP II, 2005, Q11 EC

Q11 This question generated mainly incomplete responses. As with *Q9*, there was a dearth of useful and properly annotated diagrams. Streamlined versions of Newton's second law of motion appeared in some solutions.

For the obtaining of the first result there usually appeared a correct equation of motion for each particle. For the particle on the slope this included an accurate specification of the frictional force opposing the motion. After some algebra the first result appeared. Candidates would have found it helpful, both here and later in the question, to have denoted the pervasive constant $(m_2 - m_1)/(m_2 + m_1)$ by a single letter, say λ .

The particle on the slope begins the second phase of the motion with speed $u = \lambda gT$ and so the total time to the highest point is $(1 + \lambda)T$.

For the final part of the question, the information given leads to the key equation

$$(g/10)(1 + \lambda)^2 T^2 = (\lambda g/2)T^2 + (\lambda^2 g/2)T^2. (*)$$

Provided g is set to $10 \text{ (ms}^{-2}\text{)}$, as directed by the question, it is easy to solve (*) for λ and hence for m_1/m_2 .

$$m_1/m_2 = 3/5$$



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