STEP III, 2003 Q11

11 Point B is a distance d due south of point A on a horizontal plane. Particle P is at rest at B at $t = 0$, when it begins to move with constant acceleration a in a straight line with fixed bearing β. Particle Q is projected from point A at $t = 0$ and moves in a straight line with constant speed v. Show that if the direction of projection of Q can be chosen so that Q strikes P, then

$$v^2 \geqslant ad\,(1 - \cos\beta)\ .$$

Show further that if $v^2 > ad(1 - \cos\beta)$ then the direction of projection of Q can be chosen so that Q strikes P before P has moved a distance d.