

STEP II, 2006, Q11

- 11 A projectile of unit mass is fired in a northerly direction from a point on a horizontal plain at speed u and an angle θ above the horizontal. It lands at a point A on the plain. In flight, the projectile experiences two forces: gravity, of magnitude g ; and a horizontal force of constant magnitude f due to a wind blowing from North to South. Derive an expression, in terms of u , g , f and θ for the distance OA .
- (i) Determine the angle α such that, for all $\theta > \alpha$, the wind starts to blow the projectile back towards O before it lands at A .
- (ii) An identical projectile, which experiences the same forces, is fired from O in a northerly direction at speed u and angle 45° above the horizontal and lands at a point B on the plain. Given that θ is chosen to maximise OA , show that

$$\frac{OB}{OA} = \frac{g - f}{\sqrt{g^2 + f^2} - f} .$$

Describe carefully the motion of the second projectile when $f = g$.



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