

## STEP II, 2000, Q9

- 9 In an aerobatics display, Jane and Karen jump from a great height and go through a period of free fall before opening their parachutes. While in free fall at speed  $v$ , Jane experiences air resistance  $kv$  per unit mass but Karen, who spread-eagles, experiences air resistance  $kv + (2k^2/g)v^2$  per unit mass. Show that Jane's speed can never reach  $g/k$ . Obtain the corresponding result for Karen.

Jane opens her parachute when her speed is  $g/(3k)$ . Show that she has then been in free fall for time  $k^{-1} \ln(3/2)$ .

Karen also opens her parachute when her speed is  $g/(3k)$ . Find the time she has then been in free fall.



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