

## STEP III, 2009, Q1

- 1 The points  $S$ ,  $T$ ,  $U$  and  $V$  have coordinates  $(s, ms)$ ,  $(t, mt)$ ,  $(u, nu)$  and  $(v, nv)$ , respectively. The lines  $SV$  and  $UT$  meet the line  $y = 0$  at the points with coordinates  $(p, 0)$  and  $(q, 0)$ , respectively. Show that

$$p = \frac{(m - n)sv}{ms - nv},$$

and write down a similar expression for  $q$ .

Given that  $S$  and  $T$  lie on the circle  $x^2 + (y - c)^2 = r^2$ , find a quadratic equation satisfied by  $s$  and by  $t$ , and hence determine  $st$  and  $s + t$  in terms of  $m$ ,  $c$  and  $r$ .

Given that  $S$ ,  $T$ ,  $U$  and  $V$  lie on the above circle, show that  $p + q = 0$ .



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