

## STEP II, 2007, Q8

- 8 The points  $B$  and  $C$  have position vectors  $\mathbf{b}$  and  $\mathbf{c}$ , respectively, relative to the origin  $A$ , and  $A$ ,  $B$  and  $C$  are not collinear.
- (i) The point  $X$  has position vector  $s\mathbf{b} + t\mathbf{c}$ . Describe the locus of  $X$  when  $s + t = 1$ .
- (ii) The point  $P$  has position vector  $\beta\mathbf{b} + \gamma\mathbf{c}$ , where  $\beta$  and  $\gamma$  are non-zero, and  $\beta + \gamma \neq 1$ . The line  $AP$  cuts the line  $BC$  at  $D$ . Show that  $BD : DC = \gamma : \beta$ .
- (iii) The line  $BP$  cuts the line  $CA$  at  $E$ , and the line  $CP$  cuts the line  $AB$  at  $F$ . Show that

$$\frac{AF}{FB} \times \frac{BD}{DC} \times \frac{CE}{EA} = 1.$$



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