Solution (#146) If we suppose that A, B, C are represented by complex numbers $0, b, c$ respectively then we have

$$e = -ib, \qquad d = b - ib, \qquad g = ic, \qquad f = c + ic.$$

(i) So P, the midpoint BC is $(b+c)/2$ and

$$\overrightarrow{EG} = g - e = i(c+b), \qquad \overrightarrow{AP} = m - a = \frac{b+c}{2}.$$

As $g - e = (i/2)(m-a)$ it follows that $EG \perp AP$ and that $|EG| = 2|AP|$.

(ii) Let N denote the midpoint of EG, which is represented by the complex number

$$n = \frac{e+g}{2} = \frac{-ib+ic}{2} = \frac{i(c-b)}{2}.$$

The vector $\overrightarrow{AQ}$ is in the direction $i(c-b)$ as this is perpendicular to $\overrightarrow{BC} = c - b$. So N, A, Q are collinear and in particular AQ intersects EG at N which is the midpoint of EG.