**3.** (a) Use the standard results for summations to show that, for all positive integers $n$,

$$\sum_{r=1}^{n} r^2(r+1) = \frac{1}{12}n(n+1)(n+2)(an+b)$$

where $a$ and $b$ are integers to be determined.

**(4)**

(b) Hence show that, for all positive integers $k$,

$$\sum_{r=k+1}^{3k} r^2(r+1) = \frac{1}{3}k(3k+1)(Ak^2+Bk+C)$$

where $A$, $B$ and $C$ are integers to be determined.

**(3)**

(c) Hence, using algebra and making your method clear, determine the value of $k$ for which

$$25\sum_{r=k+1}^{3k} r^2(r+1) = 192k^3(3k+1)$$

**(3)**