**1** **(a)** Use standard results from the list of formulae (MF19) to find $\sum_{r=1}^{n}\left(8r^3+12r^2+4r+3\right)$ in terms of $n$, simplifying your answer. [3]

**(b)** Show that

$$\frac{1}{r^4}-\frac{1}{(r+1)^4}=\frac{4r^3+6r^2+4r+1}{r^4(r+1)^4}$$

and hence use the method of differences to find $\sum_{r=1}^{n}\frac{4r^3+6r^2+4r+1}{r^4(r+1)^4}$. [5]

**(c)** Deduce the value of $\sum_{r=1}^{\infty}\frac{4r^3+6r^2+4r+1}{r^4(r+1)^4}$. [1]