5.

$$f(r) = \frac{1}{r(r+1)} \quad r > 0$$

(a) Express $f(r)$ in partial fractions.

(1)

$$g(r) = \frac{12r^4 + 12r^3 + kr^2 + kr + 1}{r(r+1)} \quad r > 0$$

where k is a constant.

Given that

$$g(r) = h(r) + f(r)$$

(b) show that

$$h(r) = 12r^2 + k$$

You must make your method clear.

(1)

(c) Hence, using the standard results for summations and the method of differences, show that

$$(n+1)\sum_{r=1}^{n} g(r) = 4n^4 + 10n^3 + (k + A)n^2 + (k + 3)n$$

where A is a constant to be found.

(5)

Given that

$$(n+1)\sum_{r=1}^{n} g(r) = n(n+2)(4n^2 + 2n - 1)$$

(d) determine the value of k.

You must make your method clear.

(2)

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Question 5 continued

(Total for Question 5 is 9 marks)