1. Use the standard results for $\sum_{r=1}^{n} r$ and for $\sum_{r=1}^{n} r^2$ to show that, for all positive integers n,

$$\sum_{r=1}^{n} r(r+3) = \frac{n}{a}(n+1)(n+b)$$

where a and b are integers to be found.

(4)

(Total for Question 1 is 4 marks)

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2. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

$$f(z) = z^4 - 6z^3 + 38z^2 - 94z + 221$$

(a) Given that $z = 2 + 3i$ is a root of the equation $f(z) = 0$, use algebra to find the three other roots of $f(z) = 0$

(7)

(b) Show the four roots of $f(z) = 0$ on a single Argand diagram.

(2)

(Total for Question 2 is 9 marks)

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3. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

The rectangular hyperbola H has parametric equations

$$x = 4t \quad y = \frac{4}{t}$$

The straight line with equation $3y - 2x = 10$ intersects H at the points A and B.

Given that the point A is above the x-axis,

(a) find the coordinates of the point A and the coordinates of the point B.

(5)

(b) Find the coordinates of the midpoint of AB.

(2)

(Total for Question 3 is 7 marks)
