Question	Scheme	Marks
3(a)	$u_2 = \frac{3}{2}(5) - \frac{1}{2}(5)^2 + 4 = ...(= -1)$	M1
	$u_3 = \frac{3}{2}("-1") - \frac{1}{2}("-1")^2 + 4 = (2),\ u_4 = \frac{3}{2}("2") - \frac{1}{2}("2")^2 + 4 = (5)\ [= u_1]$	M1
	e.g., $(u_4 = u_1)$ (so sequence is periodic) with period 3.	A1
		(3)
(b)	$u_{200} = -1$	B1
		(1)
(c)	$\sum_{r=1}^{200} u_r = (u_1 + u_2 + u_3) + ... + (u_{196} + u_{197} + u_{198}) + [+u_{199} + u_{200}]$	M1
	$= 66 \times (5 - 1 + 2) + 5 - 1$ OR $= 67 \times (5 - 1 + 2) - 2$	M1
	$= 400$	A1
		(3)
		(7 marks)

Notes:

(a)

M1: Substitutes 5 into the equation to find u_2

M1: Continue by using their u_2 to find the next term(s) until a repeat is found.

A1: All terms correct, (concludes periodic) **and** states period is 3

Accept either $u_1 = u_4$ or $(u_1 = 5$ and$)$ $u_4 = 5$ seen in the working with a conclusion

(b)

B1: Correct value coming from a correct sequence.

(c)

M1: Attempts to group the sum into multiples of the **three** term sum. Look for any attempt at using a multiple of the sum of their terms from part (a) e.g $\alpha(5 - 1 + 2)$ where α is an integer.

M1: Splitting the sum correctly to get 66 sets of 3 and the extra terms, or 67 sets of 3 minus one term

A1: For 400

Question	Scheme	Marks
4(a)	$\frac{\mathrm{d}y}{\mathrm{d}x} = ax^2 + b + \frac{c}{x^2}$	M1
	$\frac{\mathrm{d}y}{\mathrm{d}x} = 6x^2 + 7 - \frac{3}{x^2}$	A1
	$6x^2 + 7 - \frac{3}{x^2} = 0 \Rightarrow 6x^4 + 7x^2 - 3 = 0 \Rightarrow (3x^2 - 1)(2x^2 + 3) = 0 \Rightarrow x^2 = \ldots$	M1
	$\left[x^2 = -\frac{3}{2} \text{ impossible}\right] x^2 = \frac{1}{3} \Rightarrow (x =) \pm \frac{1}{\sqrt{3}}$	A1
		(4)
(b)	$6x^2 + 7 - \frac{3}{x^2} \geqslant 0 \Rightarrow 6x^4 + 7x^2 - 3 \geqslant 0 \ (\text{as } x^2 \geqslant 0)$	
	So need $"3x^2 - 1" \geqslant 0 \Rightarrow x \leqslant "-\frac{1}{\sqrt{3}}", x \geqslant "\frac{1}{\sqrt{3}}"$	M1
	$x \leqslant -\frac{1}{\sqrt{3}}, x \geqslant \frac{1}{\sqrt{3}}$ or $x < -\frac{1}{\sqrt{3}}, x > \frac{1}{\sqrt{3}}$	A1
		(2)
		(6 marks)

Notes:

(a)

M1: Differentiates with power decreased by 1 in at least two of the three terms

A1: Correct derivative. Coefficients need not be simplified, but indices must be simplified.

M1: Sets equal to 0, multiplies through and attempts to solve the **quadratic** in x^2 vis a non-calculator method reaching at least **one value for x^2. They must show us their method for solving the 3TQ in x^2 explicitly.** (Allow any letter to substitute for x^2)

A1: Correct values only with no other values given.

(b)

M1: Selects the outside region for **their** values.

A1: Correct range, accept with loose or strict inequalities.

Accept any valid notation.

For example:

$\left\{x : x \leqslant -\frac{1}{\sqrt{3}}\right\} \cup \left\{x : x \geqslant \frac{1}{\sqrt{3}}\right\}$ or $\left\{x : x < -\frac{1}{\sqrt{3}}\right\} \cup \left\{x : x > \frac{1}{\sqrt{3}}\right\}$

$x \leqslant -\frac{1}{\sqrt{3}}$ OR $x \geqslant \frac{1}{\sqrt{3}}$ Do not accept $x \leqslant -\frac{1}{\sqrt{3}}$ AND $x \geqslant \frac{1}{\sqrt{3}}$ for the **A** mark