| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 6(a) | $(3r-2)^2 = 9r^2 - 12r + 4$ | B1 | 1.1b |
| | $\sum_{r=1}^{n}(9r^2 - 12r + 4) = 9\times\frac{1}{6}n(n+1)(2n+1) - 12\times\frac{1}{2}n(n+1) + \ldots$ | M1 | 2.1 |
| | $= 9\times\frac{1}{6}n(n+1)(2n+1) - 12\times\frac{1}{2}n(n+1) + 4n$ | A1 | 1.1b |
| | $= \frac{1}{2}n\left[3(n+1)(2n+1) - 12(n+1) + 8\right]$ | dM1 | 1.1b |
| | $= \frac{1}{2}n\left[6n^2 - 3n - 1\right]$ * | A1* | 1.1b |
| | | **(5)** | |
| (b) | $\sum_{r=5}^{n}(3r-2)^2 = \frac{1}{2}n(6n^2 - 3n - 1) - \frac{1}{2}(4)(6(4)^2 - 3\times4 - 1)$ | M1 | 3.1a |
| | $\sum_{r=1}^{28} r\cos\left(\frac{r\pi}{2}\right) = 0 - 2 + 0 + 4 + 0 - 6 + 0 + 8 + 0 - 10 + 0 + 12 + \ldots$ | M1 | 3.1a |
| | $3n^3 - \frac{3}{2}n^2 - \frac{1}{2}n - 166 + 103\times14 = 3n^3$<br>$\Rightarrow 3n^2 + n - 2552 = 0$ | A1 | 1.1b |
| | $\Rightarrow 3n^2 + n - 2552 = 0 \Rightarrow n = \ldots$ | M1 | 1.1b |
| | $n = 29$ | A1 | 2.3 |
| | | **(5)** | |
| | | | **(10 marks)** |

**Notes**

(a) Do not allow <u>proof by induction</u> (but the B1 could score for $(3r-2)^2 = 9r^2 - 12r + 4$ if seen)

B1: Correct expansion

M1: **<u>Substitutes</u>** at least one of the standard formulae into their expanded expression

A1: Fully correct expression

dM1: Attempts to factorise $\frac{1}{2}n$ having used at least one standard formula correctly. Dependent on the first M mark and dependent on there being an $n$ in all terms.

A1*: Obtains the printed result with no errors seen

(b)

M1: Uses the result from part (a) by substituting $n = 4$ and subtracts from the result in (a) in order to find the first sum in terms of $n$.

M1: Identifies the periodic nature of the second sum by calculating terms. This may be implied by a sum of 14.

A1: Uses their sum and the given result to form the correct 3 term quadratic

M1: Solves their three term quadratic to obtain at least one value for $n$

A1: Obtains $n = 29$ only or obtains $n = 29$ and $n = -\frac{88}{3}$ and rejects the $-\frac{88}{3}$