Question	Scheme	Marks	AOs
2(a)	$(u_{12} =)400+11\times-10=290*$ or e.g. $(u_{12} =)400-110=290*$ or e.g. $(u_{12} =)400+(12-1)\times-10=290*$ or e.g. $(u_{12} =)410+12\times-10=290*$	B1*	1.1b
		(1)	
	Alternative 1:		
	$400+(n-1)\times-10=290$ $\Rightarrow 400-10n+10=290 \Rightarrow 10n=120 \Rightarrow n=12*$	B1*	1.1b
	Alternative 2:		
	$290=400+(12-1)d \Rightarrow 11d=-110 \Rightarrow d=-10*$	B1*	1.1b
(b)	$8100=\dfrac{1}{2}N\left(2\times400+(N-1)\times-10\right)$ or e.g. $8100=\dfrac{1}{2}N\left(400+400+(N-1)\times-10\right)$	M1	1.1b
	$8100=\dfrac{1}{2}N\left(2\times400+(N-1)\times-10\right)$ $\Rightarrow 16200=800N-10N^2+10N$ or e.g. $\Rightarrow 8100=400N-5N^2+5N$ $\Rightarrow N^2-81N+1620=0*$	A1*	2.1
		(2)	
(c)	$N^2-81N+1620=0 \Rightarrow (N-45)(N-36)=0 \Rightarrow N=45,36$	M1	1.1b
	$(N=)\,36$	A1	2.3
		(2)	
		(5 marks)	

Notes

(a)

B1*: Correct working to obtain 290. Must be a correct calculation so do not condone missing brackets unless they are recovered. E.g. $(u_{12} =)400+12-1\times-10=290$ scores B0 unless

followed by $=400+11\times-10=290$. Condone $(u_{12} =)400+(12-1)-10=290$

The "£" symbol is not required but the "290" must appear.

Alternative 1:

B1*: Correct working using the 290 to obtain $n = 12$.

There must be at least one intermediate line after setting up the equation and must be correct work so do not condone missing brackets unless they are recovered (as above).

A conclusion is **not** required with this approach as long as 12 is correctly obtained.

Alternative 2:

B1*: Correct working using the 290 and 400 to obtain $d = -10$.

There must be at least one intermediate line after setting up the equation and must be correct work so do not condone missing brackets unless they are recovered (as above).

A conclusion is **not** required with this approach as long as -10 is correctly obtained.

Allow candidates to list terms and show the 12th term is 290 e.g.

400, 390, 380, 370, 360, 350, 340, 330, 320, 310, 300, 290

Must list all 12 terms which must be correct and end with 290

Condone if missing 400, 390, 380 as these are given in the question.

(b) **Mark (b) and (c) together**

M1: Uses a <u>correct</u> sum formula in terms of N or n with $a = 400$ and $d = -10$ or $+10$ and sets $= 8100$. Condone e.g. > 8100 and allow A1 if this is recovered to become "=" before the final line.

Condone $8100 = \dfrac{1}{2}N\left(2 \times 400 + (N-1) - 10\right)$ if recovered or not.

A1*: Fully correct proof with sufficient working shown and no unrecovered errors.
Do not condone e.g. missing brackets or e.g. a missing N/n unless recovered before the final given answer.
Condone the use of n instead of N for **both** marks.
Condone terms in a different order as long as they are correct.
Condone $0 = N^2 - 81N + 1620\,*$
Sufficient working requires all brackets to be removed to obtain an unsimplified expanded quadratic before proceeding to the given answer including the "=0".

Alternative (further maths method): Series summation approach:
$$\sum_{r=1}^{N}(410 - 10r) = 8100 \Rightarrow 410N - 10 \times \frac{1}{2}N(N+1)$$
$$\Rightarrow 410N - 5N^2 - 5N = 8100 \Rightarrow N^2 - 81N + 1620 = 0\,*$$

M1: Attempt to sum an appropriate series with first term 400. Condone use of $+10$ as in the main scheme.

A1*: As main scheme.

(c)

M1: Solves the **given** quadratic equation by any correct method including a calculator to obtain at least one value for N. See general guidance for solving a 3-term quadratic.
If values are <u>just written down</u> and only one value is given it must be 45 or 36.
If both values are <u>just written down</u> they must both be correct.

A1: Realises that the smaller value is required and so selects $(N =)$ 36.
Ignore any units if given.
The "$N =$" is not required, just look for the correct value.
It must be clear that this value has been selected. This may be indicated by e.g. underlining the 36 or the omission of the 45. If the 45 is not rejected score A0.
$N = 36$ with no working scores M1A1