Question	Scheme	Marks	AOs
4(a)	$P_n = (K+50n)\left(20+\frac{n^2}{45}\right)-(1000+10n^2)$ where $K = 450$ or 500	M1	2.1
	$P_n = \frac{10}{9}\left(n^3+900n+7200\right)$*	A1*	1.1b
		(2)	
(b)	$T_N = \sum_{n=1}^{N} P_n = \frac{10}{9}\left(\sum_{n=1}^{N} n^3 + 900\sum_{n=1}^{N} n + 7200\sum_{n=1}^{N} 1\right)$		
	$= \frac{10}{9}\left(\underline{\frac{1}{4}N^2(N+1)^2 + 900\times\frac{1}{2}N(N+1)} + \underline{\underline{7200N}}\right)$	M1A1 B1	1.1a 1.1b 1.1b
	$= \frac{10N}{36}\left(N^3+2N^2+N+1800N+1800+28800\right)$	M1	2.1
	$T_N = \frac{5N}{18}\left(N^3+2N^2+1801N+30600\right)$	A1	1.1b
		(5)	
(c)	Total profit is £ $T_{20} = £419000$	M1	3.4
	E.g. The predicted value is much less than the actual value, and so the model seems to be underestimating the profit by some way, so not a good model.	A1ft	3.5a
		(2)	
			(9 marks)

Notes:

(a)

M1: Attempts forming (number of units sold) × (profit per unit) − production cost. Allow $450+50n$ or $500+50n$.

A1*: cso. All work must be correct with the clear statement of how the formula arises.

(b)

M1: Substitutes for one of the standard formulae for $\sum r^3$ or $\sum r$ into the expression.

A1: Both formulae correctly applied.

B1: For $\sum_{r=1}^{n} 1 = n$ used.

M1: Expanding inside the bracket and factorising out the $\frac{n}{4}$.

A1: Correct expression found.

(c)

M1: Evaluates the total profit after 20 years - through use of their formula or via summing 20 terms from (a).

A1ft: Makes a comparison with the known profit and draws appropriate conclusion. Accept any well reasoned response for either accepting or rejecting the model, but it must include some comparison of values. Follow through their result of sum, so, for example, if evaluated close to £500000 they should conclude the model is appropriate.