Question	Scheme	Marks
3(i)	At least three of: For $p=2:\ 2^3+2=8+2=10$; For $p=3:\ 3^3+3=27+3=30$ For $p=5:\ 5^3+5=125+5=130$; For $p=7:\ 7^3+7=343+7=350$	**M1**
	Each case gives a multiple of 10. As 2,3,5 and 7 are the only single digit primes, the result has been proved for all single digit primes.	**A1**
		(2)
(ii)	$(n+1)^3-n^3=n^3+3n^2+3n+1-n^3=3n^2+3n+1$	**M1A1**
	$=3(n^2+n)+1$ which is one more than a multiple of 3, so is not divisible by 3 for any $n\in\mathbb{N}$	**A1**
		(3)
		(5 marks)

Notes:

(i)

M1: Checks result for at least three of the four single digit primes (2,3,5 and 7) – attaining a multiple of 10 is enough, no need to see the product. Allow if there are slips.

A1: All four cases correctly checked, with minimal conclusion that the result is true. Ignore checks on non-prime values such as $p = 8$ which gives $8^3+8=520$, but award A0 if the case $p = 1$, leads to a conclusion that the result is not true.

(ii)

M1: Expands to a four term cubic (may have incorrect coefficients) and then cancels the n^3 terms (if $n = 2k$ and $n = 2k + 1$ are used, both must be attempted.)

A1: Correct quadratic in n. (Both correct if $n = 2k$ and $n = 2k + 1$ are used)

A1: Correct explanation and conclusion given. For the explanation accept e.g factors out 3 from the relevant terms to achieve a form $3\times\left(n^2+n\right)+1$ which is one more than a multiple of 3, or explains each term other than 1 is divisible by 3

Question	Scheme	Marks
4(a)	$\left(2+\frac{x}{8}\right)^{13} = 8192 + ...$	B1
	$+\underline{\binom{13}{1}}2^{12}\left(\frac{x}{8}\right)^{1} + \underline{\binom{13}{2}}2^{11}\left(\frac{x}{8}\right)^{2} + \underline{\binom{13}{3}}2^{10}\left(\frac{x}{8}\right)^{3} + ...$	M1
	$\left(2+\frac{x}{8}\right)^{13} = (8192) + 6656x + 2496x^2 + 572x^3 + ...$	A1A1
		(4)
(b)	$\frac{x}{8} = 0.0125 \Rightarrow x = 0.1$	B1
	$2.0125^{13} \approx 8192 + 665.6 + 24.96 + 0.572$	M1
	$= 8883.132$ cao	A1
		(3)
(c)	As all the terms in the expansion are positive, the truncated series will give an underestimate of the actual value.	B1
		(1)
		(8 marks)

Notes:

(a)

B1: For the correct constant term of 8192 in their expression. Do not accept 2^{13}

M1: Correct binomial coefficients linked with correct powers of x at least twice in the x, x^2 and x^3 terms in their expansion. Accept alternative notation, such as ${}^{13}C_1$ or just 13 etc, for the coefficients. (The power 1 need not be seen.) The powers of 2 and the 8's may be missing or incorrect.

A1: Any two of the final three terms correct. (See also note below.)

A1: All three of the final terms correct.

Note: Students may attempt to take out a common factor of 2^{13} first. In such cases the **B** mark is for correct constant term in their final expansion, **M** follows as above, correct coefficients linked to correct powers of x. The first **A** can be awarded as above or SC $8192\left(1+\frac{13}{16}x+\frac{39}{128}x^2+\frac{143}{2048}x^3\right)$ (oe), final **A** as scheme

(b)

B1: Identifies $x = 0.1$ needs to be substituted into the expression.

M1: Substitutes their $x = 0.1$ into their answer to (a)

A1: Correct answer only, must be to 3 dp.

(c)

B1: States or implies underestimate with correct explanation of why the answer found is an underestimate. Must refer to terms in the expansion being positive or equivalent wording. Do not accept just "as adding more terms" without reference to the terms being non-negative.

If all that is done is a comparison with the true value, then B0.