Question	Scheme	Marks
8(a)	$(k+4x)^{12} = k^{12} + \ldots$	**B1**
	$+\underline{\binom{12}{1}}k^{11}(4x)^1 + \underline{\binom{12}{2}}k^{10}(4x)^2 + \underline{\binom{12}{3}}k^9(4x)^3 + \ldots$	**M1**
	$(k+4x)^{12} = k^{12} + 48k^{11}x + 1056k^{10}x^2 + 14080k^9x^3 + \ldots$	**A1A1**
		(4)
(b)	$14080k^9 = \frac{55}{2} \Rightarrow k^9 = \frac{1}{512} \Rightarrow k = \ldots$	**M1**
	$k = \frac{1}{2}$	**A1**
		(2)
(c)	"$48\left(\frac{1}{2}\right)^{11}$" or "$1056\left(\frac{1}{2}\right)^{10} \times 2$"	**M1**
	$48\left(\frac{1}{2}\right)^{11} + 1056\left(\frac{1}{2}\right)^{10} \times 2 = \ldots = \frac{267}{128}$	**dM1A1**
		(3)
		(9 marks)

Notes:

(a)

B1: For the correct constant term of k^{12} in their expression. They may have initially factored out the k, but must achieve the correct constant in the final expression for this mark.

M1: Correct binomial coefficients linked with **correct** powers of x in their expansion. Accept alternative notation, such as ${}^{12}C_1$ or just 12, 66, 220, for the coefficients. (The power 1 need not be seen.) The powers of 4 and k may be missing or incorrect.

ALT for the M mark

$$k^{12}\left(1+\frac{4x}{k}\right)^{12} = \left[k^{12}\right]\left(1+\underline{12}\times\left(\frac{4\underline{x}}{k}\right)+\left[\frac{12\times11}{2!}\right]\times\left(\frac{4\underline{x}}{k}\right)^2+\left[\frac{12\times11\times10}{3!}\right]\times\left(\frac{4\underline{x}}{k}\right)^3+\right)$$

With **correct** coefficients (with the correct denominators [2 and 6 oe]) and with the **correct** power of x

A1: Any two of the final three terms correct and simplified

A1: All three of the final terms correct and simplified.

Note: Students may attempt to take out a common factor of k^{12} 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 $k^{12}\left(1+\frac{48}{k}x+\frac{1056}{k^2}x^2+\frac{14080}{k^3}x^3\right)$ (oe), final **A** as scheme

(b)

M1: Sets their x^3 coefficient equal to $\frac{55}{2}$ and proceeds to a value for k. They must have had a k in their coefficient.

A1: Correct answer.

(c)

M1: Correct attempt for at least one of the two terms in y^3 in the expansion

- Using their coefficients from (a) (which may not have involved k).
- Realises the y's are squared.
- May be part of an attempt at a full expansion. Allow with k or their value of k.

dM1: Correct attempt at finding both terms and adding, must have both involved k (which may be left as k), but otherwise follow through their attempt at (a). May be part of an attempt at a full expansion.

A1: Correct answer, accept $\frac{267}{128}y^3$, but must have been extracted from a full expansion and identified as the answer.

Question	Scheme	Marks
9(a)	At 12 noon $t=(12-8)=4$ so $\theta=17+5\sin\left(\frac{4\pi}{12}\right)$	**M1**
	$\theta=17+5\sin\left(\frac{4\pi}{12}\right)=(17+4.33...)\approx 21.3\,(°\text{C})$	**A1**
		(2)
	Alt: Working backwards from the given answer	
	$21.3=17+5\sin\left(\frac{\pi t}{12}\right)\Rightarrow \sin\left(\frac{\pi t}{12}\right)=\frac{43}{50}\Rightarrow t=\frac{12}{\pi}\arcsin\left(\frac{43}{50}\right)=...$	**M1**
	$t\approx 4$ with a conclusion; 8am + 4 = 12 noon	**A1**
		(2)
(b)	$17+5\sin\left(\frac{\pi T}{12}\right)=16+6\sin\left(\frac{\pi T}{12}\right)+3\cos^2\left(\frac{\pi T}{12}\right)$	**M1**
	Use of: $\cos^2\left(\frac{\pi T}{12}\right)=1-\sin^2\left(\frac{\pi T}{12}\right)$	**B1**
	$3\sin^2\left(\frac{\pi T}{12}\right)-\sin\left(\frac{\pi T}{12}\right)-2=0*$	**A1***
		(3)
(c)	$\Rightarrow\left(3\sin\left(\frac{\pi T}{12}\right)+2\right)\left(\sin\left(\frac{\pi T}{12}\right)-1\right)=0\Rightarrow\sin\left(\frac{\pi T}{12}\right)=-\frac{2}{3},1$	**B1**
	$\Rightarrow T=\frac{12}{\pi}\left[(\pi-)\arcsin\left(-\frac{2}{3}\right)\right]$ or $\frac{12}{\pi}\left[\arcsin\left(-\frac{2}{3}\right)+2\pi\right]$ or $T=\frac{12}{\pi}\arcsin(1)$	**M1**
	$T=6,\text{awrt}\,14.8,\text{awrt}\ 21.2$	**A1A1 A1**
		(5)
		(10 marks)

Notes:

(a)

M1: Substitutes $t = 4$ into the equation.

A1: Correct expression **seen** leading to awrt 21.3

Note: This is a show question and using $t = 8$ leading to a value of $\theta = 21.3$ is M0A0

Alt

M1: Substitutes 21.3 into the equation and works backwards to find a value for T

Allow working in degrees for the M mark

A1: Correct value for T with a conclusion that 8 am + 4 hrs = 12 noon.