Question Number	Scheme	Marks
4a	3^5 or 243	B1
		(1)
bi	$(B=)5\times3^4p\ (=405p)$ $\quad(D=)10\times3^2p^3\ (=90p^3)$	M1A1
	$B=18D \Rightarrow= 405p=18\times90p^3 \Rightarrow p^2=\frac{1}{4}\Rightarrow p=-\frac{1}{2}$	M1A1
ii	$(C=)\ {}^5C_2\times3^3\times\left(-\frac{1}{2}\right)^2=\frac{135}{2}$	M1A1
		(6)
		(7 marks)

(a) **Mark (a) and (b) together**

B1 3^5 or 243 seen. Do not award if it is outside the bracket as $3^5\left(1+\frac{px}{3}\right)^5$, but allow if some of the terms of the binomial expansion are found and 243 is the constant term.
e.g. $243+405px+...$ Do not accept e.g. ${}^5C_0\times243\times(px)^0$ for this mark.

(b)(i)

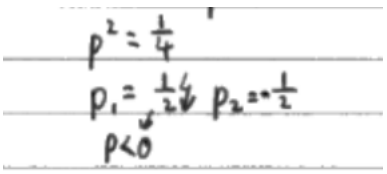
M1 $(B=)5\times3^4p\ (=405p)$ or $(D=)10\times3^2p^3\ (=90p^3)$ (simplified or unsimplified including unprocessed indices).
The coefficients of *B* or *D* may be embedded within the binomial expansion such as $...+5\times3^4px+...+10\times3^2(px)^3$. Also allow e.g. $\binom{5}{1}3^4p$ or $\binom{5}{3}3^2p^3$ or ${}^5C_1 3^4p$ or ${}^5C_3 3^2p^3$

A1 $(B=)5\times3^4p\ (=405p)$ and $(D=)10\times3^2p^3\ (=90p^3)$ (simplified or unsimplified) Allow this mark if the coefficients have not been isolated from *x* and x^3, but the brackets around (px) and $(px)^3$ must be correctly removed. Binomial notation such as ${}^5C_1$ or ${}^5C_3$ must have been evaluated.

M1 Uses $"B"=18"D"$ to form a cubic equation in *p* and attempts to take out a factor of *p* or divide by *p* leading to $p^2=...$ (or may be implied by their value of *p*). $"B"="D"$ is M0
Condone equations involving *x* and x^3 as long as they are removed as they proceed to $p^2=...$
Note that equations may have been simplified before they are formed by cancelling factors e.g. 3^2, 3, 5 or *p* so look carefully at equations which are acceptable such as $5\times3^2p=180p^3$ or $9=36p^2\Rightarrow p^2=...$ (condone if negative)

Note $405p=90p^3\Rightarrow p=\pm\frac{3\sqrt{2}}{2}$ **scores M1A1M0A0 in (b)(i)** (did not use $"B"=18"D"$)
They can proceed in (b)(ii) to score M1A0.

A1 $p=-\frac{1}{2}$ only following correct coefficients for *B* and *D* (the positive root and $p=0$ must be rejected if found / a clear choice of $p=-\frac{1}{2}$) Watch out for notation rejecting the positive root such as:



Can only be scored provided all previous marks have been awarded.

Note if the coefficients of *B* and *D* are incorrect leading to $p=-\frac{1}{2}$ then this is max M0A0M1A0 in (b) and M1A0 in (c)

Alternative method (b)(i)

If the expansion is written as $243\left(1+5\left(\frac{px}{3}\right)+\frac{5\times4}{2!}\left(\frac{px}{3}\right)^2+\frac{5\times4\times3}{3!}\left(\frac{px}{3}\right)^3\right)$ then 243 is not required to find *p* as this will cancel from both sides when setting $"B"=18"D"$.

M1 $(B=)\ (243\times)5\left(\frac{p}{3}\right)$ or $(D=)(243\times)\frac{5\times4\times3}{3!}\left(\frac{p}{3}\right)^3$ (unsimplified with or without the 243)

A1 $(B=)\ (243\times)5\left(\frac{p}{3}\right)$ and $(D=)(243\times)\frac{5\times4\times3}{3!}\left(\frac{p}{3}\right)^3$ (unsimplified either both with or both without the 243 included). Allow this mark if the coefficients have not been isolated from *x* and x^3, but the brackets around $\left(\frac{px}{3}\right)$ and $\left(\frac{px}{3}\right)^3$ must be correctly removed. Any binomial notation would now have to be evaluated as in the main scheme notes.

M1 As above in main scheme notes

A1 As above in main scheme notes

(ii)

M1 Uses their value of p^2, p or $|p|$ and either attempts ${}^5C_2\times3^3p^2$ to find a value for *C*, or attempts to find ${}^5C_2\times3^3p^2x^2$ and then proceeds to identify the value for *C*.

Condone values for *p* where *x* had not been removed from (i) e.g. $\pm\frac{1}{2}x$ being substituted in provided a value without *x* is identified/extracted in (ii)

Condone a slip in calculating ${}^5C_2$ and allow this mark if they substitute both values of *p* into the expression and find two values for *C*.

The method mark may be implied by the value found using their *p*

A1 $\frac{135}{2}$ o.e. e.g. 67.5 or $67\frac{1}{2}$ or $\frac{270}{4}$ following a correctly found $p=\pm\frac{1}{2}$ or $p^2=\frac{1}{4}$

Condone where both values of *p* are used provided they both give the correct answer.

Do not accept e.g. $\frac{135}{2}x^2$ unless the coefficient is clearly identified

Question Number	Scheme	Marks
5	$\log_2 16x + \log_2(x+1) = 3 + \log_2(x+6)$	
	$\log_2 a = b \Rightarrow 2^b = a$	B1
	$\log_2 16x(x+1) = \log_2 8(x+6)$	M1
	$2x^2 + x - 6 = 0$	A1
	$(2x-3)(x+2) = 0$	dM1
	$x = \frac{3}{2}$ only	A1cso
		(5 marks)

Note a correct answer with no working is 0 marks

B1 Correct use of $\log_2 a = b \Rightarrow 2^b = a$ This will usually result from either $\log_2 8 = 3$ or $\log_2 16 = 4$ being stated or seen applied.

e.g. $\log_2\left(\frac{16x(x+1)}{x+6}\right) = 3 \Rightarrow \frac{16x(x+1)}{x+6} = 8$

May be implied by e.g. $\log_2 16x(x+1) = \log_2 8(x+6)$ or $\log_2\left(\frac{x(x+1)}{x+6}\right) = -1$ o.e.

M1 Applies the addition (or subtraction) laws of logs at least once correctly. Condone invisible brackets. e.g. $\log_2 16x^2 + 16x$

This mark can be scored for expressions where the law has been applied correctly and does not need to be a full equation e.g. $\log_2\left(\frac{x+6}{x+1}\right)$ scores M1. Do not withhold this mark if they subsequently apply a law incorrectly.

e.g. $\log_2 16x(x+1) = 3 + \log_2 x + \log_2 6$ still scores M1

Also allow the mark to be scored despite an error dealing with the 3 when writing it as a log

e.g. $3 + \log_2(x+6) = \log_2 6 + \log_2(x+6) = \log_2 6(x+6)$

A1 $2x^2 + x - 6 = 0$ or equivalent 3TQ (quite often $16x^2 + 8x - 48 = 0$) Terms must be collected but do not need to be collected on the same side. Condone the omission of = 0 . Can only be scored from correct working.

dM1 Attempts to solve their 3TQ via any valid method including via a calculator (you may need to check this). Condone complex roots. It is dependent on the previous method mark.

A1cso $\frac{3}{2}$ o.e. only (-2 must be rejected if found)

This mark can only be scored if a correct quadratic is achieved (following correct log work)