Question Number	Scheme	Marks
2	$g(x)=\dfrac{2x^2-5x+8}{x-2}$	
(a)	Sets $2x^2-5x+8=\left(Ax+B\right)(x-2)+C$ with an attempt at one constant	M1
	Attempts all 3 constants. E.g. Sets $x=2\Rightarrow C=...,-2B+C=8\Rightarrow B=...$	dM1
	and compares x^2 terms gives $A=...$	
	$2x-1+\dfrac{6}{x-2}$	A1
		(3)
(b)	$\int 2x-1+\dfrac{6}{x-2}\,dx=x^2-x+6\ln\left(x-2\right)$	M1 A1ft
	$\int_4^8 2x-1+\dfrac{6}{x-2}\,dx=\left[x^2-x+6\ln\left(x-2\right)\right]_4^8=56+6\ln 6-12-6\ln 2$	
	$=44+6\ln 3$	dM1 A1
		(4)
		(7 marks)

ANSWERS IN (a) of $A=2, B=-5, C=2$, and/or $28+2\ln 3$ in (b) please send to review

(a) **Note that correct values for *A*, *B*, and *C* imply the first two marks**

M1: Attempts to find one of the constants via

- an identity e.g. $2x^2-5x+8=\left(Ax+B\right)(x-2)+C$

  Note that if an identity is used it must be correct. Condone arithmetical slips when evaluating.
  The identity may be implied by correct equations
  e.g. $x^2: A=2,\ x: -2A+B=-5,\ \text{constant}: -2B+C=8$

- division is used look for a quotient as far as $2x$

$$\begin{array}{r} 2x-1 \\ x-2\overline{)2x^2-5x+8} \\ \text{.....} \\ 6 \end{array}$$

Note that the division may appear in many different formats or may be by inspection so $2x$ is sufficient to score this mark.

e.g. $\dfrac{2x^2-5x+8}{x-2}=\dfrac{2x(x-2)+4x-5x+8}{x-2}=2x+\dfrac{-(x-2)-2+8}{x-2}=2x-1+\dfrac{6}{x-2}$

e.g.

	$2x$	-1	
x	$2x^2$	$-x$	6
-2	$-4x$	2	

dM1: Attempts to find all 3 constants which are all non-zero. It is dependent upon the previous mark. Via an identity: If three simultaneous equations are formed allow this mark to be scored for proceeding to values for *A*, *B* and *C*. You do not need to check this. Allow sign slips only in forming the equations. Via division: Look for a quotient of $2x \pm c$ and a constant remainder

A1: $2x-1+\dfrac{6}{x-2}$ The expression must be written; it cannot be awarded for just stating the correct values of *A*, *B* and *C*, unless it is later written correctly as an expression in (b) (may be seen within an integral)

(b)

M1: Attempts to integrate the term $\dfrac{C}{x-2}$ proceeding to $D\ln\left|x-2\right|$ *C* does not have to be equal *D* (do not be concerned with brackets or modulus sign)

A1ft: Correct integration of $\mathrm{g}(x)$ for their *A*, *B* and *C* in part (a).

They must be integrating an expression of the form $Ax+B+\dfrac{C}{x-2} \Rightarrow \dfrac{Ax^2}{2}+Bx+C\ln\left|x-2\right|$ o.e (where $A,B,C \neq 0$) which may be unsimplified with or without a constant of integration.

Do not be concerned by the absence of the bracket or modulus on the $x-2$ (as both values substituted in will give positive lns)

dM1: Attempts to proceed to the form $p+q\ln r$ by

- using the limits 8 and 4 in an expression of the form $Ex^2+Fx+D\ln\left|x-2\right|$ o.e. (where $D,E,F \neq 0$) and subtracting either way round
- combining their ln terms **correctly**. e.g. this mark cannot be scored for $\ln 6-\ln 2=\dfrac{\ln 6}{\ln 2}=\ln 3$ but treat as a sign slip in front of the log rather than incorrect log work e.g. $6\ln 6-6\ln 2=-6\ln 3$

Condone slips when evaluating or multiplying out brackets only (condone a spurious + *c* present for this mark). The substitution and combining of their ln terms can be implied by their $p+q\ln r$ provided no incorrect log work is seen. Note that ln *r* does not have to be ln 3 e.g. it may be ln 729.

A1: $44+6\ln 3$ Withhold the final mark if there is an integral and d*x* around the answer or + *c*

Alt (b) Attempts via substitution

Note there may be attempts using substitution e.g. $u=x-2$ on **some or all** of their expression.

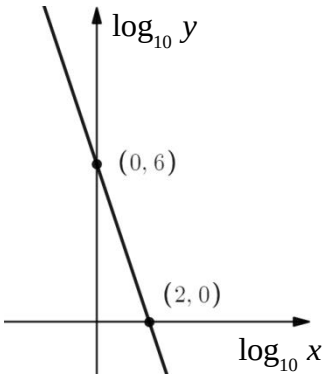
e.g. $\displaystyle\int_4^8 \frac{6}{x-2}\,\mathrm{d}x \rightarrow \int_2^6 \frac{6}{u}\,\mathrm{d}u=\left[6\ln u\right]_2^6$

M1: Correct attempt to integrate $\dfrac{C}{u}$ to $D\ln\left|u\right|$ *C* does not have to be equal *D*

A1ft: $A(u+2)+B+\dfrac{C}{u} \Rightarrow \dfrac{Au^2}{2}+(2A+B)x+C\ln\left|u\right|$ or condone $\dfrac{Ax^2}{2}+Bx+C\ln\left|u\right|$

dM1: Attempts to either substitute in the limits 6 and 2, subtracts either way round and combines their ln terms correctly, or substitutes back to an expression in terms of *x* and proceeds as in the main scheme and notes. If they are working in a mixture of variables, $x^2-x+6\ln u$ then the correct limits must be substituted into the appropriate terms.

A1: $44+6\ln 3$ Withhold the final mark if there is an integral and d*x* around the answer or + *c*

Question Number	Scheme	Marks
3 (i)	$y = \dfrac{10^6}{x^3} \Rightarrow \log_{10} y = \log_{10} 10^6 - \log_{10} x^3 \Rightarrow \log_{10} y = 6 - 3\log_{10} x$	
		B1 B1 B1 **(3)**
(ii)	States $\log_3 N = 2t + 4$ **or** $\log_3 N = \log_3 a + t\log_3 b$	B1
	$N = 3^{2t+4} = 3^{2t} \times 3^4$ **or** $\log_3 a = 4 \Rightarrow a = ...$ **or** $\log_3 b = 2 \Rightarrow b = ...$	M1
	$N = 81 \times 9^t$	A1cso **(3)** **(6 marks)**

(i) **Condone invisible brackets around coordinates provided the meaning is clear.**

Coordinates may be stated away from the graph which is fine provided a graph is drawn.
Note that they may draw a curve so B0B1B1 is possible as the marks are earned independently of each other.
Note that if they draw on Figure 2 the axis labels are incorrect so maximum score is B0B1B1

B1: For a straight line with negative gradient anywhere on a set of axes. It must intersect both axes and not stop at these points. Do not penalise if the line is not perfectly straight and do not be concerned with the steepness provided there is no intention to draw a curve or a horizontal line. Axes do not need to be labelled but if they are then the *y*-axis needs to be $\log y$ and the horizontal axis must be $\log x$ (with or without base 10 labelled)

B1: For an intercept of 6 on the $\log_{10} y$ axis for their graph. Can be labelled as just 6 instead of $(0, 6)$. The line must pass through (or start/stop at) this point. Condone *y* intercept labelled as $(6, 0)$ provided the point is on the positive *y*-axis. Do not be concerned by the axis labelling for this mark.

B1: For an intercept of 2 on the $\log_{10} x$ axis for their graph. Can be labelled as just 2 instead of $(2, 0)$. The line must pass through (or start/stop at) this point. Condone *x* intercept being labelled as $(0, 2)$ provided the point is on the positive *x*-axis. Do not be concerned by the axis labelling for this mark.