1.

EITHER

$4 \ln 2 - 3 \ln 2^2 = -\ln k$ M1

$4 \ln 2 - 6 \ln 2 = -\ln k$ (M1)

$-2 \ln 2 = -\ln k$ (A1)

$-\ln 2^2 = -\ln k$ M1

$k = 4$ A1

OR

$\ln 2^4 - \ln 4^3 = -\ln k$ M1

$\ln \frac{2^4}{4^3} = \ln k^{-1}$ M1A1

$\frac{2^4}{4^3} = \frac{1}{k}$ A1

$\Rightarrow k = \frac{4^3}{2^4} = \frac{64}{16} = 4$ A1

[5]

2

$\ln(x^2 - 1) - \ln(x + 1)^2 + \ln x(x + 1)$ (A1)

$= \ln \frac{x(x^2 - 1)(x+1)}{(x+1)^2}$ (M1)A1

$= \ln \frac{x(x+1)(x-1)(x+1)}{(x+1)^2}$ (A1)

$= \ln x(x - 1)$ $(= \ln(x^2 - x))$ A1

[5]

3.

$\log_3(x + 17) - 2 = \log_3 2x$

$\log_3(x + 17) - \log_3 2x = 2$

$\log_3\left(\frac{x+17}{2x}\right) = 2$ M1A1

$\frac{x+17}{2x} = 9$ M1A1

$x + 17 = 18x$

$17 = 17x$

$x = 1$ A1

[5]

4.

$2^{2x+2} - 10 \times 2^x + 4 = 0$

$y = 2^x$

$4y^2 - 10y + 4 = 0$ M1A1

$2y^2 - 5y + 2 = 0$

By factorisation or using the quadratic formula (M1)

$y = \frac{1}{2}$ $\quad y = 2$ A1

$2^x = \frac{1}{2}$ $\quad 2^x = 2$

$x = -1$ $\quad x = 1$ A1A1

[6]

5.

$2^{2x-2} = 2^x + 8$ (M1)

$\frac{1}{4}2^{2x} = 2^x + 8$ (A1)

$2^{2x} - 4 \times 2^x - 32 = 0$ A1

$(2^x - 8)(2^x + 4) = 0$ (M1)

$2^x = 8 \Rightarrow x = 3$ A1

Notes: Do not award final A1 if more than 1 solution is given.

[5]

6.

$g(x) = 0$

$\log_5|2\log_3 x| = 0$ (M1)

$|2\log_3 x| = 1$ A1

$\log_3 x = \pm\frac{1}{2}$ (A1)

$x = 3^{\pm\frac{1}{2}}$ A1

so the product of the zeros of g is $3^{\frac{1}{2}} \times 3^{-\frac{1}{2}} = 1$ A1 N0

[5]

7.

EITHER

$$\begin{cases}\ln \dfrac{x}{y} = 1 \\ \ln x^3 + \ln y^2 = 5\end{cases} \Leftrightarrow \begin{cases}\ln x - \ln y = 1 \\ 3\ln x + 2\ln y = 5\end{cases}$$ M1A1

solve simultaneously

$$\begin{cases}\ln x = \dfrac{7}{5} \\ \ln y = \dfrac{2}{5}\end{cases}$$ M1

$x = e^{\frac{7}{5}}$ $(= 4.06)$ and $y = e^{\frac{2}{5}}$ $(= 1.49)$ A1A1

OR

$\ln \dfrac{x}{y} = 1$

$\Rightarrow x = ey$ A1

$\ln x^3 + \ln y^2 = 5$

$\ln x^3y^2 = 5$

$x^3y^2 = e^5$ M1

$e^3y^5 = e^5$

$y^5 = e^2$ M1

$y = e^{\frac{2}{5}}$, $x = e^{\frac{7}{5}}$ A1A1

[5]

8.

(a) rewrite the equation as $(4x - 1)\ln 2 = (x + 5)\ln 8 + (1 - 2x)\log_2 16$ (M1)

$(4x - 1)\ln 2 = (3x + 15)\ln 2 + 4 - 8x$ (M1)(A1)

$x = \dfrac{4 + 16\ln 2}{8 + \ln 2}$ A1

(b) $x = a^2$ (M1)

$a = 1.318$ A1

Note: Treat 1.32 as an ***AP***.
Award A0 for ±.

[6]

9.

$\log_{x+1} y = 2$

$\log_{y+1} x = \frac{1}{4}$

so $(x + 1)^2 = y$ A1

$(y+1)^{\frac{1}{4}} = x$ A1

EITHER

$x^4 - 1 = (x + 1)^2$ M1

$x = -1$, not possible R1

$x = 1.70, y = 7.27$ A1A1

OR

$(x^2 + 2x + 2)^{\frac{1}{4}} - x = 0$ M1

attempt to solve or graph of LHS M1

$x = 1.70, y = 7.27$ A1A1

[6]