

$$\begin{aligned}
 \textcircled{1} \text{ a) } & \log_3 27 \\
 &= \log_3 3^3 \\
 &= 3 \log_3 3 \checkmark \\
 &= 3 \times 1 \\
 &= 3 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } & \log_5 \frac{1}{5} \\
 &= \log_5 5^{-1} \\
 &= -\log_5 5 \checkmark \\
 &= -1 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{c) } & \log_3 \frac{1}{9} \\
 &= \log_3 9^{-1} \\
 &= -\log_3 9 \checkmark \\
 &= -\log_3 3^2 \\
 &= -2 \log_3 3 \checkmark \\
 &= -2 \times 1 \\
 &= -2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{d) } & \log_{10} \sqrt[3]{10} \\
 &= \log_{10} 10^{\frac{1}{3}} \\
 &= \frac{1}{3} \log_{10} 10 \checkmark \\
 &= \frac{1}{3} \times 1 \\
 &= \frac{1}{3} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{2} \text{ a) } & \log_6 9 + \log_6 4 \\
 &= \log_6 36 \checkmark \\
 &= \log_6 6^2 \\
 &= 2 \log_6 6 \checkmark \\
 &= 2 \times 1 \\
 &= 2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } & \log_3 54 - \log_3 6 \\
 &= \log_3 9 \checkmark \\
 &= \log_3 3^2 \\
 &= 2 \log_3 3 \checkmark \\
 &= 2 \times 1 \\
 &= 2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{c) } & 6 \log_2 32 \\
 &= 6 \log_2 2^5 \\
 &= 30 \log_2 2 \checkmark \\
 &= 30 \times 1 \\
 &= 30 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{d) } & 7 \log_4 2 - \log_4 8 \\
 &= \log_4 2^7 - \log_4 8 \\
 &= \log_4 2^{\frac{7}{1}} \\
 &= \log_4 \frac{2^7}{2^3} \\
 &= \log_4 2^4 \\
 &= \log_4 16 \checkmark \\
 &= \log_4 4^2 \\
 &= 2 \log_4 4 \checkmark \\
 &= 2 \times 1 \\
 &= 2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{e) } & 4 \log_{25} 5 \\
 &= \log_{25} 5^4 \checkmark \\
 &= \log_{25} 625 \\
 &= \log_{25} 25^2 \\
 &= 2 \log_{25} 25 \checkmark \\
 &= 2 \times 1 \\
 &= 2 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{f) } & 4 \log_3 \sqrt{3} \\
 &= 4 \log_3 3^{\frac{1}{2}} \\
 &= 2 \log_3 3 \checkmark \\
 &= 2 \times 1 \\
 &= 2 \checkmark
 \end{aligned}$$

Total 45

$$\begin{aligned}
 \textcircled{4} \text{ a) } P &= 55e^{-t/100} \\
 &= 55e^{-365/100} \\
 &= 55e^{-3.65} \\
 &= 1.429\dots \\
 &= 1.43 \text{ Watts (to 3 sf)}
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } P_0 &= 55e^{-\frac{0}{100}} \\
 &= 55e^0 \\
 &= 55 \times 1 \\
 &= 55 \text{ watts} \\
 \text{let } P &= 27.5 \text{ watts} \\
 27.5 &= 55e^{-t/100} \\
 0.5 &= e^{-t/100} \\
 \ln 0.5 &= -t/100 \\
 t &= -100 \ln 0.5 \\
 &= 69.314\dots \\
 &= 70 \text{ days (to nearest day)}
 \end{aligned}$$

$$\begin{aligned}
 \textcircled{3} \text{ a) } \ln(x+2) &= 3 \\
 x+2 &= e^3 \\
 x &= e^3 - 2 \\
 &= 18.085\dots \\
 &= 18.1 \text{ (to 3 sf)}
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } 4^t &= 33 \\
 t &= \log_4 33 \\
 &= 2.522\dots \\
 &= 2.52 \text{ (to 3 sf)}
 \end{aligned}$$

$$\begin{aligned}
 \text{c) } \log_{10}(1+x) &= 0.3 \\
 1+x &= 10^{0.3} \\
 x &= 10^{0.3} - 1 \\
 &= 0.995\dots \\
 &= 1.00 \text{ (to 3 sf)}
 \end{aligned}$$

$$\begin{aligned}
 \text{d) } 2e^{3x} &= 15 \\
 e^{3x} &= 7.5 \\
 3x &= \ln 7.5 \\
 x &= \frac{\ln 7.5}{3} \\
 &= 0.671\dots \\
 &= 0.67 \text{ (to 3 sf)}
 \end{aligned}$$