Logs practice *[48 marks]*

1. Solve the equation $2 \ln x = \ln 9 + 4$. Give your answer in the form $x = p\mathrm{e}^q$ where $p,\ q \in \mathbb{Z}^+$. *[5 marks]*

2. Solve the equation $\log_3 \sqrt{x} = \frac{1}{2\log_2 3} + \log_3\left(4x^3\right)$, where $x > 0$. *[5 marks]*

Let $f(x) = a\log_3(x-4)$, for $x > 4$, where $a > 0$.

Point $\mathrm{A}(13, 7)$ lies on the graph of f.

3a. Find the value of a. *[3 marks]*

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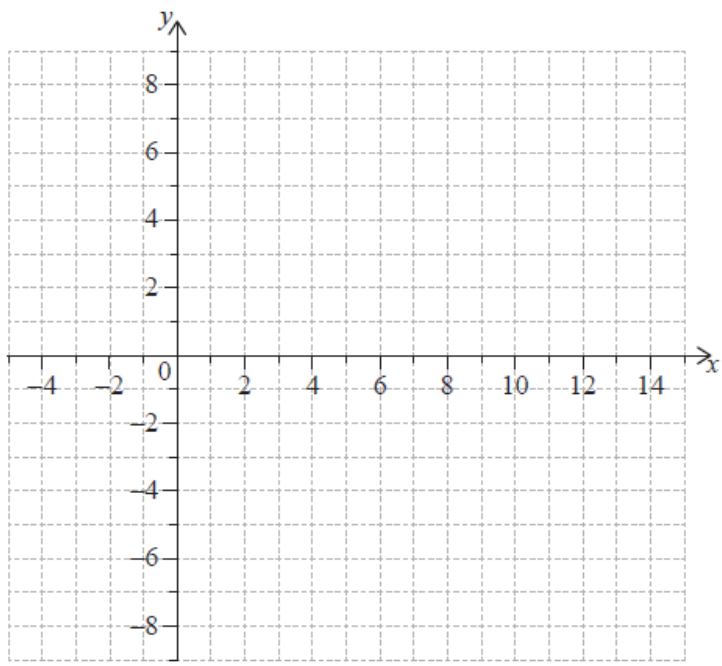
3b. The x-intercept of the graph of f is $(5,\ 0)$. *[3 marks]*

On the following grid, sketch the graph of f.

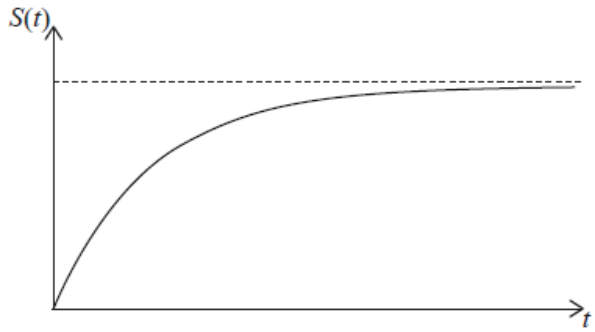


Jean-Pierre jumps out of an airplane that is flying at constant altitude. Before opening his parachute, he goes through a period of freefall.

Jean-Pierre's vertical speed during the time of freefall, S, in $\mathrm{m\,s^{-1}}$, is modelled by the following function.

$$S(t) = K - 60\left(1.2^{-t}\right), t \geq 0$$

where t, is the number of seconds after he jumps out of the airplane, and K is a constant. A sketch of Jean-Pierre's vertical speed against time is shown below.



Jean-Pierre's initial vertical speed is $0\ \mathrm{m\,s^{-1}}$.

4a. Find the value of K. *[2 marks]*

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4b. In the context of the model, state what the horizontal asymptote represents. *[1 mark]*

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4c. Find Jean-Pierre's vertical speed after 10 seconds. Give your answer in $\mathrm{km\,h^{-1}}$. *[3 marks]*

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5. Solve the simultaneous equations *[7 marks]*

$\log_2 6x = 1 + 2\log_2 y$

$1 + \log_6 x = \log_6 (15y - 25)$.

6. Solve the equation $\log_2(x+3) + \log_2(x-3) = 4$. *[5 marks]*

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7. Find the solution of $\log_2 x - \log_2 5 = 2 + \log_2 3$. *[4 marks]*

8. Given that $\log_{10}\left(\frac{1}{2\sqrt{2}}(p+2q)\right) = \frac{1}{2}(\log_{10}p + \log_{10}q)\,,\ p>0,\ q>0,$ find p in terms of q. *[5 marks]*

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9. Solve the equation $4^x + 2^{x+2} = 3$. *[5 marks]*

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