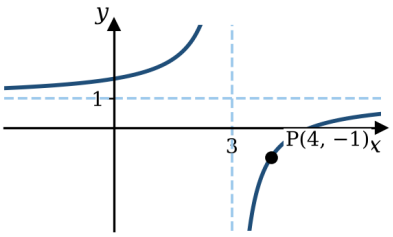
Day 224	A Level Maths: S Tier 10-a-day

1 A population of bacteria is modelled by $P = P_0e^{kt}$, t in hours.
Initially P = 500 and after 4 hours P = 625.
Find k, and the time for the population to reach 1000, to 3 s.f.

2 $f(x) = x^3 + 4x^2 + 12x + 27$.
Show that (x + 3) is a factor of f(x), and that the equation f(x) = 0 has exactly one real root.

3 An arrow is projected from a point O on horizontal ground with speed 49 m s^{-1} at an angle θ above the horizontal, where $\tan\theta = \frac{4}{3}$.
Find (a) the greatest height, (b) the speed when it is at half of this height (3 s.f.). Take g = 9.8 m s^{-2}.

4 The diagram shows the curve C, its asymptotes (dashed) and a point P. C has equation $y = \frac{a}{x + p} + q$. Find a, p and q.



5 A box of weight 170 N is pulled at constant speed up a line of greatest slope of a rough plane ($\tan\alpha = \frac{3}{4}$, $\mu = \frac{7}{24}$) by a force P N at angle β above the plane.
(a) Find P when $\tan\beta = \frac{4}{3}$. (b) Find the least possible value of P as β varies.

Day 224	A Level Maths: S Tier 10-a-day
6 $f(x) = 2x^3 + ax^2 + bx - 36$, where a and b are constants. $(x + 3)$ is a factor of $f(x)$, and $f(x)$ leaves remainder 0 when divided by $(x + 2)$. Find a and b, and hence solve $f(x) = 0$.	
7 (a) Write $\frac{-x - 7}{(x + 5)^2}$ in the form $\frac{A}{x + 5} + \frac{B}{(x + 5)^2}$. (b) Find the exact value of $\int_0^1 \frac{-x - 7}{(x + 5)^2}\,dx$.	
8 Each shot Amira takes scores with probability $\frac{1}{4}$, independently. (a) Find the probability that her third score comes on shot number 5. (b) Find the probability that her third score comes on or before shot number 5.	
9 The points A, B, C have coordinates $(3, -2, 4)$, $(1, 1, -2)$, $(0, -2, 4)$. Find angle ABC to 1 d.p., and the exact area of triangle ABC.	
10 Calls arrive at a switchboard at an average rate of 4 per hour, independently and at random. (a) Find the probability of at least 3 in a 10-minute period. (b) Find the probability that, of 6 separate 10-minute periods, exactly 2 have no arrivals.	