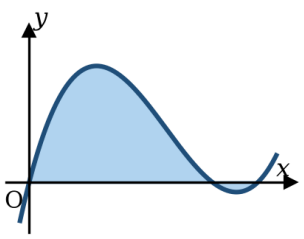
Day 236	A Level Maths: A Tier 10-a-day
1 A uniform rod AB (10 kg, 1.5 m) is smoothly hinged at A to a vertical wall, with a 2 kg particle at B. A light string from B to the wall above A holds the rod horizontal, at angle θ to it, $\tan\theta = \frac{3}{4}$. Find (a) the tension, (b) the magnitude of the hinge force. Take g = 9.8. Give answers to 3 s.f. if not exact.	
2 Find the coefficient of x^2 in the expansion of $(-3 - x)^7$.	
3 How many arrangements of the letters of NUMBERS have R and E not next to each other?	
4 Prove that $n^2 + n + 7$ is odd for every positive integer n.	
5 The diagram shows the curve $y = x(x - 4)(x - 5)$. Find the total area of the two shaded regions. 	

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6 The table summarises the journey time, t minutes of 30 items.
Use linear interpolation to estimate the upper quartile.

Class	Frequency
$50 \le t < 60$	7
$60 \le t < 70$	6
$70 \le t < 80$	9
$80 \le t < 90$	6
$90 \le t < 100$	2

7 A uniform plank AB (mass 15 kg, length 4 m) rests horizontally on supports at C and D, where AC = 1 m and DB = 1.5 m. A 5 kg particle is placed at E, AE = x m, and the plank is about to tilt about D. Find x.

8 Water drains from a tank so that the depth h metres falls at a rate proportional to $\sqrt{h}$. Initially h = 25, and after 6 hours h = 4.
Form and solve a differential equation to find how long, in total, the tank takes to empty.

9 The population of a town is modelled by $P = 100\,e^{kt}$, where t is time in years.
After 5 years, P = 500.
Find (a) the exact value of k, (b) the time for P to reach 1000, to 3 s.f.

10 $f(x) = \frac{-11x + 6}{(1 - x)(1 - 2x)}$.
(a) Express f(x) in partial fractions.
(b) Hence expand f(x) up to x^2.
(c) State the range of x for which the expansion is valid.