Day 239	A Level Maths: A Tier 10-a-day
1 A, B and C have position vectors $\begin{pmatrix}1\\1\\0\end{pmatrix}$, $\begin{pmatrix}1\\3\\0\end{pmatrix}$ and $\begin{pmatrix}1\\k\\0\end{pmatrix}$ relative to O, where k is a constant. Given that A, B and C are collinear, find k and the ratio AB : BC.	
2 A stone is dropped from rest from the top of a cliff. In the last second before it hits the sea it falls 83.3 m. Find the height of the cliff. Take g = 9.8.	
3 A claim is that the probability p that a seed germinates is 0.1. In a sample of 18, the number of successes is 0. Test at the 10% level whether p has decreased.	
4 Particles A (6 kg) and B (8 kg) move towards each other on a smooth horizontal line at 8 m s^{-1} and 3 m s^{-1}. They collide directly, and A then moves in the opposite direction at 3 m s^{-1}. Find (a) the speed of B after the collision, (b) the magnitude of the impulse of A on B.	
5 Given that $(x - 1)$ is a factor of $f(x) = x^3 - x$, solve $f(x) \leq 0$.	

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6 Use integration by parts to find the exact value of

$\int_0^1 xe^{-2x}\,dx$.

7 Solve $x(\sqrt{5} - 3) = -5 - 2\sqrt{5}$, writing x in the form $p + q\sqrt{5}$.

8 A curve has parametric equations $x = 4(t - \sin t)$, $y = 4(1 - \cos t)$.

Find $\frac{dy}{dx}$ in terms of t and the exact equation of the tangent at the point where $t = \frac{\pi}{3}$, in the form $y = mx + c$.

9 The table summarises the length, l mm, of leaves of 56 items.

Use linear interpolation to estimate the lower quartile.

Class	Frequency
$10 \le l < 20$	3
$20 \le l < 30$	10
$30 \le l < 40$	2
$40 \le l < 50$	5
$50 \le l < 60$	16
$60 \le l < 70$	20

10 (a) Expand $(1 + 2x)^{\frac{1}{2}}$ in ascending powers of x up to x^2.

(b) Use $x = 0.02$ to estimate $\sqrt{104}$ to 3 decimal places.