Day 142 **A Level Maths: A Tier 10-a-day**

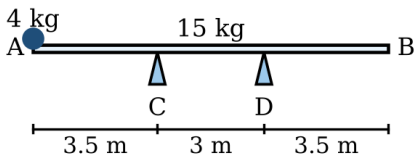
1 $y = x^2 e^{-2x}$ for $x > 0$.
Find the exact coordinates of the stationary point and determine its nature.

2 The 408 items in a list are numbered 1 to 408.
A systematic sample of 34 items is taken, starting with a random item among the first few.
The first item selected is number 10.
Find the sampling interval and the number of the last item selected.

3 The line l has equation $3x + 3y = -8$.
(a) Find the coordinates of the foot of the perpendicular from P$(-1, 5)$ to l.
(b) Hence find the shortest distance from P to l, in exact form.

4 The vectors $\begin{pmatrix} k \\ k \\ -1 \end{pmatrix}$ and $\begin{pmatrix} k \\ 6 \\ -5 \end{pmatrix}$ are perpendicular.
Find the possible values of k and, for the larger value, the exact length of the first vector.

5 A uniform beam AB rests on supports at C and D, with a particle attached at A. Find the reactions at C and D. Take g = 9.8. Give answers to 3 s.f. if not exact.



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6 Express $\frac{2x^2 - 4x - 8}{(x + 2)(x - 2)}$ in the form $2 + \frac{A}{(x + 2)} + \frac{B}{(x - 2)}$, where A and B are constants to be found.	
7 A regression line of v on w is $v = -3019 + -15w$, where $w = \frac{t - 2010}{10}$. (a) Find the regression line of v on t in the form $v = p + qt$. (b) Estimate v when $t = 2040$.	
8 A 3 kg particle rests on a smooth plane inclined at α, $\tan \alpha = \frac{5}{12}$, held by a string in the vertical plane through a line of greatest slope, at angle θ above the slope, $\tan \theta = \frac{3}{4}$. Find the tension and the normal reaction. Take $g = 9.8$. Give answers to 3 s.f. if not exact.	
9 Prove the identity $\frac{\sin 6x}{1 - \cos 6x} \equiv \cot 3x$	
10 A circle touches both coordinate axes and passes through the point (8, 1). Its centre lies in the first quadrant. Find the equations of the two possible circles.	