Day 120 **A Level Maths: A Tier 10-a-day**

1 $f(x) = \ln x + 4x - 7$.
Show that the equation $f(x) = 0$ has a root α in the interval $[1, 2]$.

2 A lift of mass 250 kg carries a person of mass 40 kg. The cable tension is 2610 N and the lift is accelerating. Find (a) the magnitude and direction of the acceleration, (b) the force of the floor on the person. Take $g = 9.8$.

3 The table summarises the journey time, t minutes of 79 items.
Use linear interpolation to estimate the 90th percentile.

Class	Frequency
$0 \le t < 20$	15
$20 \le t < 40$	16
$40 \le t < 60$	14
$60 \le t < 80$	18
$80 \le t < 100$	7
$100 \le t < 120$	9

4 A and B have position vectors $\begin{pmatrix} 6 \\ -2 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$.
The point P lies on AB with AP : PB = 2 : 1.
Find the position vector of P and the exact distance OP.

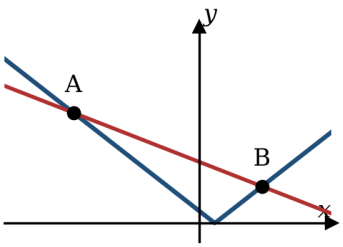
5 A data set has mean 53 and standard deviation 4.
A value is treated as an outlier if it is more than 3 standard deviations from the mean.
Which of 38, 63, 68, 73 are outliers?

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6 The sum of the first n terms of an arithmetic series is $S_n = n^2 + n$.
(a) Find the first term and the common difference.
(b) Find u_{28}.

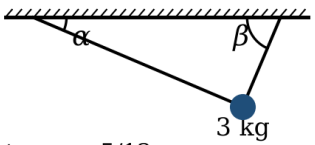
7 The line l has equation $\mathbf{r} = \begin{pmatrix} -8 \\ -5 \\ 3 \end{pmatrix} + t\begin{pmatrix} -3 \\ -3 \\ 3 \end{pmatrix}$.
Find the coordinates of the foot of the perpendicular from P(−3, 1, −4) to l, and the exact distance from P to l.

8 The diagram shows the graphs of $y = |2x - 1|$ and $y = -x + 5$.
The graphs meet at A and B.
Find the coordinates of A and B.



9 The line $4x - 3y = 37$ meets the circle $(x - 4)^2 + (y + 1)^2 = 49$ at the points A and B. Find the exact length of AB.

10 A 3 kg particle hangs in equilibrium from two light strings, as shown. Find the tension in each string (T_1 in the string at angle α). Take g = 9.8. Give answers to 3 s.f. if not exact.



$\tan \alpha = 5/12$
$\tan \beta = 12/5$