Day 24 **A Level Maths: S Tier 10-a-day**

1 The table shows the times, t minutes, taken by some runners.
Using linear interpolation, the median is estimated as 60 minutes. Find the value of k.

t (min)	0-20	20-40	40-60	60-80	80-120
Frequency	k	6	8	12	14

2 Solve $2^{2x} - 12 \times 2^{x+1} + 128 = 0$,
giving each answer exactly and, where not an integer, to 3 s.f.

3 Prove that $n^2 + 1$ is never a multiple of 3, for any integer n.

4 A particle P moves on a straight line. The velocity of P is v m s^{-1} and its acceleration is $-0.2v^2$ m s^{-2}. At t = 0, v = 5.
Find (a) the time taken for the speed of P to halve, (b) the distance P travels in this time, to 3 s.f.

5 The curve C has equation $x^2y + xy^2 = -12$.
Find the equation of the normal to C at the point $(-3, -1)$,
in the form ax + by + c = 0 with integers a, b, c.

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6 Find the term independent of x in the expansion of $(3x - \frac{1}{x^2})^{12}$.	
7 A car of mass 800 kg, with engine power 10.6 kW, climbs a straight road with $\sin \alpha = \frac{1}{14}$ against a constant resistance of 500 N. Find (a) the greatest steady speed up the hill, (b) the acceleration at 2.5 m s^{-1}. Take g = 9.8 m s^{-2}.	
8 A circle has its centre in the first quadrant and touches both the x-axis and the y-axis. It passes through the point (6, 3). Find the two possible equations of the circle.	
9 A bag has 3 yellow counters and some black counters, n in total. Two are taken without replacement. P(at least one yellow) = $\frac{8}{15}$. Find n.	
10 Find the exact coordinates of the point of inflection of $y = (x - 3)e^{-2x}$, justifying that it is a point of inflection.	