Day 181	A Level Maths: S Tier 10-a-day
1 θ is small and measured in radians. Use small angle approximations to find the value that $\frac{\sin 6\theta \tan 5\theta}{1 - \cos 2\theta}$ approaches as $\theta \to 0$.	
2 For n = 15 pairs of values: $\Sigma x = 210$, $\Sigma y = 720$, $\Sigma x^2 = 3072$, $\Sigma xy = 10476$. (a) Find the equation of the regression line of y on x. (b) The x values lie between 10 and 19. Estimate y when x = 22 and comment on its reliability.	
3 Use the trapezium rule with 5 strips to estimate $\int_1^2 \sqrt{x}e^x \, dx$, to 4 s.f. Is it an overestimate or an underestimate? Explain.	
4 A binomial random variable X has mean 34.5 and variance 8.625. (a) Find n and p. (b) Find P(X = 32), correct to 3 significant figures.	
5 A chord AB of a circle, centre O and radius 4 cm, subtends an angle of $\frac{\pi}{3}$ at O. Find the exact area and the exact perimeter of the minor segment cut off by AB.	

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6 Express $\frac{-4-3\sqrt{6}}{4+\sqrt{6}}$ in the form $p + q\sqrt{6}$, where p and q are rational numbers.	
7 A particle P moves with constant acceleration. At t = 0 seconds P is at $(-5\mathbf{i} - 2\mathbf{j})$ m with velocity $(6\mathbf{i} + 4\mathbf{j})$ m s^{-1}. At t = 6, P has velocity $(4\mathbf{j})$ m s^{-1}. Find (a) the acceleration of P, (b) the time at which P moves parallel to $(\mathbf{i} + \mathbf{j})$, (c) the position vector of P at that time.	
8 Prove by contradiction that $\log_4 3$ is irrational.	
9 A box of weight 175 N is pulled at constant speed up a line of greatest slope of a rough plane ($\tan\alpha = \frac{7}{24}$, $\mu = \frac{3}{4}$) by a force P N at angle β above the plane. (a) Find P when $\tan\beta = \frac{3}{4}$. (b) Find the least possible value of P as β varies.	
10 The first term of an arithmetic sequence is 2 and its common difference d is non-zero. The 1st, 2nd and 7th terms are the first three terms of a geometric sequence. Find d and the common ratio.	