Day 313	A Level Maths: S Tier 10-a-day
1 Three forces $(4\mathbf{i} - 2\mathbf{j})$ N, $(-2\mathbf{i} + k\mathbf{j})$ N and $(-\mathbf{i} + 6\mathbf{j})$ N act on a particle of mass 4 kg. The resultant is parallel to $(\mathbf{i} + 3\mathbf{j})$. Find (a) the value of k, (b) the magnitude of the acceleration of the particle, to 3 s.f.	
2 Find the exact value of $\int_0^3 \frac{6x + 3}{x^2 + x + 5}\,dx$	
3 An arithmetic sequence has $u_6 = 31$ and $S_{12} = 408$. (a) Find the first term and common difference. (b) Find the least n for which $S_n > 360$.	
4 Large Data Set, daily mean air temperature (°C), Heathrow, August 2015 (n = 184): mean 19.4, sd 2.8. ($F = 1.8C + 32$) (a) Find the mean and sd in °F. (b) Is a reading of 27 more than 2 sd above the mean?	
5 A box of mass 20 kg is at rest on rough horizontal ground ($\mu = 0.25$). A horizontal force of 77 N acts on it for 7 s and is then removed. Find (a) the speed when the force is removed, (b) the total distance travelled before the box stops. Take $g = 9.8$ m s^{-2}.	

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6 A geometric series has sum to infinity 18 and second term -8. Find the possible values of the common ratio r and the first term a in each case.

7 $f(\theta) = \dfrac{4}{26 + 24\sin\theta + 7\cos\theta}$

(a) Write $24\sin\theta + 7\cos\theta$ as $R\sin(\theta + \alpha)$, $R > 0$, $0 < \alpha < 90°$.

(b) Find the greatest and least values of $f(\theta)$, and the smallest positive θ at which the greatest value occurs, to 1 d.p.

8 (a) Show that $\dfrac{x^2 + 11x + 23}{(x + 4)(x + 3)} \equiv 1 + \dfrac{A}{x + 4} + \dfrac{B}{x + 3}$.

(b) Hence find the exact value of $\int_0^2 \dfrac{x^2 + 11x + 23}{(x + 4)(x + 3)}\,dx$.

9 A circle passes through P(−13, 12), Q(−4, 15) and R(−16, −9). Find its equation.

10 For events A and B, P(A) = 0.3, P(B) = 0.1 and P(A | B) = 0.5.

(a) Find $P(A \cap B)$.

(b) Find $P(A \mid B')$.