Day 268 **A Level Maths: S Tier 10-a-day**

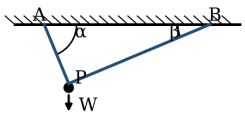
1 $f(x) = \dfrac{-6x + 4}{(1 - 3x)(1 - x)}$.

(a) Express f(x) in partial fractions.

(b) Hence expand f(x) in ascending powers of x up to x^3, stating the range of validity.

2 A particle P of weight 26 N hangs in equilibrium from two light strings AP and BP attached to a horizontal ceiling at A and B (see diagram), where $\tan\alpha = \frac{12}{5}$ and $\tan\beta = \frac{5}{12}$.

Find (a) the tension in each string, (b) the greatest weight P could have if neither tension may exceed 84 N.



3 X ~ B(11, p). It is given that P(X = 2) = 1 × P(X = 1).

(a) Find the value of p.

(b) Find P(X = 0), correct to 3 significant figures.

4 Find the sum of all the integers from 1 to 403 inclusive that are divisible by 5 or by 7, but not by both.

5 Use the substitution u = tan x to find the exact value of

$$\int_0^{\pi/3} \sec^2 x \tan^4 x \, dx$$

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6 $u_{n+1} = u_n + 3n + 3$, $u_1 = 4$. (a) Show that $u_n = an^2 + bn + c$ and find a, b, c. (b) Find the least n for which $u_n > 1089$.	
7 (a) Express $\frac{-5x - 9}{(x + 3)(x + 1)}$ in partial fractions. (b) Hence find the exact value of $\int_0^2 \frac{-5x - 9}{(x + 3)(x + 1)}\,dx$.	
8 The points A, B, C have coordinates (1, 4, −1), (0, −2, 4), (2, 0, −2). Find angle ABC to 1 d.p., and the exact area of triangle ABC.	
9 A particle P moves in a plane. At time t seconds its position vector relative to a fixed origin O is r metres, where $\mathbf{r} = (-2t^2 - 2t)\mathbf{i} + (1.5t^2 - 6t)\mathbf{j}$. Find (a) the value of t at which P is moving parallel to $(2\mathbf{i} + \mathbf{j})$, (b) the speed of P at this time (3 s.f. if not exact).	
10 $X \sim N(\mu, 49)$. H_0: $\mu = 82$ is tested against H_1: $\mu > 82$ using the mean of a sample of size 16 at the 10% level. (a) Find the critical region for the sample mean. (b) Find the probability of a Type II error when $\mu = 84.5$.	