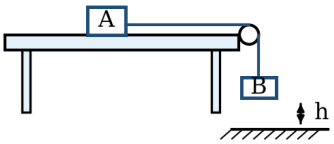
Day 229 **A Level Maths: S Tier 10-a-day**

1 A box of weight 200 N is pulled at constant speed along rough horizontal ground ($\mu = \frac{7}{24}$) by a force P N at angle θ above the horizontal.
(a) Find P when $\tan\theta = \frac{4}{3}$. (b) Find the least possible value of P as θ varies, and the corresponding θ to 1 d.p.

2 (a) Show that $\frac{1 - \cos 2\theta}{1 + \cos 2\theta} \equiv \tan^2\theta$.
(b) Hence solve $\frac{1 - \cos 2\theta}{1 + \cos 2\theta} = 5$ for $0 \leq \theta < 360°$ (1 d.p.).

3 The function f is defined by $f(x) = 4x^2 - 8x + 5$ for $x \geq k$. Given that k is the least value for which
f is one-one, find k, $f^{-1}(x)$, and the domain of f^{-1}.

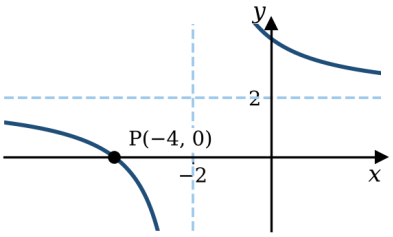
4 Particles A (2 kg) and B (1 kg) are joined by a light string over a smooth pulley (see diagram). A lies on a rough table with $\mu = 0.1$, and B is 1.5 m above the floor.
The system is released from rest. Find the total distance A moves before coming to rest (A does not reach the pulley).



5 Large Data Set, daily total sunshine (hours), Leuchars, October 2015 (n = 31): mean 8.2, sd 2.3. (1 hour = 60 minutes)
(a) Find the mean and sd in minutes.
(b) Is a reading of 14 more than 2 sd above the mean?

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6 The diagram shows the curve C, its asymptotes (dashed) and a point P. C has equation $y = \frac{a}{x + p} + q$. Find a, p and q.



7 The pdf of X is $f(x) = kx(4 - x)$ for $0 \leq x \leq 4$, and 0 otherwise.
(a) Find k.
(b) Find E(X) and Var(X).
(c) Find P(X > 1).

8 $\frac{dy}{dx} = e^{x - y}$, and $y = \ln 2$ when $x = 0$.
Show that $e^y = e^x + 1$ and hence find y in terms of x.

9 Prove by contradiction that $\log_{10} 7$ is irrational.

10 $f(\theta) = \frac{4}{24 + 15 \sin \theta + 8 \cos \theta}$
(a) Write $15 \sin \theta + 8 \cos \theta$ 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.