



Free-Standing Mathematics Qualification
Advanced Level
June 2013

Modelling with Calculus 6992/2PM

Unit 12

Preliminary Material

Data Sheet

To be opened and issued to candidates between
Friday 3 May 2013 and Friday 10 May 2013

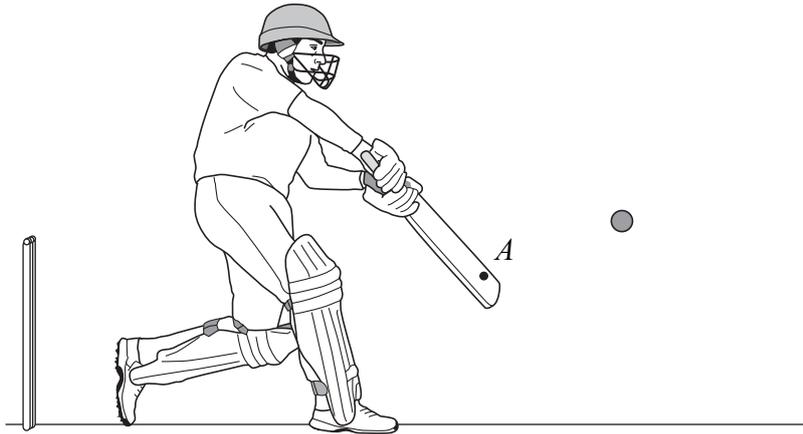
REMINDER TO CANDIDATES

YOU MUST **NOT** BRING THIS DATA SHEET
WITH YOU WHEN YOU SIT THE EXAMINATION.
A CLEAN COPY WILL BE MADE AVAILABLE.

Cricket

When a ball is hit by a batsman in a game of cricket, its position, t seconds after it was hit, can be given in terms of x and h , where

x metres is the horizontal distance from A , the point at which the ball is hit, and h metres is the height above A .



Traffic flow

Surrey County Council's Transport Survey Team collects traffic flow data from 115 Automatic Traffic Counter (ATC) sites throughout the county.

Traffic flows on A roads in Surrey are far higher than the national average. The traffic flow averages 21 400 vehicles per day, which is 64 % greater than the national average of 13 100 vehicles per day.

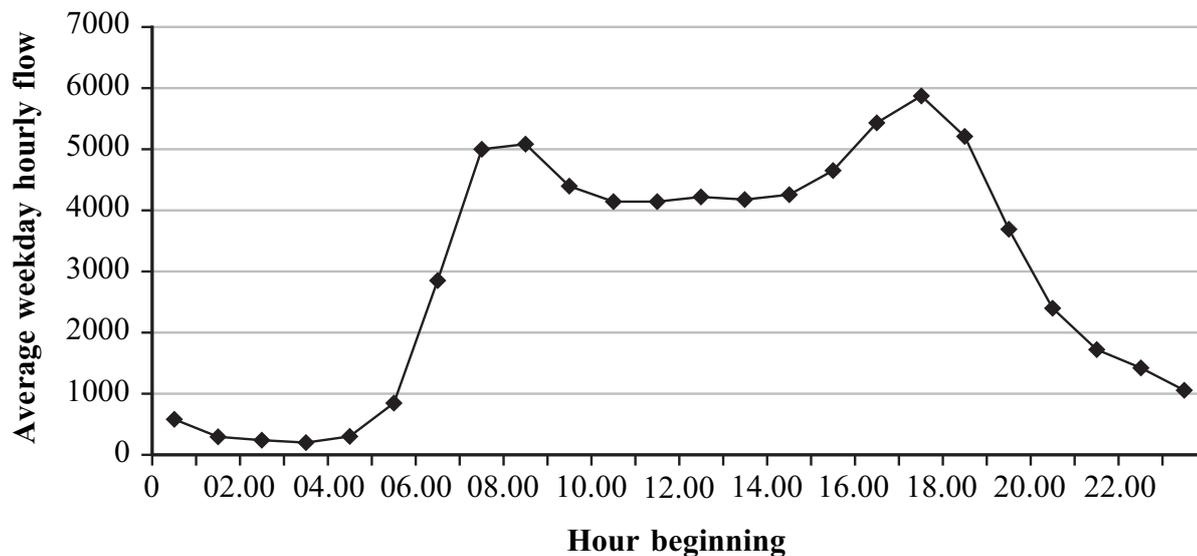
The traffic flows on specific A roads vary considerably; in general, A roads in non built-up areas have a far greater flow than A roads in built-up areas.

Some A roads are classed as 'trunk roads'; these carry more traffic than most A roads as they are the recommended route for long-distance and freight traffic.

Surrey County Council found out how the traffic flow varied during an average weekday on different types of road in the county.

The graph below shows the hourly variation in weekday traffic flow for trunk roads in non built-up areas in Surrey.

Hourly variation in weekday traffic flow



Turn over

Turn over ►

Fridge

When a warm can of cola is placed in a fridge, the temperature of the cola starts to fall. The rate of decrease in the temperature will depend on the temperature difference between the fridge and the can of cola.

The temperature of the fridge may be assumed to be constant.

If c is the temperature of the can of cola in degrees Celsius, then the rate of the decrease in the temperature of the can of cola, $\frac{dc}{dt}$, is proportional to $c - f$, ie $\frac{dc}{dt} \propto (c - f)$,

where f is the temperature of the fridge in degrees Celsius.

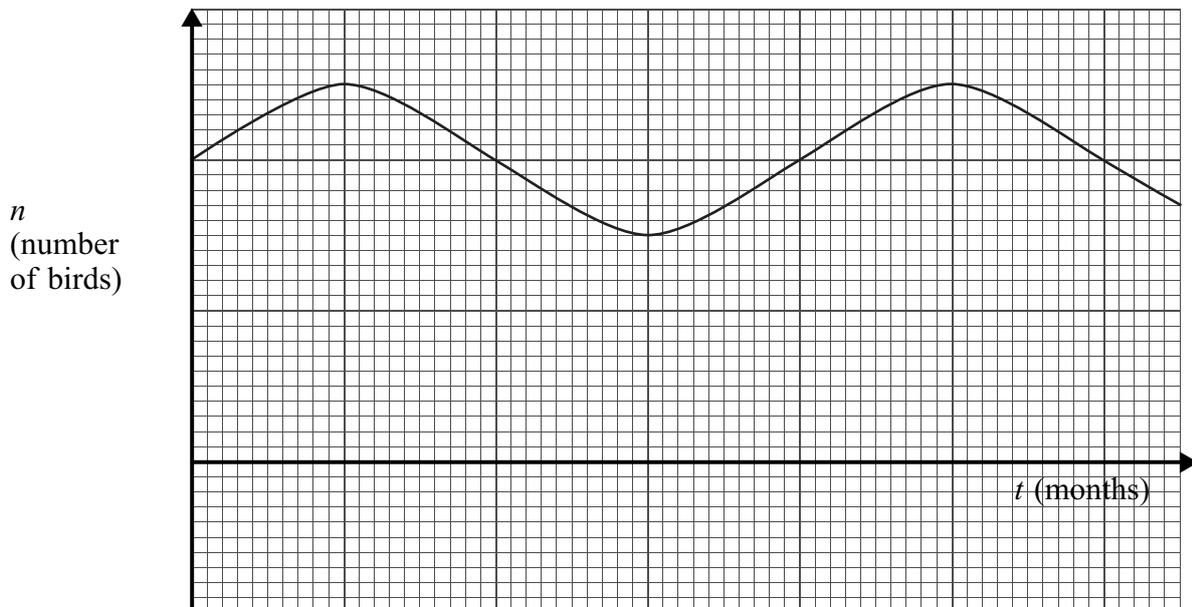
This can be expressed by the differential equation

$$\frac{dc}{dt} = -\lambda(c - f)$$

where λ is a positive constant.

Birds in a garden

Paolo counts the number of birds which he sees in his garden between 2 pm and 2.30 pm every day. Each month, he records the total number of birds seen. He then plots a graph of his results, as shown below.



END OF DATA SHEET

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Traffic flow: 'Transport Statistics for Surrey: Movement Monitoring Report 2008/9', © www.surreycc.gov.uk

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