



Free-Standing Mathematics Qualification
Advanced Level
June 2014

Modelling with Calculus

6992/2PM

Unit 12

Preliminary Material

Data Sheet

To be opened and issued to candidates between
Friday 2 May 2014 and Friday 9 May 2014

REMINDER TO CANDIDATES

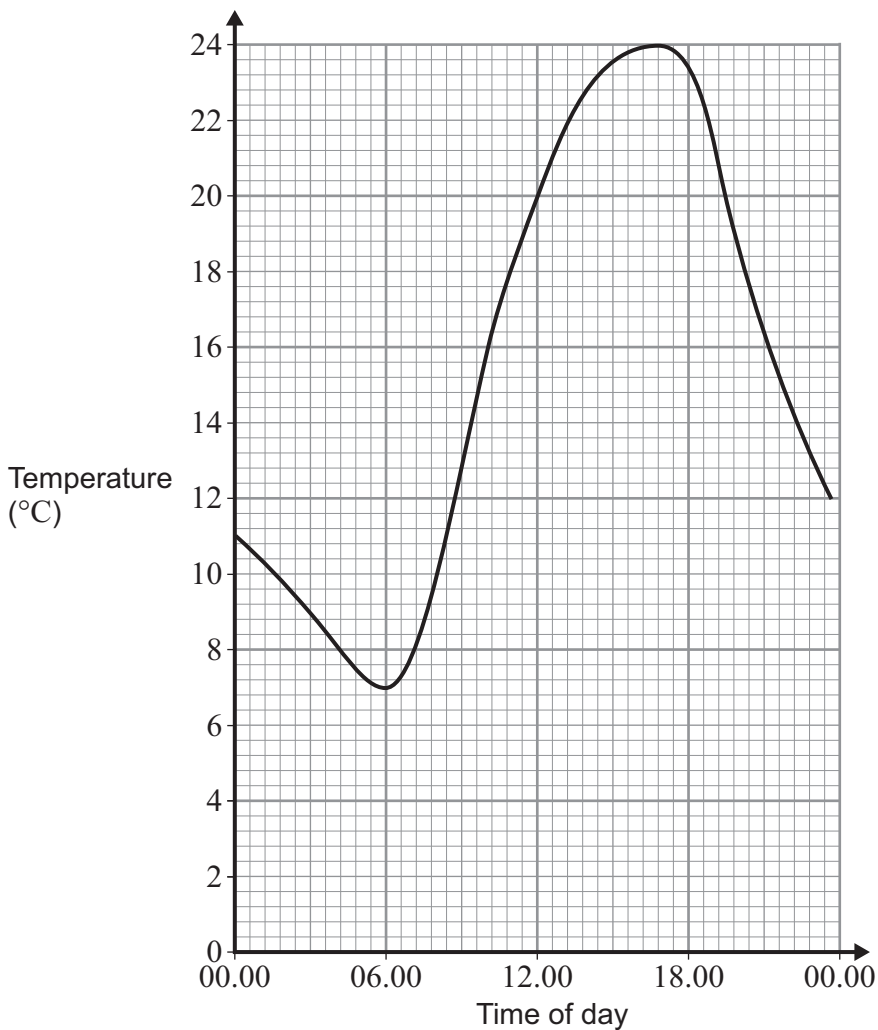
YOU MUST **NOT** BRING THIS DATA SHEET
WITH YOU WHEN YOU SIT THE EXAMINATION.
A CLEAN COPY WILL BE MADE AVAILABLE.

Javelin

Susie is taking part in a javelin competition.

She throws a javelin at a speed of 24 m s^{-1} .

The javelin is thrown with its tip at point O .

**Temperature**

Throughout the world, the temperature fluctuates as the day progresses. The minimum temperature is normally shortly after dawn, and the maximum temperature is normally reached in mid-afternoon. Thus the actual times of day for the minimum and maximum temperatures depend on the season.

The graph shows the temperature, in $^{\circ}\text{C}$, in Sarajevo, a town in Bosnia and Herzegovina, on Friday 4 May 2012.

Radioactive isotopes

Radioactive isotopes are used in many ways in modern life, including detecting bombs at airports, preservation of food and medical diagnosis.

More than twenty different radioactive isotopes are used in medical applications. Each isotope has a different half-life.

The table below shows a number of different isotopes, their half-lives and their uses in the field of medicine.

Isotope	Half-life	Medical use
Carbon-11	20.3 minutes	Brain scan
Gadolinium-153	242 days	Determining bone density
Iodine-131	8.07 days	Thyroid therapy
Iron-59	45 days	Detection of anaemia
Technetium-99m	6.0 hours	Imaging of liver, kidney, etc

The half-life of a radioactive isotope is the time taken for the mass of the radioactive isotope to halve.

The mass of a radioactive isotope, m grams, at time t , can be expressed by the differential equation

$$\frac{dm}{dt} = -km$$

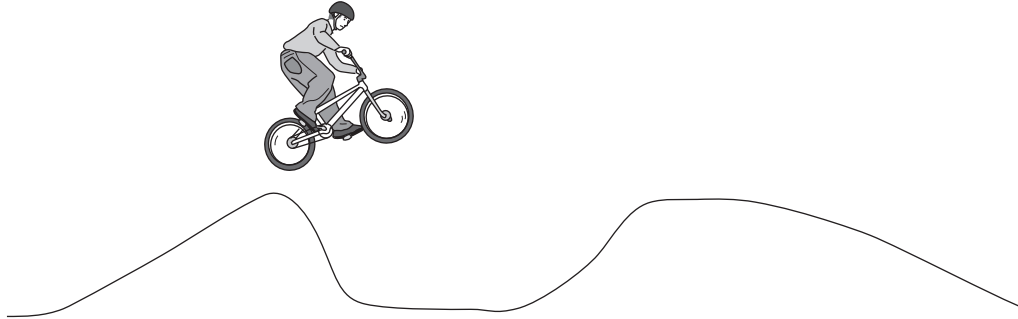
where k is a positive constant.

Turn over

Turn over ►

BMX track

Evan is racing on a BMX track. One section of the track includes a number of dirt jumps. The diagram below shows the cross section of the dirt jump part of the track.



The horizontal distance, x metres, is measured from a point O .

END OF DATA SHEET

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Javelin: © Getty Images

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