CM

AS Level Maths Question Countdown

6 days until the 1st exam

Information

- Each of the ten sheets will contain five pure questions and two applied questions.

Pure questions

- Two of the pure questions will be 'standard'.
- Two of the pure questions will be 'problems'.
- The last pure question will involve modelling.

Applied questions

- One of the questions will focus on statistics.
- One of the questions will focus on mechanics.
- On alternate days, the statistics question will look at the large data set. Note that these questions may be brief as opposed to full length exam questions.

Notes to self

Pure questions – standard

1 Without using a calculator, show that

$$\int_{1+\sqrt{2}}^{4} \frac{1}{x^2}\,dx = \frac{1}{4}(a\sqrt{2}+b)$$

where a and b are constants to be found.

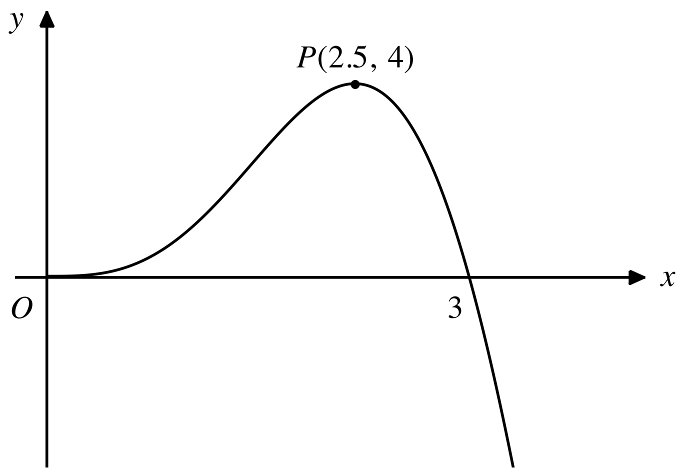
2 The curve C has the equation $y = f(x)$.

The point $P(5, 2)$ lies on C.

Under the transformation $y = f(x) + k$, the point P is transformed to the point $(5, -3)$.

(a) State the value of k.

(b) Write down the coordinates of P under the transformation $y = f(x - 2)$.



The diagram above shows a sketch of another curve with equation $y = g(x)$.

The curve crosses the x axis at $(0, 0)$ and $(3, 0)$ and it has a maximum point at $(2.5, 4)$.

(c) Sketch the curve with equation $y = g'(x)$, showing the coordinates of any intersections with the x axis.

Pure questions – problems

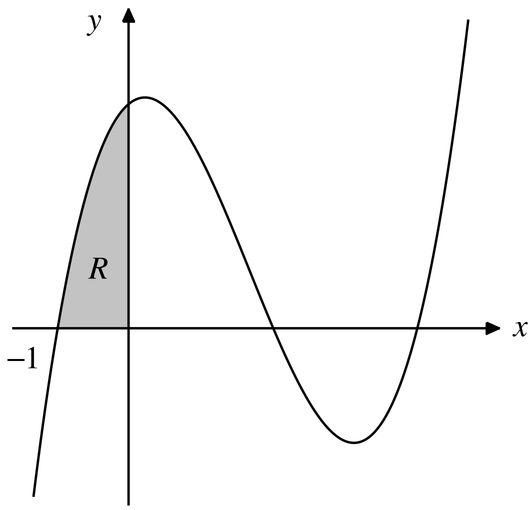
3 Points A, B and C lie in a straight line such that the ratio $AB : BC = 2 : 3$.

Relative to a fixed origin O, points B and C have position vectors $2\mathbf{i} + 3\mathbf{j}$ and $\mathbf{i} - 6\mathbf{j}$ respectively.

(a) Showing your working, find the position vector of A.

(b) Hence find the distance of A from the origin O.

4



The diagram above shows a sketch of the curve C with equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = x^3 + ax^2 + bx + 8, \quad \text{where } a \text{ and } b \text{ are constants.}$$

Given that C crosses the x axis at $(-1, 0)$.

(a) (i) write down a factor of $\mathrm{f}(x)$,

(ii) and show that $b - a = 7$.

The region R, shown shaded in the diagram, is bounded by C, the x axis and the y axis.

Given that the area of R is $\dfrac{61}{12}$,

(b) show that $3b - 2a = 16$.

(c) (i) Deduce that $a = -5$ and $b = 2$.

(ii) Hence express $\mathrm{f}(x)$ as a product of three linear factors.

Pure questions – modelling

5 The size of a population, p thousands, is modelled to vary due to a disease according to

$$p = \frac{a\mathrm{e}^{0.15t} - 1}{\mathrm{e}^{0.3t} + 1}, \quad t \geqslant 0$$

The initial size of the population is 1500.

(a) Show that $a = 4$.

(b) Use the model to show that the size of the population is never 2000.

(c) Show that $p = \dfrac{4\mathrm{e}^{-0.15t} - \mathrm{e}^{-0.3t}}{1 + \mathrm{e}^{-0.3t}}$.

(d) Describe the long term impact of the disease on the population, justifying your answer.

Applied questions – mechanics

6 A particle of mass 3 kg is moving on a smooth horizontal surface. At time $t = 0$, the particle passes through the point A and is moving at a constant speed of 15 m/s. After 8 s, the surface becomes rough and the particle is subject to a constant frictional force of magnitude 18 N. The particle subsequently comes to rest at the point B on the surface.

(i) Find the total time taken for the particle to come to rest.

(ii) Find the distance between the points A and B.

Applied questions – statistics

7 Edward is investigating daily mean temperature, t °C, from the large data set.

He looks specifically at the data from 1987 Cambourne.

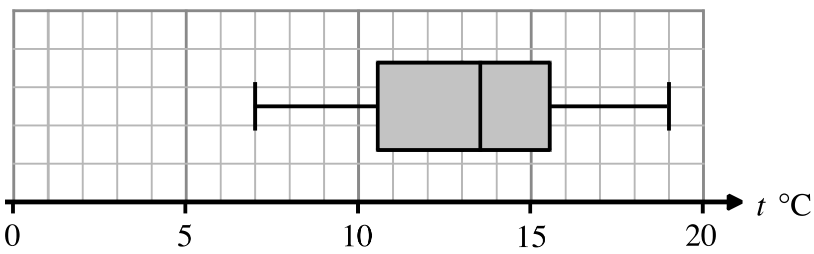
To obtain a sample of the data, he selects the first value using a random number from 1 and 4 and then selects every third value after that until he has a sample of size 12.

(a) State the sampling technique used by Edward.

Clare states that,

"Edward's sampling method may not always lead to a size 12 because there are gaps in the data set."

(b) Explain why Clare's comment is not relevant for Edward's investigation.



Edward now uses **all** of the data from 1987 Cambourne in the large data set to investigate daily mean temperature.

The data is summarised in the box plot above.

(c) Determine the median and interquartile range of Edward's results.

In 1987, the lowest recorded daily mean temperature in Cambourne was about –9 °C.
This is inconsistent with Edward's box plot which has minimum temperature at 7 °C.

(d) Using your knowledge of the large data set, suggest a reason for this inconsistency.