For the final ten days leading up to the first AS Maths exam paper (8MA0/01 for Edexcel), we will publish four exam questions. Three of the questions will focus on the Pure Mathematics content, and one of the questions will focus on Mechanics content. There will be no questions on Statistics content. The three questions will vary in difficulty, but they will usually increase in difficulty. You may use a calculator for any of the questions and solutions are provided at the end of the document.

1 The function f is defined such that

$$f(x) = 3x^3 - 19x^2 + 22x + 24$$

(a) Show that $(x - 3)$ is a factor of $f(x)$.

(b) Find the roots of the equation $f(x) = 0$.

(c) Sketch the curve with equation $y = f(x)$.

2 The line l_1 passes through the points $(3, 6)$ and $(-4, 10)$.

(a) Find the equation of the line l_1. Give your answer in the form $y = mx + c$.

The line l_2 is perpendicular to l_1 and passes through the point $(1, k)$.

The point A is where l_2 crosses the x-axis. The point B is where l_2 crosses the y-axis.

(b) Find, in terms of k,

   (i) the equation of the line l_2,

   (ii) the coordinates of the point A,

   (iii) the coordinates of the point B.

Given that the area of the triangle OAB, where O is the origin, is $\frac{1}{14}$ units^2,

(c) find possible values of k.

3 A closed rectangular box has dimensions x cm, x cm and $(2y + 1)$ cm.

The total surface area of the box is 130 cm^2.

(a) Find an expression for the volume of the box, V cm^3, in terms of x only.

(b) Use calculus to find the maximum volume of the box.

4 A ball is released from rest at a point P, which is 20 m above the ground.

The ball falls vertically towards the ground under the influence of gravity.

(a) Calculate the speed of the ball at the instant it hits the ground.

When the ball hits the ground, it rebounds and bounces off the ground.

The ball bounces off the ground with a speed that is 30% of the speed it hit the ground.

(b) Show that the rebound speed of the ball is about 5.9 m s^{-1}.

(c) Calculate the **total** time taken for the ball to hit the ground a second time after being relased from P.

END OF WORKSHEET