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 on a separate document.

1　Find the maximum value of the function $f(x) = \dfrac{2}{\sqrt{x^3}} - \dfrac{1}{x^3}$ for $x > 0$.

2　The number of individuals in a population, N individuals, at time t weeks after an outbreak is given by $N = 120\,e^{-0.9t} + e^{2t}$.

(a) Find the number of individuals in the population before the outbreak.

Given that $\dfrac{dN}{dt} = 2\,e^{2t} - 108\,e^{-0.9t}$,

(b) solve the equation $\dfrac{dN}{dt} = 0$. Give your answer as an exact value.

(c) Hence, write down the range of values of t for which N is decreasing.

(d) Criticise the model with reference to its long term behaviour.

3　Are the following statements true or false? If it is true, prove it, and if it is false, give a counterexample.

(a) The sum of any two rational numbers is always rational.

(b) The product of any two rational numbers is always rational.

(c) The sum of any two irrational numbers is always irrational.

(d) The product of any two irrational numbers is always irrational.

4 [In this question, **i** and **j** are perpendicular unit vectors directed due east and due north respectively.]

The particle P has mass 2 kg and is set into motion with an initial velocity of $(6\mathbf{i} + 4\mathbf{j})$ m s^{-1}. The particle moves under the influence of a constant force **F** N where $\mathbf{F} = 12\mathbf{i} - 8\mathbf{j}$.

(a) Find the magnitude and direction of the acceleration of P. Give your direction as a bearing.

(b) Find the speed of the particle P three seconds from being set into motion.

END OF WORKSHEET