

Question 17**(15 marks)**

A microbiologist is studying the effect of temperature on the growth of a certain type of bacteria under controlled laboratory conditions. A population of bacteria is incubated at a temperature of 30°C and the size of the population measured at hourly intervals for six hours. The logarithm of the population size appears to lie on a straight line when plotted against time (measured in hours) and the line of best fit shown on the axes below.



- (a) (i) On the basis of the graph above, what is the size of the bacteria population after two hours? (2 marks)
- (ii) The equation of the line can be written in the form $\log_{10}(P) = At + B$. Use the graph to determine the values of A and B . (2 marks)

Another population of the same bacteria is cultured at 40 °C. The size of the population, P , after t hours satisfies the equation

$$\log_{10}(P) = \frac{1}{3}t + 2.$$

- (b) (i) Express the above equation in the form $P = A(10)^{Bt}$. (3 marks)
- (ii) Determine the size of the population after exactly four hours to the nearest whole number. (1 mark)
- (iii) Express the above equation in the form $t = C \log_{10} \left(\frac{P}{D} \right)$. (3 marks)
- (iv) How many minutes does it take for the population to reach a size of 5000? Give your answer to the nearest minute. (2 marks)

- (c) With reference to parts (a) and (b), describe the effect of temperature on the population growth of this type of bacteria. (2 marks)