Question 9 (55 marks)

The number of bacteria in the early stages of a growing colony of bacteria can be approximated using the function:

$$N(t) = 450e^{0.065t}$$

where t is the time, measured in hours, since the colony started to grow, and $N(t)$ is the number of bacteria in the colony at time t.

(a) **(i)** Find the number of bacteria in the colony after 4·5 hours.
Give your answer correct to the nearest whole number.

(ii) Find the time, in **hours**, that it takes the colony to grow to 790 bacteria.
Give your answer correct to 1 decimal place.

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(b) Using the function $N(t) = 450e^{0 \cdot 065t}$, find the average number of bacteria in the colony during the period from $t = 3$ to $t = 12$.
Give your answer correct to the nearest whole number.

(c) Find the rate at which $N(t) = 450e^{0 \cdot 065t}$ is changing when $t = 12$.
Give your answer correct to one decimal place.
Interpret this value in the context of the question.

Rate:

Interpretation:

(d) After k hours, the rate of increase of $N(t)$ is greater than 90 bacteria per hour.
Find the least value of k, where $k \in \mathbb{N}$.
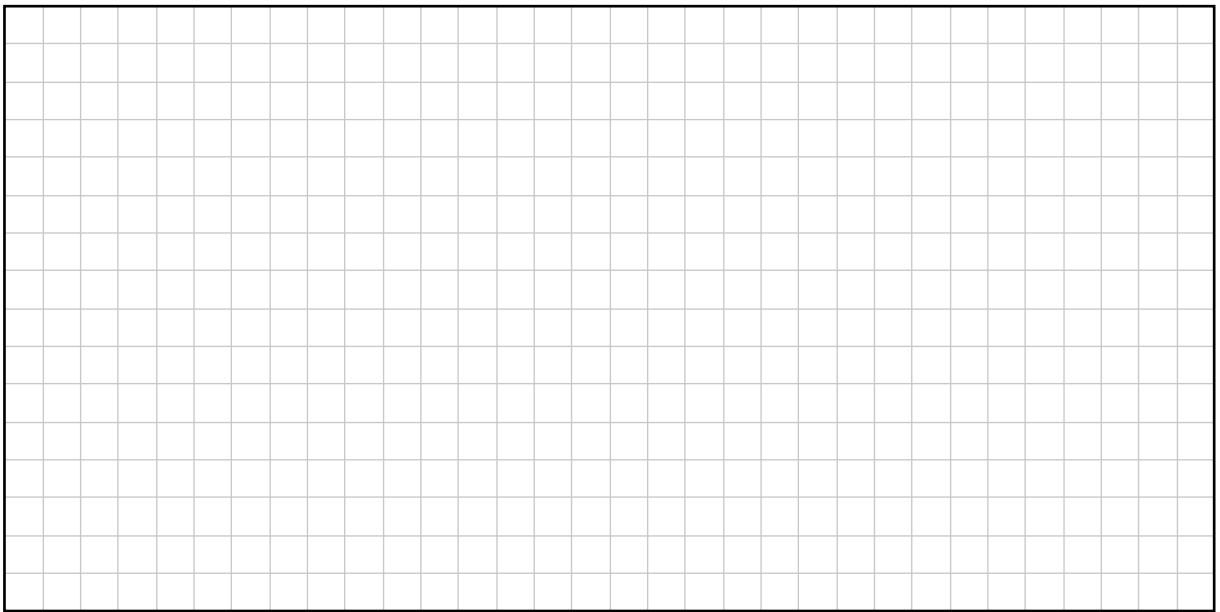
(e) The number of bacteria in the early stages of a **different** colony of bacteria can be
approximated using the function:

$$P(t) = 220e^{0 \cdot 17t}$$

where $P(t)$ is the number of bacteria and t is measured in hours.
Assume that both colonies start growing at the same time.
Find the time, to the nearest hour, at which the number of bacteria in both colonies will be
equal.