Advanced Higher Maths
SQA 2024 Paper 2
Question 15

Advanced Higher Maths
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A storage tank contains a mixture of salt and water. An additional amount of salt and water pours in while, at the same time, some of the existing mixture pours out.

The process can be modelled by the differential equation

$$\frac{dW}{dt} = \frac{36 - W}{120}, \; W < 36$$

where W is the amount of salt in kilograms at time t minutes.

Initially, the storage tank contains 8 kilograms of salt.

(a) Express W in terms of t. **5**

(b) Find the rate at which the amount of salt is increasing after 67 minutes. **2**

As the process continues, the amount of salt approaches a limit L kilograms.

(c) Find the value of L, justifying your answer. **1**

Answers:

(a) $W = 36 - 28e^{-\frac{1}{120}t}$

(b) $\frac{7}{30}e^{-\frac{67}{120}}$ (kilograms per minute)

(c) $L = 36$ AND

$e^{-\frac{1}{120}t} \to 0$ as $t \to \infty$

(or $28e^{-\frac{1}{120}t} \to 0$ as $t \to \infty$)