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JC MATHEMATICS (H2) STUDY TIPS

**FOLLOW THIS APPROACH THAT
COULD POSSIBLY HELP YOU SET
UP MOST OF THE DIFFERENTIAL
EQUATIONS**

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www.h2maths.com

JC_H2Maths_010



$$5/\text{min} \rightarrow \boxed{n} \rightarrow 3/\text{min} \quad \frac{dn}{dt} = 5 - 3$$

↑ ↓

7. Formulating a Differential Equation from a Problem Situation

In general, the required differential equation involves rate of change, which is controlled by two components as shown below.

$$\text{Rate of Change} = \text{Rate of } \uparrow - \text{Rate of } \downarrow$$

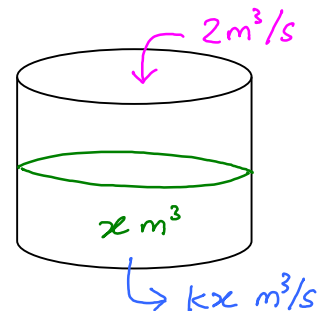
Let's look at how we apply this concept in the following case studies.

Case Study 1

The diagram below shows a cylindrical tank, containing water with volume $x \text{ m}^3$ at time t seconds. Water is flowing into the tank at a constant rate $2 \text{ m}^3 \text{ s}^{-1}$ and leaking out at a rate proportional to the volume of water inside the tank. Form a differential equation based on the given information.

$$\frac{dx}{dt} = 2 - kx$$

↑ ↓



Case Study 2

The number of fish at time t weeks inside a pond is denoted by x (in thousands). It is known that the rate of birth per week is three times of x and the rate of death per week is inversely proportional to x^2 . Form a differential equation based on the given information.

$$\frac{dx}{dt} = 3x - \frac{k}{x^2}$$

↑ ↓

Example 14 : Case Study 3

At time t minutes, the temperature, $x^\circ\text{C}$ of an object decreases at a rate proportional to the difference of its temperature and the room temperature. It is assumed that the room temperature is fixed at 25°C . Form a differential equation based on the given information.

$$\frac{dx}{dt} = 0 - k(x - 25), \quad k > 0$$

↑ ↓



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Explanation

When turning a real-life story into a differential equation, it is very common to look at it as a simple balancing act between gains and losses.

The ultimate tip here is that every such scenario simply measures how a quantity changes over time. To master this technique, you just need to identify the rate of increase and the rate of decrease and then perform a subtraction as shown.

Keep a close eye out for text clues that reveal whether these changes happen at a constant rate or if they depend directly on the current size of what you are measuring.

Double-check this self-built result before solving it, as a huge loss of marks might occur if there are too many discrepancies.

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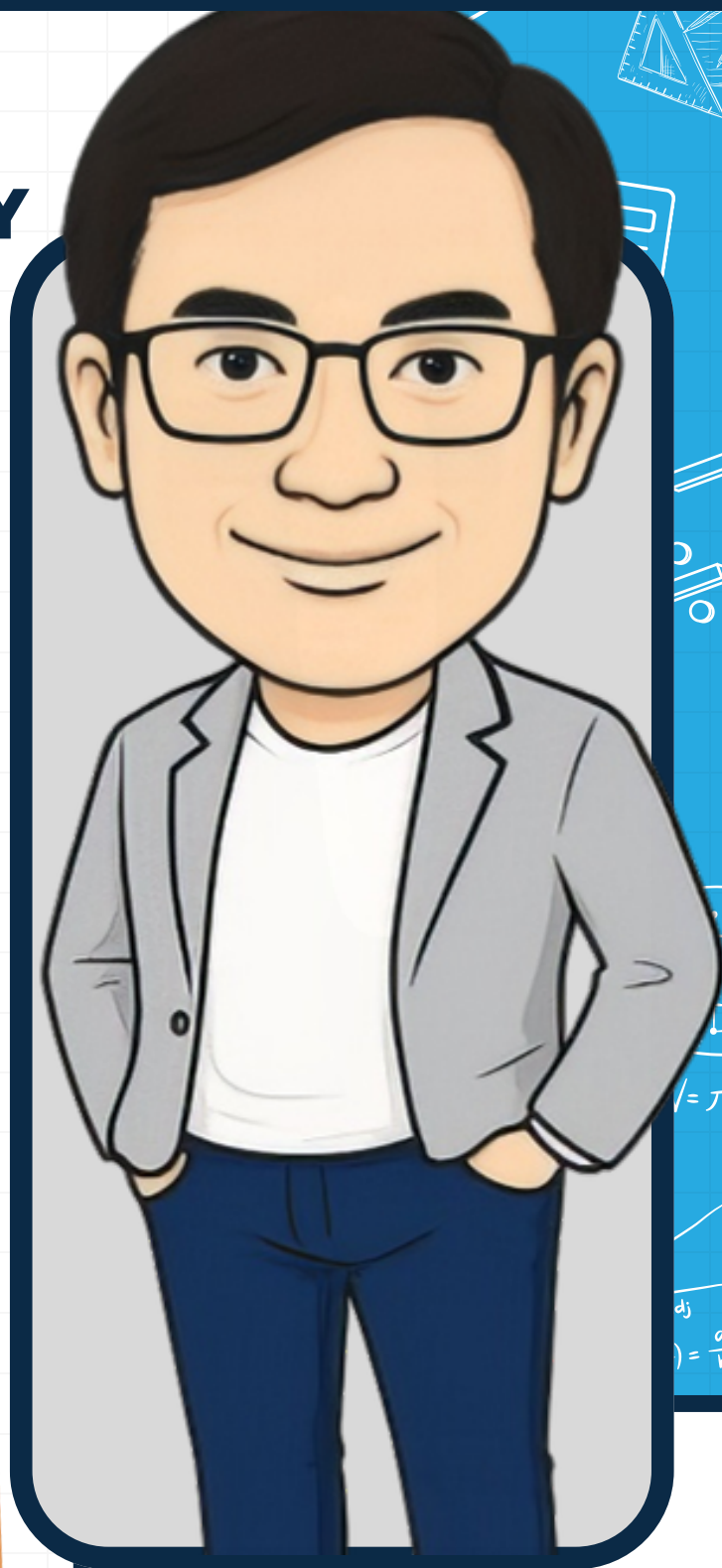
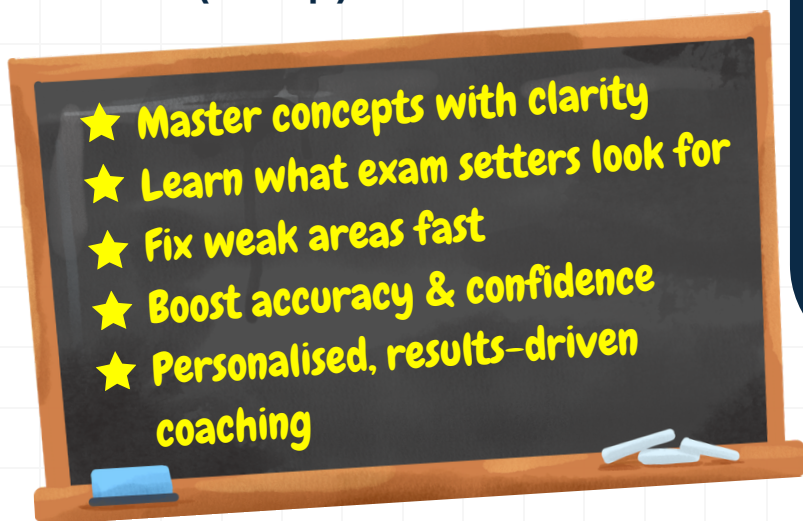
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