Dimensional analysis – AS Further Mathematics Mechanics

1. June/2022/Paper_7366/02/No.4

Wavelength is defined as the distance from the highest point on one wave to the highest point on the next wave.

Surfers classify waves into one of several types related to their wavelengths.

Two of these classifications are deep water waves and shallow water waves.

(a) The wavelength w of a deep water wave is given by

$$w = \frac{gt^2}{k}$$

where g is the acceleration due to gravity and t is the time period between consecutive waves.

Given that the formula for a deep water wave is dimensionally consistent, show that k is a dimensionless constant.

[2 marks]

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(b) The wavelength w of a shallow water wave is given by

$$w = (gd)^\alpha t^\beta$$

where g is the acceleration due to gravity, d is the depth of water and t is the time period between consecutive waves.

Use dimensional analysis to find the values of α and β

[3 marks]

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