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IB Maths Made Simple

Maths Studies Mini Topic Exams

Mathematical Models

Recommended time: 40 minutes

Worked solutions & video tutorials to these exam questions can be found at:
https://www.revisionvillage.com/mini-topic-exams-studies-mathematical-models

Question 1

[Maximum mark: 6]

A structural column of a building is in the shape of a cylinder with radius r m and height h m. The curved surface area of the column is 5 m^2.

(a) Write down an equation in terms of r and h to describe this information. [2]

(b) The height h of the column is equal to its diameter. Calculate the value of r. [4]

Question 2

[Maximum mark: 6]

Atmospheric pressure, P, in kPa, decreases exponentially with increasing height above sea level, h. The atmospheric pressure can be modelled by the function

$$P(h) = 101 \times \left(\frac{25}{22}\right)^{-h},$$

where h is the height above sea level in kilometres.

(a) Write down the exact atmospheric pressure at sea level, in kPa. [1]

Mount Kosciuszko is the highest mountain in Australia with a height of 2228 metres above sea level at the top.

(b) Calculate the atmospheric pressure at the top of the Mount Kosciuszko. [2]

(c) Calculate the height where the atmospheric pressure is equal to 10 kPa. [3]

Question 3

[Maximum mark: 13]

A cannon-ball is fired from the top of a tower. The height, h, in metres, of the cannon-ball above the ground is modelled by the function:

$$h(t) = -2t^2 + 20t + 8, t \geq 0,$$

where t is the time, in seconds, since the moment the cannon-ball was fired.

(a) Write down the height of the tower. [1]

(b) Calculate the height of the cannon-ball 5 seconds after it was fired. [2]

The cannon-ball hits its target on the ground n seconds after it was fired.

(c) Find the value of n. [2]

(d) Find $h'(t)$. [2]

(e) Calculate the maximum height reached by the cannon-ball, and write down the corresponding time t. [3]

(f) Determine the total time the cannon-ball was above the height of the tower. [3]