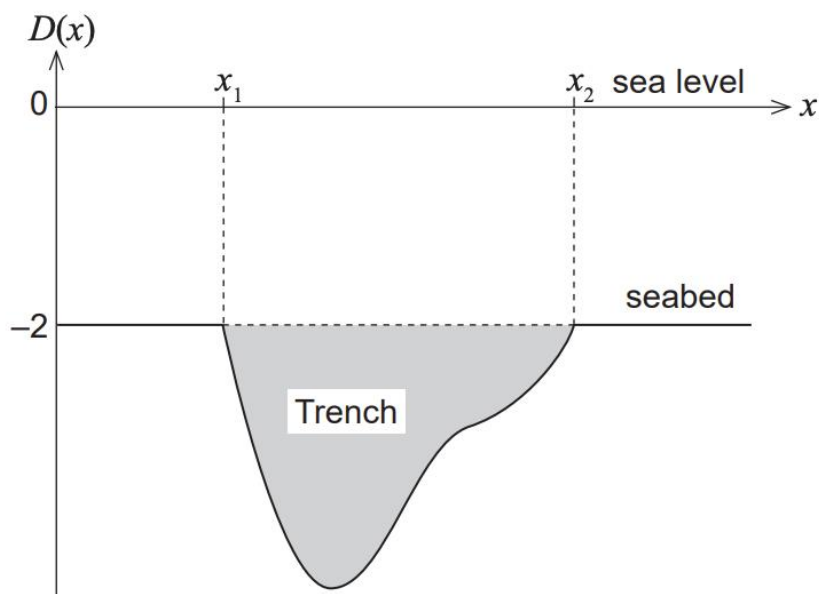


Question 7**(10 marks)**

A team of oceanographers surveyed the depth of the ocean in a region populated by a particular endangered fish species. They discovered a large trench extending below the otherwise flat seabed as shown in the figure below.



The displacement, in kilometres, from sea level to the ocean floor is given by

$$D(x) = \begin{cases} (x-4)^2 + \cos(2x-3\pi) - 5, & x_1 \leq x \leq x_2 \\ -2, & \text{otherwise} \end{cases}$$

where x (measured in kilometres) is the east–west horizontal displacement relative to a reference marker at sea level.

(a) With reference to the figure above:

(i) determine the values of x_1 and x_2 . (2 marks)

(ii) use calculus to determine the cross-sectional area of the trench shaded in the figure above. (3 marks)

(b) Using calculus, determine the maximum distance of the trench below sea level. (5 marks)