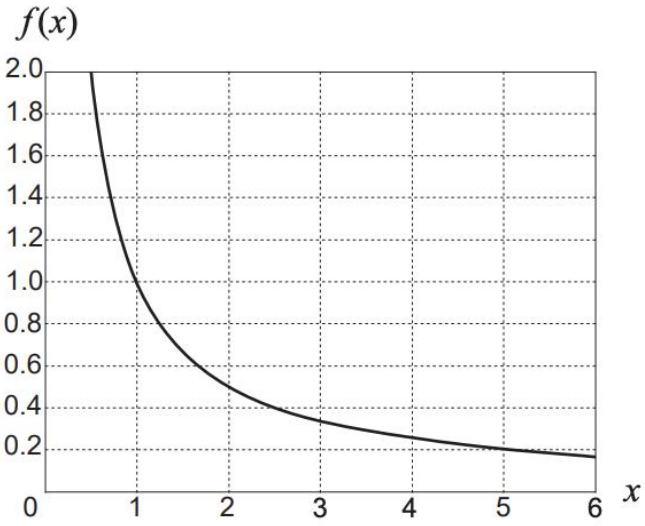
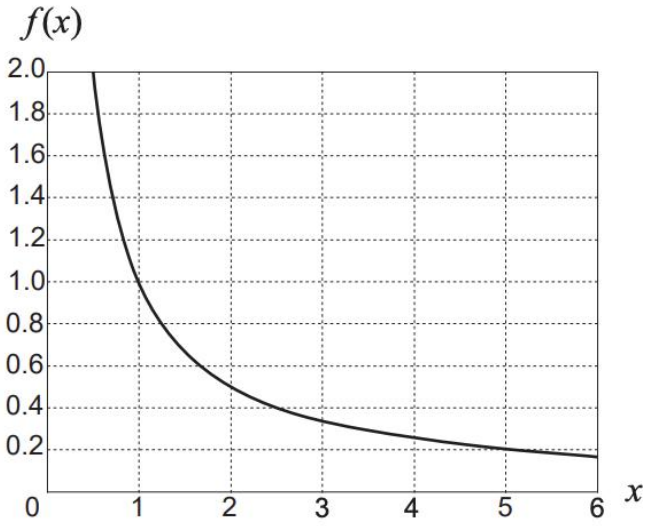
Question 7 **(9 marks)**

(a) Consider the function $f(x) = \frac{1}{x}$, graphed twice below.





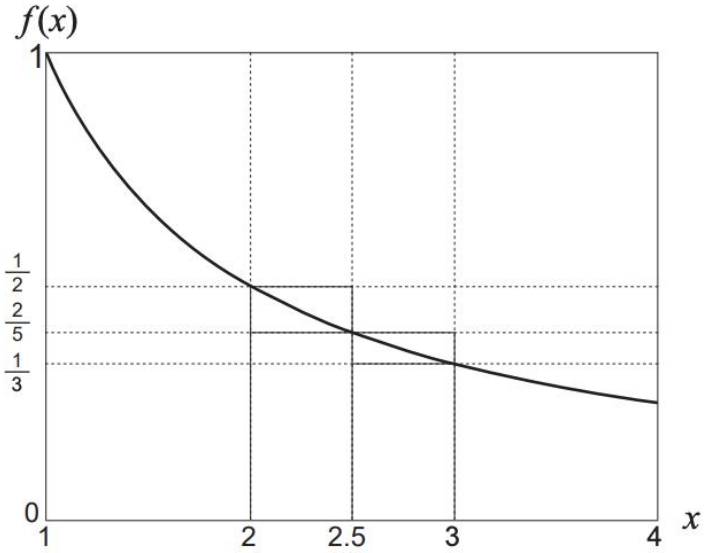
(i) Shade **two** different regions (one on each graph above) each with area exactly $\ln(2)$. (2 marks)

(ii) Given that

$$\int_a^b \frac{1}{x}\,dx = \ln(3)$$

what is the relationship between a and b? (2 marks)

(b) Another graph of $f(x) = \frac{1}{x}$ is shown below.



(i) By considering the areas of the rectangles shown, demonstrate and explain why

$$\frac{11}{30} < \int_2^3 \frac{1}{x}\,dx < \frac{9}{20}.$$

(3 marks)

(ii) Hence show that $\frac{11}{30} < \ln(1.5) < \frac{9}{20}$.

(2 marks)