

1. $f(x) = x^3 + ax^2 + bx - 10$, where a and b are constants.

When $f(x)$ is divided by $(x - 3)$, the remainder is 14.

When $f(x)$ is divided by $(x + 1)$, the remainder is -18 .

- (a) Find the value of a and the value of b . **(5 marks)**
- (b) Show that $(x - 2)$ is a factor of $f(x)$. **(2 marks)**
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2. (a) Write down the first four terms of the binomial expansion, in ascending powers of x , of $(1 + ax)^n$, where $n > 2$. **(2 marks)**

Given that, in this expansion, the coefficient of x is 8 and the coefficient of x^2 is 30,

- (b) find the value of n and the value of a , **(4 marks)**
- (c) find the coefficient of x^3 . **(2 marks)**
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3. A population of deer is introduced into a park. The population P at t years after the deer have been introduced is modelled by

$$P = \frac{2000a^t}{4 + a^t},$$

where a is a constant. Given that there are 800 deer in the park after 6 years,

- (a) calculate, to 4 decimal places, the value of a , **(4 marks)**
- (b) use the model to predict the number of years needed for the population of deer to increase from 800 to 1800. **(4 marks)**
- (c) With reference to this model, give a reason why the population of deer cannot exceed 2000. **(1 marks)**
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4. Given that $f(x) = (2x^{\frac{3}{2}} - 3x^{-\frac{3}{2}})^2 + 5$, $x > 0$,

- (a) find, to 3 significant figures, the value of x for which $f(x) = 5$. **(3 marks)**
- (b) Show that $f(x)$ may be written in the form $Ax^3 + \frac{B}{x^3} + C$, where A , B and C are constants to be found. **(3 marks)**

- (c) Hence evaluate $\int_1^2 f(x) \, dx$. **(5 marks)**
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5.

Figure 1

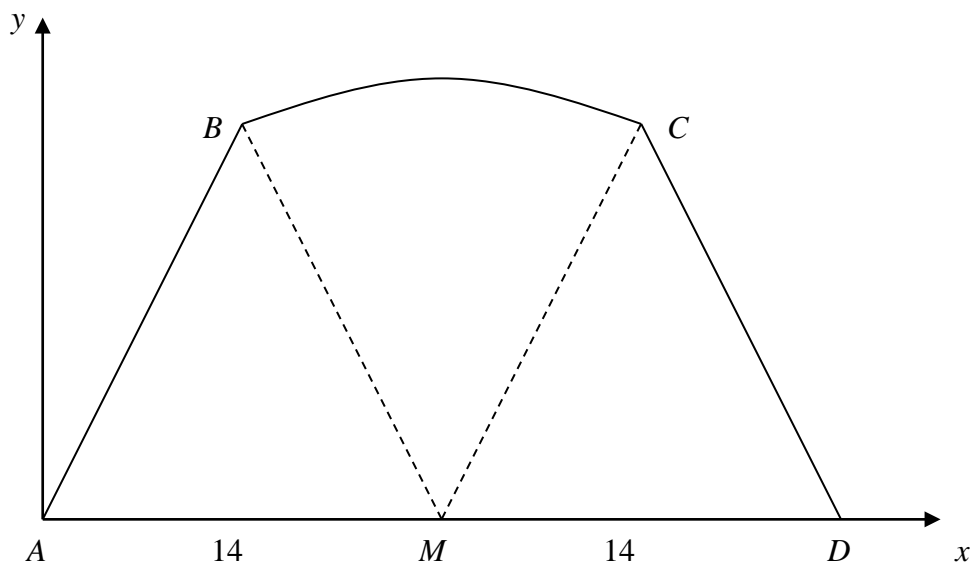


Figure 1 shows the cross-section $ABCD$ of a chocolate bar, where AB , CD and AD are straight lines and M is the mid-point of AD . The length AD is 28 mm, and BC is an arc of a circle with centre M .

Taking A as the origin, B , C and D have coordinates $(7, 24)$, $(21, 24)$ and $(28, 0)$ respectively.

- (a) Show that the length of BM is 25 mm. **(1 marks)**
- (b) Show that, to 3 significant figures, $\angle BMC = 0.568$ radians. **(3 marks)**
- (c) Hence calculate, in mm^2 , the area of the cross-section of the chocolate bar. **(5 marks)**

Given that this chocolate bar has length 85 mm,

- (d) calculate, to the nearest cm^3 , the volume of the bar. **(2 marks)**
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6.

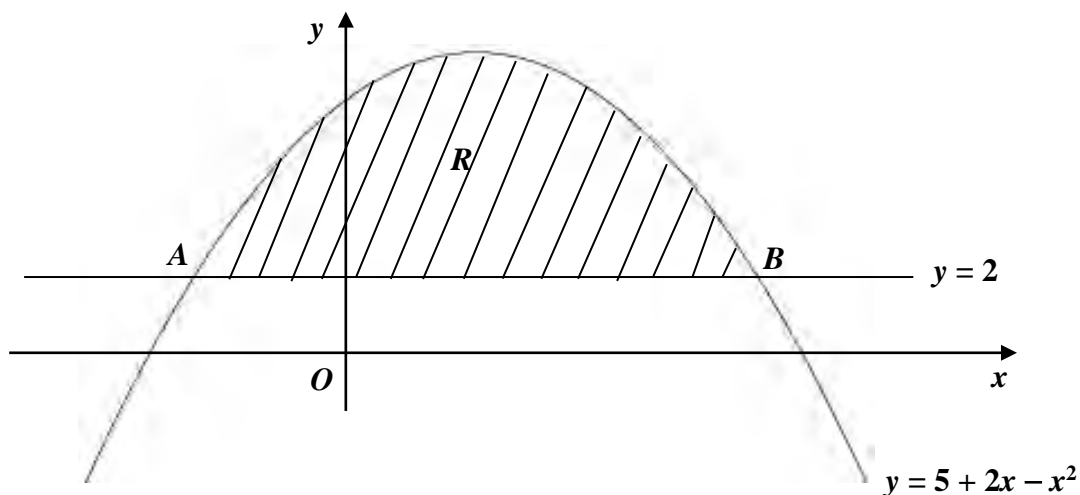


Fig. 1

Figure 1 shows the curve with equation $y = 5 + 2x - x^2$ and the line with equation $y = 2$. The curve and the line intersect at the points A and B .

(a) Find the x-coordinates of A and B . (3 marks)

The shaded region R is bounded by the curve and the line.

(b) Find the area of R . (6 marks)

7. Find all the values of θ in the interval $0 \leq \theta < 360^\circ$ for which

(a) $\cos(\theta - 10^\circ) = \cos 15^\circ$, (3 marks)

(b) $\tan 2\theta = 0.4$, (5 marks)

(c) $2 \sin \theta \tan \theta = 3$. (6 marks)

END