

Springburn Academy : Mathematics Department

Higher Mathematics : Lesson Starters

Block 3 (Applications of Differentiation 1)

Without using a calculator :

Task 1

- 1 If $f(x) = x^3 - 4x + 7$, find $f'(-2)$.
- 2 A curve has equation $y = x^3 - 2x + 5$. What is the gradient of the tangent at the point where $x = 2$?
- 3 What is the gradient of the line perpendicular to the line with equation $2y - 5x = 6$?
- 4 For what value of x does $y = \frac{1}{3}x^3 - 2x^2 + 3x + 7$ have a maximum turning point?

Task 2

- 1 Solve $(x - 3)(x + 4) \geq 0$.
- 2 Calculate the distance between the points A(-1, 7) and B(-9, 13).
- 3 Calculate $\tan \frac{3\pi}{4}$
- 4 Find the values for which $f(x) = \frac{2}{x^2}$ has a positive gradient.

Task 3

- 1 If $f(x) = 3 \cos^2 x$, find an expression for $f'(x)$.
- 2 Given that $\log_3 \frac{1}{27} = p$ find the value of p .
- 3 In triangle ABC the line AD cuts the side BC at the midpoint of BC.
What type of line is AD?
- 4 The volume of a box is given by

$$V(x) = 200x - \frac{4}{3}x^3$$

Calculate the value of x for which this volume is a maximum.

Task 4

- 1 Expand and simplify $2 \sin\left(x + \frac{\pi}{6}\right) - 2 \cos x$.
- 2 If vectors \mathbf{a} and \mathbf{b} are perpendicular what can you say about $\mathbf{a} \cdot \mathbf{b}$?
- 3 Factorise fully $y = 3x^3 - 2x^2 - 19x - 6$
- 4 The weekly profit of a desk manufacturer, $P(x)$ for producing x desks is given by

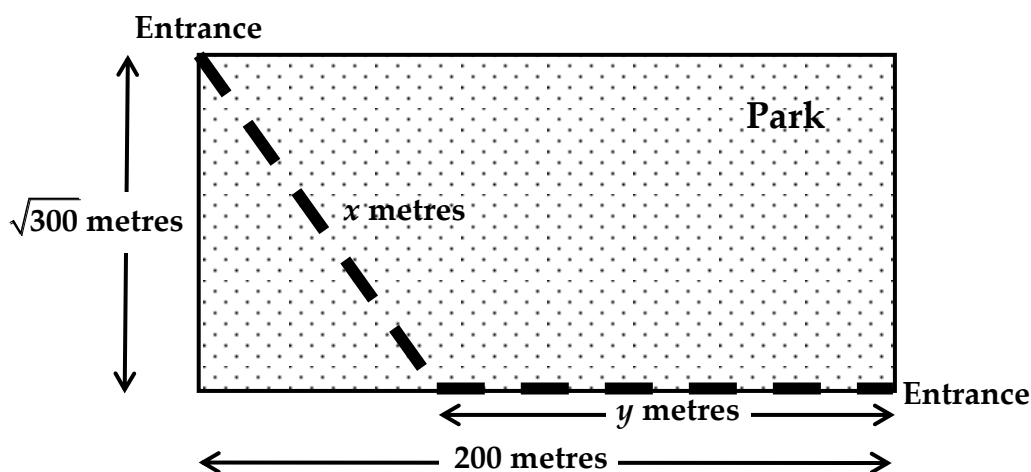
$$P(x) = -x^3 + 6x^2 + 1440x - 800$$

How many desks would the manufacturer have to make each week in order to maximise his profit?

Task 5

A rectangular park measures 200 metres by $\sqrt{300}$ metres.

A path connecting the two entrances, at opposite corners of the park, is to be laid through the park as shown.



The cost per metre of laying the path through the park is twice the cost, per metre, of laying the path along the perimeter.

- (a) Show that the total cost of laying this path can be modelled by

$$C(x) = 2x + 200 - \sqrt{x^2 - 300}$$

- (b) Find the value of x which would minimise the cost of laying the path.