

91262



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Level 2 Mathematics and Statistics 2022

91262 Apply calculus methods in solving problems

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Apply calculus methods in solving problems.	Apply calculus methods, using relational thinking, in solving problems.	Apply calculus methods, using extended abstract thinking, in solving problems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.


You should attempt ALL the questions in this booklet.

Show ALL working.

Make sure that you have the Formulae Sheet L2–MATHF.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION ONE

- (a) A function f is given by $f(x) = 2x^4 + 4x^3 - 20x^2 - 5$.

Use calculus to find the gradient of the graph of the function at the point where $x = 3$.

- (b) For the function f :

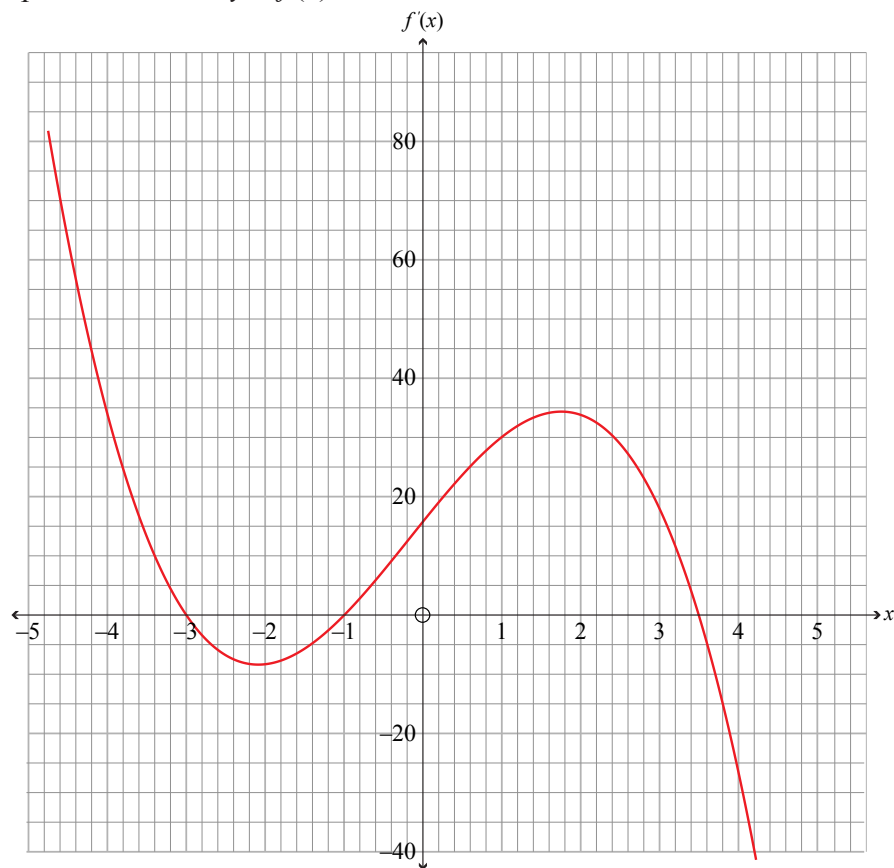
$$f'(x) = 4 - 6x + 2x^2$$

The graph of $f(x)$ passes through the point $(3,4)$.

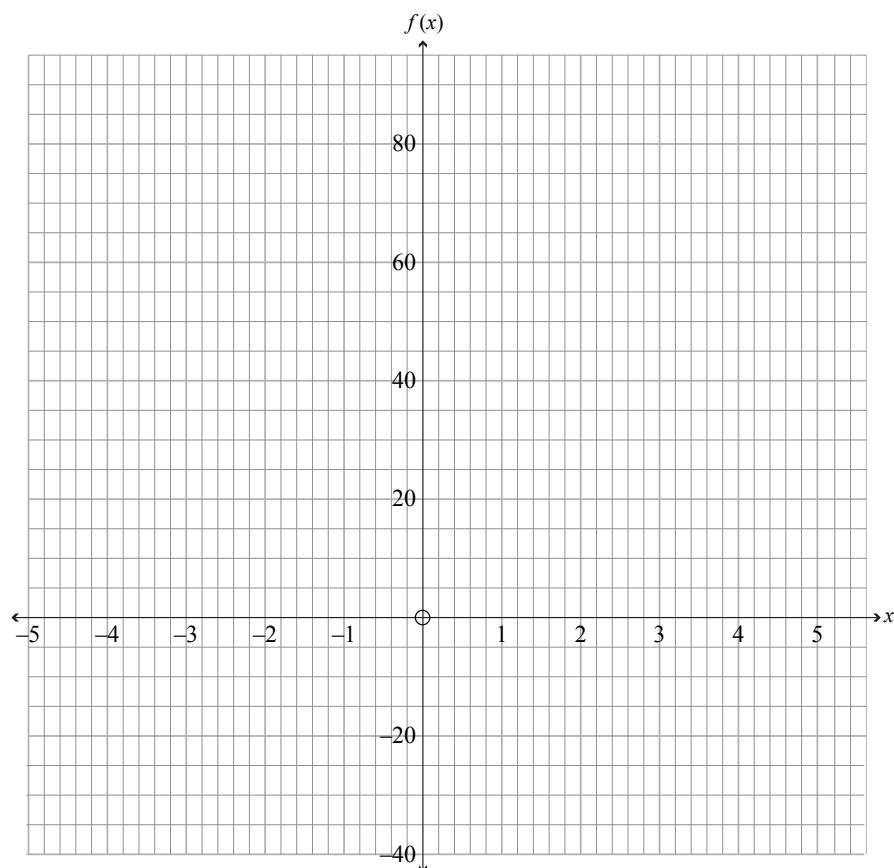
Find the equation of the function f .

QUESTION TWO

- (a) The gradient graph of a function $y = f(x)$ is shown on the axes below.



Sketch a possible graph of the original function $y = f(x)$ on the axes below.

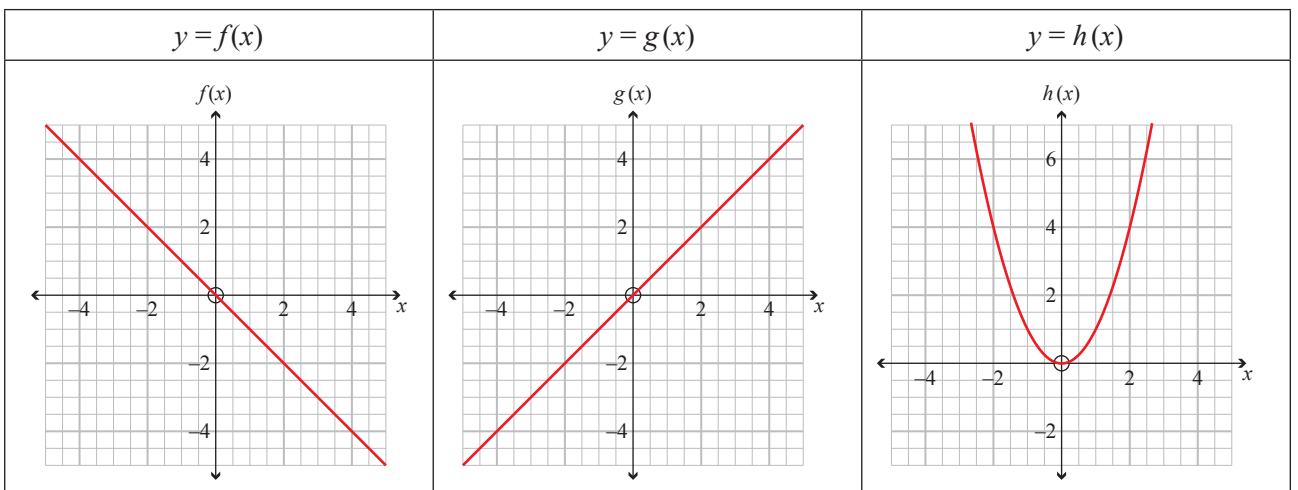


If you need to redraw your graph, use the grid on page 12.

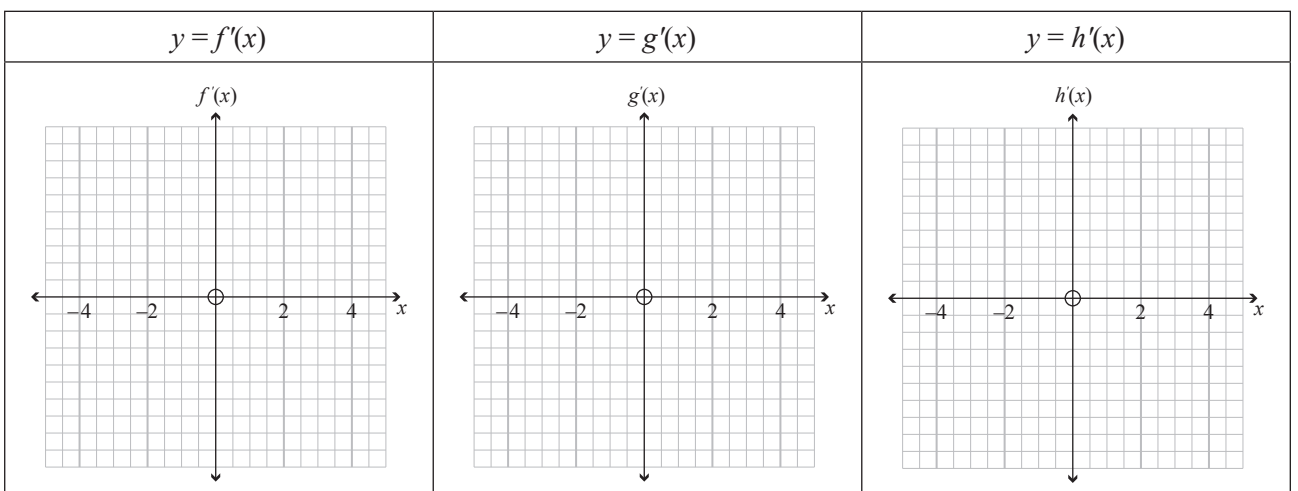
QUESTION THREE

- (a) Find the equation of the tangent of the curve $y = 2x(x - 3)$, where $x = 1$.

- (b) The diagrams below show the graphs for the functions of $y = f(x)$, $y = g(x)$, and $y = h(x)$.

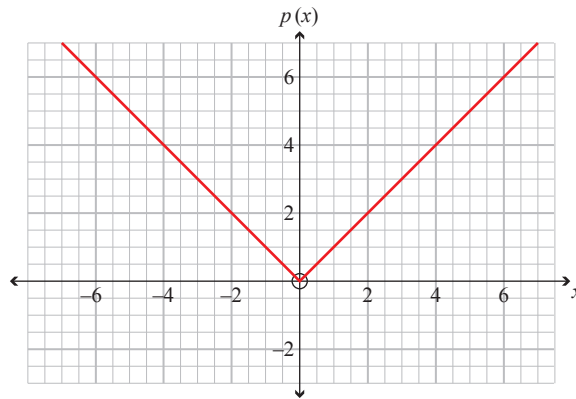


- (i) On the axes below, sketch the graphs of their respective gradient functions.

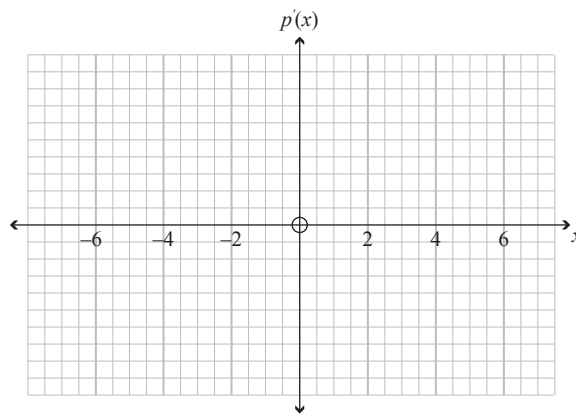


If you need to redraw any of your graphs, use the grids on page 12.

- (ii) The diagram below shows the graph of the function $y = p(x)$.



On the axes below sketch the graph of the gradient function $y = p'(x)$.

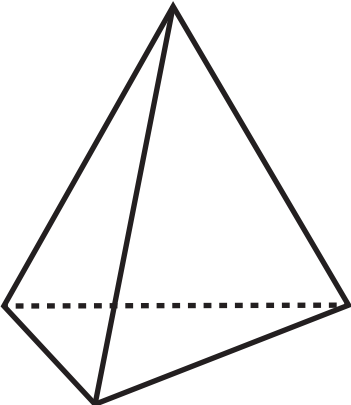
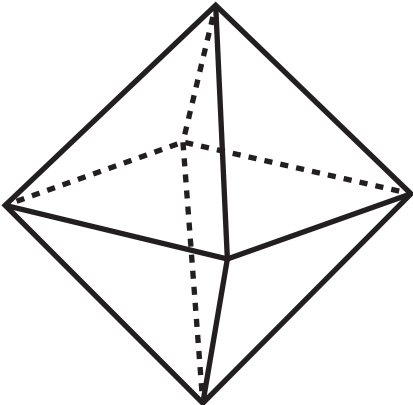


If you need to redraw any of your graphs, use the grid on page 13.

- (iii) Is it true to say that the gradient of the function $p(x)$ is zero when $x = 0$?

Justify your response using the graphs on pages 8 and 9, and/or mathematical reasoning.

- (c) A calculus class is exploring 3-D geometrical art. The students decide that they want to create wireframe models of a tetrahedron and an octahedron, similar to those shown below.

Tetrahedron	Octahedron
	
<p>Surface area = $\sqrt{3}a^2$ where a represents the length of each edge of the tetrahedron</p>	<p>Surface area = $2\sqrt{3}b^2$ where b represents the length of each edge of the octahedron</p>

They will make each edge with a piece of wire, and join each piece together, and then cover each surface with paper to create lanterns similar to those below.



Source: <https://timesofindia.indiatimes.com/city/ahmedabad/20-unique-diy-mathematical-lamps-of-paper-by-ccl-iitgn/>

They wish to create each model so that the total resulting surface area of the two shapes is a minimum.

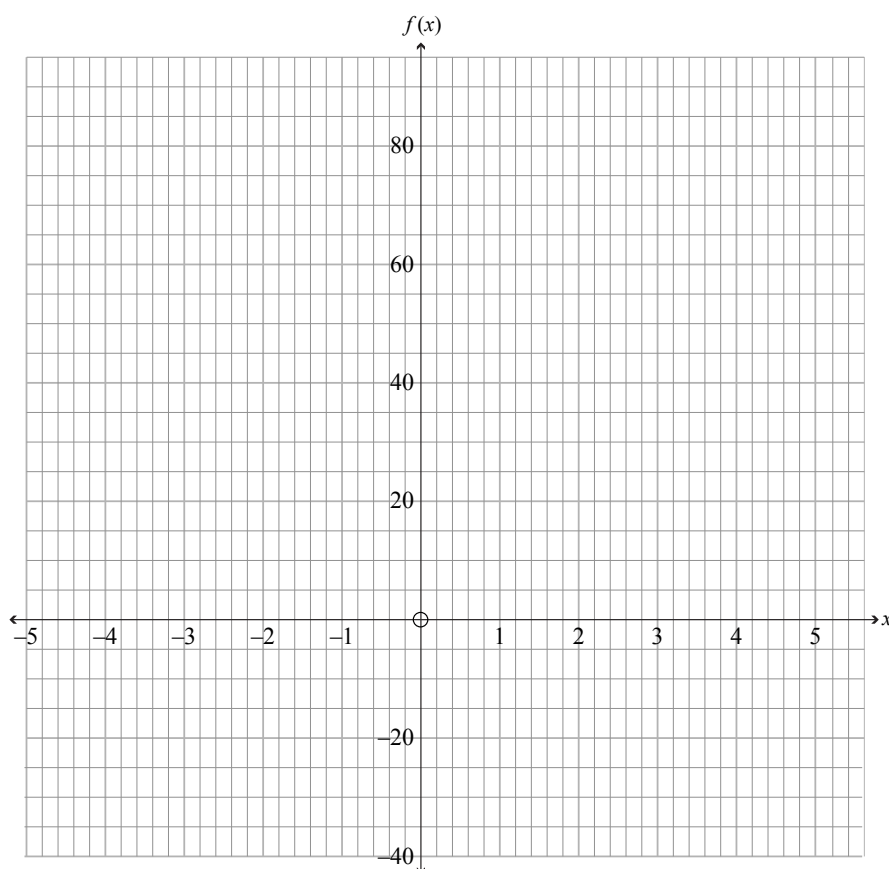
They have a total of 180 cm of wire to cut and use for both models.

Determine the lengths of the edges, a and b , required to minimise the total surface area of the two shapes when all of the wire is used.

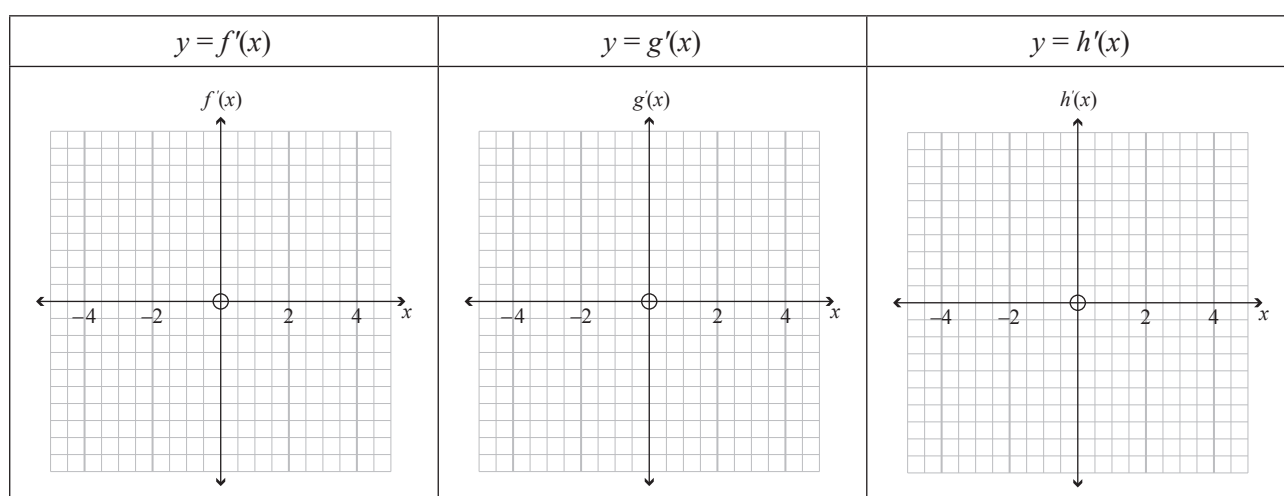
Use calculus to justify that the surface area is a minimum.

SPARE DIAGRAMS

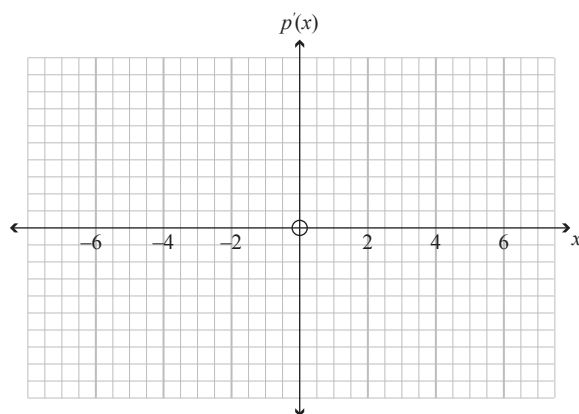
If you need to redraw your response to Question Two (a), use the grid below. Make sure it is clear which answer you want marked.



If you need to redraw any of your responses to Question Three (b)(i), use the grids below. Make sure it is clear which answers you want marked.



If you need to redraw your response to Question Three (b)(ii), use the grid below. Make sure it is clear which answer you want marked.



**Extra space if required.
Write the question number(s) if applicable.**

QUESTION
NUMBER

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