SUPERVISOR'S USE ONLY

2

91262

912620

Draw a cross through the box (☒) if you have NOT written in this booklet

+

NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Mathematics and Statistics 2026

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.

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

Show ALL working.

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 2–12 in the correct order and that none of these pages is blank.

Do not write in the margins (////). This area will be cut off when the booklet is marked.

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

© New Zealand Qualifications Authority, 2026. All rights reserved.
No part of this publication may be reproduced by any means without the prior permission of the New Zealand Qualifications Authority.

QUESTION ONE

(a) A function f is given by $f(x) = 2x^3 + 4x^2 - 4x + \frac{1}{2}$.

Find the gradient of the curve when $x = 3$.

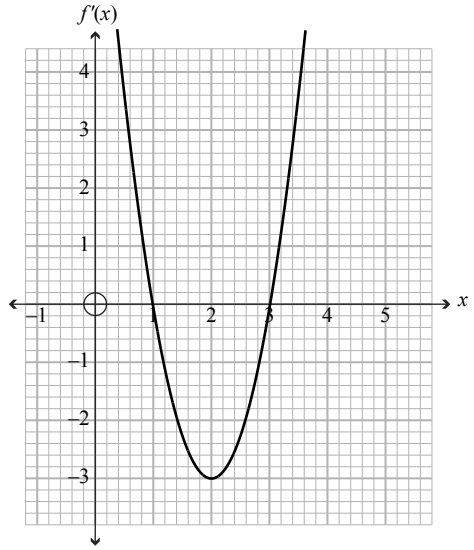
(b) Find the function whose gradient function is $f'(x) = 6x^2 - 4x + 5$, and which passes through the point (–1,2).

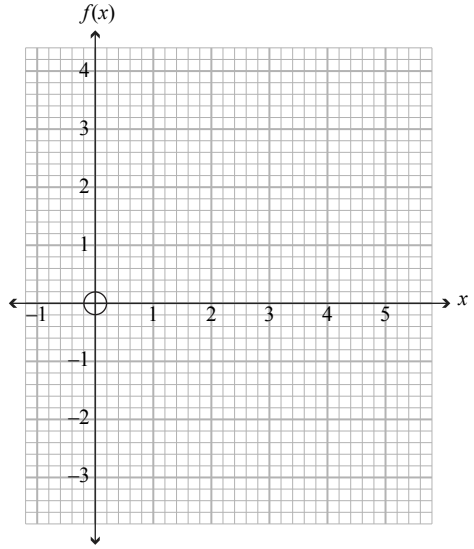
(c) Kate is riding a bike down a straight road. Her displacement, in metres, from her starting point, at a given time t, in seconds, is modelled by the function $S(t) = t^3 - 9t^2 + 15t$.

Kate begins by moving to the right, and during her ride, she changes direction twice.

Using calculus, calculate the total distance travelled by Kate between the two changes in direction.

(d) The gradient function of a curve f is drawn below and is given by the equation $f'(x) = 3(x-1)(x-3)$.





If you need to redraw your response, use the graph on page 10.

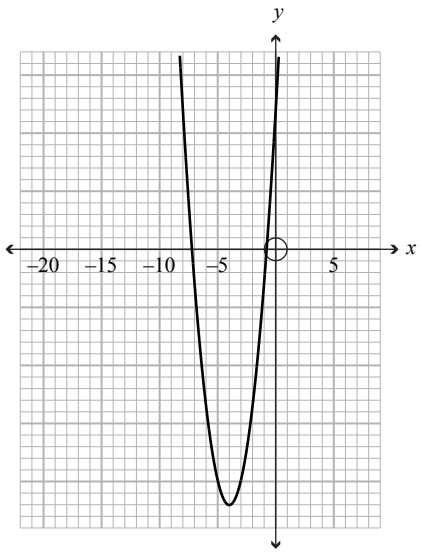
Draw the original curve $f(x)$ if the curve passes through **(2,0)**, making sure to label all stationary points.

QUESTION TWO

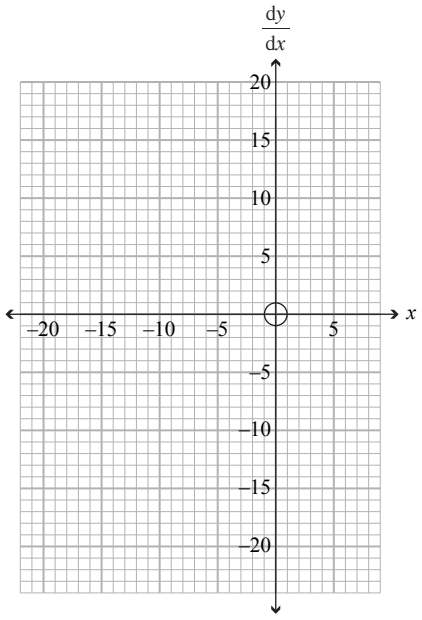
(a) A function f is given by $f(x) = 7x - \frac{x^2}{2} + 3$.

Find the **coordinate point** where this function has a gradient of –2.

(b) The graph of $y = 2x^2 + 16x + a$ is drawn below, where a is a constant.



Draw the gradient function of the initial graph below, making sure to label the y-intercept.



If you need to redraw your response, use the graph on page 11.

(c) A gardener is monitoring the temperature in a greenhouse from midday ($t = 0$) until 6 p.m. ($t = 6$).

At midday, the automated cooling system turns on to cool the air in the greenhouse.

The temperature of the greenhouse can be modelled using this formula:

$$T(t) = \frac{-t^4}{8} + t^3 - 2t^2 + 25,$$

where T is the temperature in degrees Celsius (°C) and t is the time in hours since midday.

(i) Show that at 1 p.m., the rate of change of temperature is –1.50 °C / hour.

(ii) Between what times of the day, has the cooling system turned off?

(d) *NZkits* produces two types of modular houses: the Kiwi model and the Pūkeko model.

Let x represent the number of Kiwi models made.

Let y represent the number of Pūkeko models made.

The company must make a total of 154 units each month.

The cost (C) of each model, in thousands of dollars, are:

Kiwi model: $C_k = x^3 - x^2$

Pūkeko model: $C_p = y^2 - 200y$

Using calculus, find the number of each unit that *NZkits* should produce to minimise their total cost in producing both models.

Show that this solution is a minimum.

QUESTION THREE

(a) A function is given by $h(t) = \frac{2t^2}{3} + t - \frac{1}{2}$.

Find the value of t so that the gradient of $h(t)$ is equal to 7.

(b) A function $g(x)$ is given by $g(x) = x^3 + \frac{3x^2}{2} - 18x + 5$.

Find the region(s) where the graph is decreasing.

(c) Louis the dog drops a toy from a jetty into a still body of water, which causes ripples to form that travel out in a circular direction.

(i) Calculate the rate at which the area is changing, with respect to radius, at the instant the radius of the ripple is 0.25 m.

(ii) The surface tension of the water is represented by a constant k. When the rate of change of the ripple's area, with respect to its radius, reaches this constant k, the ripple breaks and stops spreading.

Derive an expression for the area of the ripple, in terms of k, at the instant it reaches this limit.

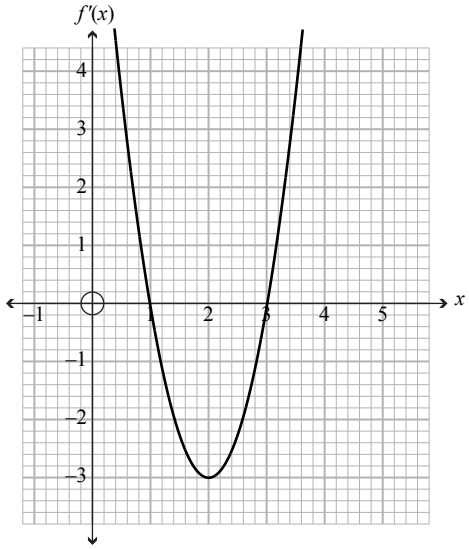
(d) The curve y is defined by the equation $y = x^3 - 4x^2 + kx + 1$, where k is a positive constant.

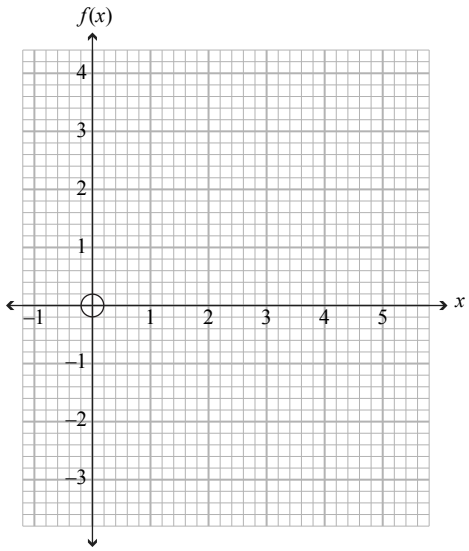
A straight line L is tangent to the curve at the point where $x = 1$. This tangent line L passes through the point (2,1).

Find the value of k and the y-value of the point where the line L crosses the y-axis.

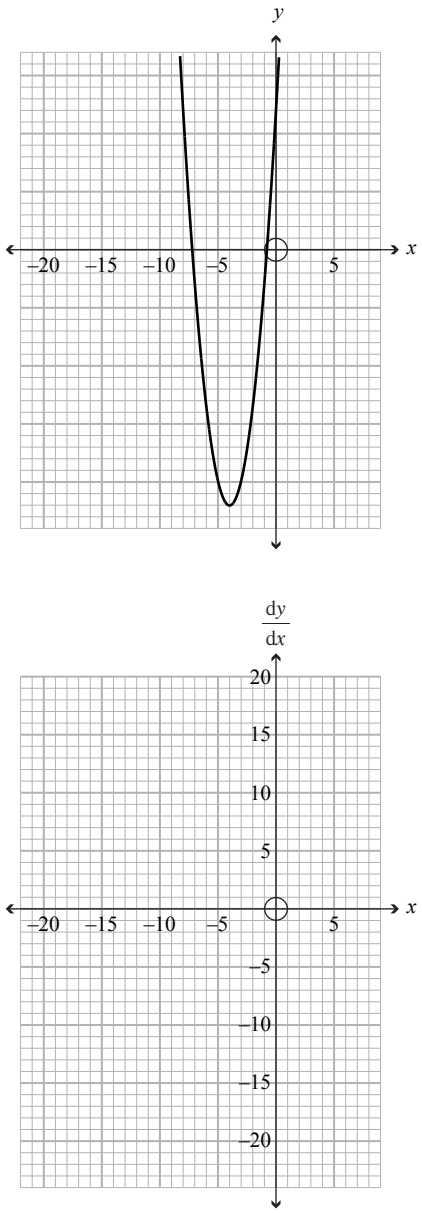
SPARE DIAGRAMS

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





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



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

QUESTION NUMBER