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NZQA

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Level 2 Mathematics and Statistics, 2019

91261 Apply algebraic methods in solving problems

9.30 a.m. Thursday 21 November 2019
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply algebraic methods in solving problems.	Apply algebraic methods, using relational thinking, in solving problems.	Apply algebraic 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 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.

You are required to show algebraic working in this paper. Guess-and-check methods, and correct answer(s) only, will generally limit grades to Achievement.

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

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

TOTAL

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QUESTION ONE

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(a) Solve each of the following equations:

(i) $3x^2 - 6 = 7x$

(ii) $\frac{3}{x^2} + \frac{4}{x} = 5$

(b) A drug is used to reduce the level of cholesterol in the blood. For a daily dose of the drug, the cholesterol level C in the blood t months after taking the first dose may be modelled by the function

$$C = 0.02t^2 - 0.6t + k,$$

where k is the initial cholesterol level and the function is valid for the first 15 months only.

A person with an initial cholesterol level of 9.18 is given the drug.

How long will it take the person's cholesterol level to reduce to 5.05?

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(c) The polynomial $p(x) = (2m - 1)x^2 + (m + 1)x + (m - 4)$ can be written as a **perfect square**.

Find the value(s) of m.

(d) By factorising, find an expression in terms of p for the difference between the roots of the equation $(px)^2 + 4px - 12 = 0$.

(e) Use algebra to show that the graph of the function $y = (x - a)(x - b) - c^2$, where $c \neq 0$, crosses the x-axis at two distinct points.

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QUESTION TWO

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(a) Simplify fully, leaving your answers with positive indices:

(i) $(9a^2b^{-4})^{0.5}$

(ii) $\left(\dfrac{2a}{3b^4}\right)^{-2}$

(b) Write $\dfrac{2c+1}{c^2-9}+\dfrac{c-2}{c^2-4c+3}$ as a single fraction in its simplest form.

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(c) Factorise fully $fm - 6gn + 3fn - 2gm$.

(d) The shape below is divided into rectangles. All measurements are in cm.

This diagram has been corrected from that used in the examination.

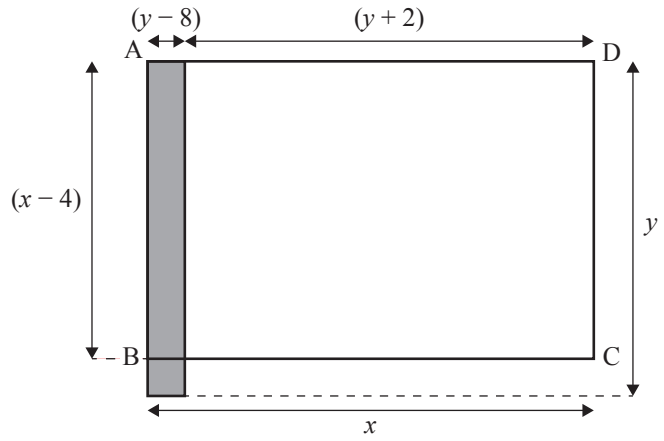

Diagram is NOT to scale

The shaded rectangle has an area of 9 cm^2.

Find the area of the rectangle ABCD.

(e) One root of the equation $x^2 + px + q = 0$ is n times the other, where $n \neq 0$.

Show that $qn^2 + (2q - p^2)n + q = 0$.

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QUESTION THREE

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(a) Find the value of m if $\log_5 m - 3 = 0$

(b) Write as a single logarithm: $\log 6 - 2\log y$

(c) Fully simplify $\dfrac{3^{2n-1} + 3^{2n+1}}{3^{2n} - 9^{n-2}}$

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(d) (i) The number of people N suffering from a contagious virus increases exponentially at a constant rate of 5.3% each week after the virus was initially diagnosed.

If N_0 is the number of people initially diagnosed with the virus, then t weeks after the virus was initially diagnosed, N can be modelled by the function $N = N_0 (1.053)^t$.

How long will it take for the number of people diagnosed with the virus to be three times the number initially diagnosed?

(ii) The number of people N suffering from a different virus also increases exponentially at a constant rate of r % each week. 2500 people were initially diagnosed with this virus. After 10 weeks, the number of people suffering from this virus had increased to 4250.

Find r, assuming the form of model in part (i) still applies.

Question 3 continues on page 10 ➤

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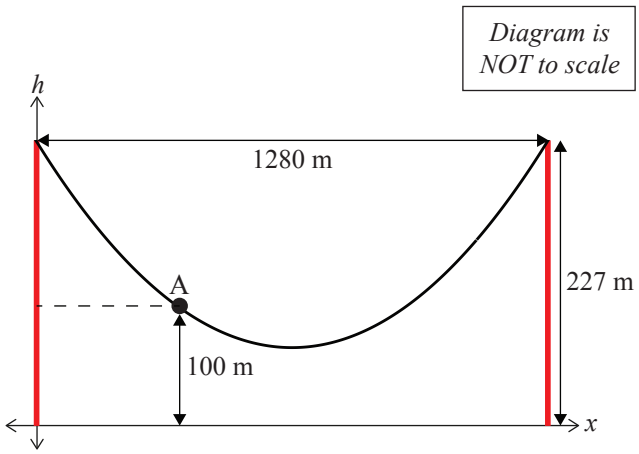
(e) The Golden Gate Bridge in San Francisco has two towers.

The height h in metres of the suspension cables above the mean water level, at a horizontal distance x metres from the base of the left tower, can be modelled by the function $h = k(x - 640)^2 + 67$.

At the mid-point between the two towers, the suspension cables are 67 metres above the mean water level. The distance between the towers is 1280 metres and the towers are 227 metres tall, measured from the mean water level.



Rich Niewiroski Jr (https://commons.wikimedia.org/wiki/File:GoldenGateBridge-001.jpg), CC BY 2.5.

An anemometer (shown as A in the left-hand diagram above) to measure wind speed is placed on a cable at a height of 100 metres above the mean water level.

Find the horizontal distance of the anemometer from the left tower.

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

QUESTION NUMBER

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