GRADE
12

THE ANSWER SERIES

MATHEMATICS

TAS-style Diagnostic Report

Each Question + its Memo, each with

- **Common Errors & Misconceptions**
- **Suggestions to Teachers for Improvement**



November Exam
Paper 1
2025

ALGEBRA (67%): DBE NOVEMBER 2025

QUESTION 1 67%

70%

1.1 Solve for x:

1.1.1 $(x+5)(x-2) = 0$ (2)

1.1.2 $5x^2 + 2 = -9x$ *(correct to TWO decimal places)* (4)

1.1.3 $8x^2 > 2x$ (4)

Memo

1.1.1 $(x+5)(x-2) = 0$

$\therefore x = -5$ or $x = 2$ ➤

1.1.2 $5x^2 + 2 = -9x$

$\therefore 5x^2 + 9x + 2 = 0$ *(a = 5, b = 9, c = 2)*

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-9 \pm \sqrt{(9)^2 - 4(5)(2)}}{2(5)}$$

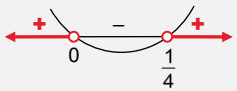
$$= \frac{-9 \pm \sqrt{41}}{10}$$

$= -0{,}26$ or $-1{,}54$ ➤

1.1.3 $8x^2 > 2x$

$\therefore 8x^2 - 2x > 0$

$\therefore 2x(4x-1) > 0$



$\therefore x < 0$ or $x > \frac{1}{4}$ ➤

Common Errors and Misconceptions

(a) In **Q1.1.2** some candidates substituted incorrect values of b and c into the quadratic formula because they had not written the equation correctly in standard form. Candidates were still unable to round off their answers correct to two decimal places. Some candidates rejected the answer of $x = -1{,}54$, perhaps because the answer was a negative value.

(b) In **Q1.1.3** many candidates were able to calculate the *critical values* but were unable to identify the correct intervals for the solution to the inequality. They provided the following incorrect answers: $0 < x < \frac{1}{4}$ or $x > 0$ or $x > \frac{1}{4}$. Other candidates used the word 'and' in the solution, which was incorrect. Notation still seemed to be problematic as some candidates left their answer as $0 > x > \frac{1}{4}$.



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1.1.4 $2.2^{2x} - 9.2^x + 4 = 0$ (4)

Memo

1.1.4 $2.2^{2x} - 9.2^x + 4 = 0$

$(2.2^x - 1)(2^x - 4) = 0$

$\therefore 2.2^x - 1 = 0$ or $2^x - 4 = 0$

$\therefore 2^x = \frac{1}{2}$ $\quad \therefore 2^x = 4$

$\therefore 2^x = 2^{-1}$ $\quad \therefore 2^x = 2^2$

$\therefore \boldsymbol{x = -1}$ $\quad \therefore \boldsymbol{x = 2}$ ◄

OR: $2.2^{2x} - 9.2^x + 4 = 0$

Let $2^x = k$

$\therefore 2k^2 - 9k + 4 = 0$

$\therefore (2k - 1)(k - 4) = 0$

$\therefore k = \frac{1}{2}$ or $k = 4$

$\therefore 2^x = 2^{-1}$ $\quad \therefore 2^x = 2^2$

$\therefore \boldsymbol{x = -1}$ $\quad \therefore \boldsymbol{x = 2}$ ◄

Common Errors and Misconceptions

(c) Factorising the exponential equation in **Q1.1.4** proved to be a challenge for many candidates. Common factorisation errors were that the given equation was factorised to $2^x(2 - 9) = -4$ or $2.2^x - 9.2^x + 4 = 0$ was factorised to $2(2x - 9 + 2) = 0$. Some candidates used the k-substitution method to answer this question. They correctly arrived at $k = 4$ or $k = \frac{1}{2}$ but then failed to solve for x.



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1.1.5 $\sqrt{\sqrt{\frac{1}{x}}+2} = \frac{1}{\sqrt{x}}$ (5)

Memo

1.1.5 $\left(\sqrt{\sqrt{\frac{1}{x}}+2}\right)^2 = \left(\frac{1}{\sqrt{x}}\right)^2$

$\therefore \sqrt{\frac{1}{x}}+2 = \frac{1}{x}$

$\therefore \left(\sqrt{\frac{1}{x}}\right)^2 = \left(\frac{1}{x}-2\right)^2$

$\therefore \frac{1}{x} = \frac{1}{x^2}-\frac{4}{x}+4$

$\therefore x = 1-4x+4x^2$ (× by x^2)

$\therefore 4x^2-5x+1 = 0$

$\therefore (4x-1)(x-1) = 0$

$\therefore x = \frac{1}{4}$ or $x \neq 1$

$\therefore x = \frac{1}{4}$ only ✓

Check

$x = 1$: LHS $= \sqrt{3}$ but RHS $= 1$ ✗

$x = \frac{1}{4}$: LHS $= 2 =$ RHS ✓



OR:

$\sqrt{\sqrt{\frac{1}{x}}+2} = \frac{1}{\sqrt{x}}$

Let $\frac{1}{\sqrt{x}} = k$ $\left(\sqrt{\frac{1}{x}} = \frac{1}{\sqrt{x}}\right)$

$\therefore \left(\sqrt{k+2}\right)^2 = (k)^2$

$\therefore k+2 = k^2$

$\therefore k^2-k-2 = 0$

$\therefore (k-2)(k+1) = 0$

$\therefore k = 2$ or $k \neq -1$ $\left(\sqrt{\frac{1}{x}} \neq -1\right)$

$\therefore \left(\sqrt{\frac{1}{x}}\right)^2 = (2)^2$

$\therefore \frac{1}{x} = 4$

$\therefore x = \frac{1}{4}$ ✓



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Common Errors and Misconceptions

(d) In **Q1.1.5** many candidates found it challenging to work with two *surds* that had fractions in them. Some were able to square both sides of the equation correctly and arrived at $\sqrt{\frac{1}{x}}+2 = \frac{1}{x}$. Thereafter, they incorrectly squared the terms in this equation: $\left(\frac{1}{\sqrt{x}}\right)^2 + (2)^2 = \left(\frac{1}{x}\right)^2$. Some candidates converted the *surds* to *exponents*. However, they applied the exponential laws incorrectly. Despite being mentioned in previous reports, candidates still did not check their answers and reject the extraneous solution.



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55%

1.2 Calculate the values of x and y if:

- x is the sum of 2 and y
- Five times the product of x and y, is 6 more than the square of x. (6)

[25]



Memo

1.2 $x = 2 + y$ ... ❶

$5xy = x^2 + 6$ ... ❷

Substitute ❶ into ❷:

$5(2 + y)y = (2 + y)^2 + 6$

$\therefore 10y + 5y^2 = 4 + 4y + y^2 + 6$

$\therefore 4y^2 + 6y - 10 = 0$

$\therefore 2y^2 + 3y - 5 = 0$

$\therefore (2y + 5)(y - 1) = 0$

$\therefore y = -\frac{5}{2}$ or $y = 1$

If $y = -\frac{5}{2}$, then $x = 2 + \left(-\frac{5}{2}\right) = -\frac{1}{2}$

If $y = 1$, then $x = 2 + (1) = 3$

$\therefore$ Solution: $\left(-\frac{1}{2}; -\frac{5}{2}\right)$ or (3; 1) ◄

OR:

$x = 2 + y$

$\therefore y = x - 2$ ... ❶

$5xy = x^2 + 6$ ... ❷

Substitute ❶ into ❷:

$5x(x - 2) = x^2 + 6$

$\therefore 5x^2 - 10x = x^2 + 6$

$\therefore 4x^2 - 10x - 6 = 0$

$\therefore 2x^2 - 5x - 3 = 0$

$\therefore (2x + 1)(x - 3) = 0$

$\therefore x = -\frac{1}{2}$ or $x = 3$

If $x = -\frac{1}{2}$ then $y = -\frac{1}{2} - 2 = -\frac{5}{2}$

If $x = 3$, then $y = 3 - 2 = 1$

$\therefore$ Solution: $\left(-\frac{1}{2}; -\frac{5}{2}\right)$ or (3; 1) ◄

Common Errors and Misconceptions

(e) Most candidates were unable to establish the correct equations from the statements given in **Q1.2**.

The following incorrect equations were established for the second statement:

$5(x + y) = 6x^2$ or $5(x + y) = 6\sqrt{x}$ or $5xy = 6x^2$ instead of $5xy = 6 + x^2$.

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QUESTION 1: Suggestions for Improvement



(a) Learners must ensure that they are able to correctly identify the values of a, b and c in any *quadratic equation*.

(b) It must be emphasised that the balance of an equation is maintained by performing the same operation on both sides of the equation. Squaring the individual terms on one side is not the same as squaring an individual term on the other side.

(c) Learners must be taught to check their solutions when using the squaring technique to solve an equation that is not originally quadratic, as well as to check the validity of solutions generated in *exponential* equations. Teachers must emphasise that implicit restrictions are placed on *surd* equations.

(d) *Quadratic inequalities* should be taught in relation to the *quadratic function*. Notation in *quadratic inequalities* should be emphasised. Graphical tools should be shown to the learners to ensure they understand what the mathematical notation means on a graph.

(e) Exponential rules, manipulation and equations should be practised. Learners should understand when to use the technique of equating *exponents* because the *bases* are the same, and when to factorise. Simplification of *exponential expressions* and solving *exponential equations* are equally important.

(f) Teachers must make time to revise work involving algebraic manipulations and exponential laws.

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(g) Word problems in earlier grades should not be ignored. Translating words to mathematical statements is an important skill in understanding mathematical language.



(h) As suggested in previous reports:

- Teachers should not take for granted that learners know how to round off a number to the required number of places. Where necessary, this skill should be retaught in Grades 11 and 12. Teachers should penalise learners in class work and SBA tasks when they do not round off to the correct number of places

- Teachers should take some time, preferably in Grade 10, to focus on teaching learners how to represent inequalities (e.g. $0 < x < \frac{1}{4}$) on a number line and how to also write an inequality from the illustration on a number line. This will benefit learners as they are required to write inequality solutions for a number of questions in both examination papers. Emphasis on the correct notation is essential when writing down the solutions to inequalities.

- Linked to this, teachers should explain the difference between 'and' and 'or' in the context of inequalities. Learners cannot use these words interchangeably as they have different meanings.

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PATTERNS (53%; 69%): DBE NOVEMBER 2025



QUESTION 2 53%

69%

2.1 Given the infinite geometric series:

$$(t + 10) + (t - 2) + (t + 4) + \ldots$$

2.1.1 Show that $t = -2$. (3)

2.1.2 Calculate the value of T_{25}. Write your answer in the form $T_n = b^x$. (3)

2.1.3 Calculate the sum of the infinite series. (2)

Memo



2.1.1 $(t + 10) + (t - 2) + (t + 4) + \ldots$ is an infinite GS

$$\therefore \frac{t-2}{t+10} = \frac{t+4}{t-2} \quad \ldots$$

In a geometric series $\frac{T_2}{T_1} = \frac{T_3}{T_2}$

$$\therefore (t + 10)(t + 4) = (t - 2)^2$$

$$\therefore t^2 + 14t + 40 = t^2 - 4t + 4$$

$$\therefore 18t = -36$$

$$\therefore \mathbf{t = -2} \blacktriangleleft$$

2.1.2 The first three terms are: $8; -4; 2$

$a = 8$ and $r = -\frac{1}{2}$

$$\therefore T_{25} = (8)\left(-\frac{1}{2}\right)^{24}$$

$$= (2^3)\left(\frac{1}{2}\right)^{24}$$

$$= (2^3)(2^{-24})$$

$$= 2^{-21}$$

$$= \left(\frac{1}{2}\right)^{21} \blacktriangleleft$$



2.1.3 $S_\infty = \frac{a}{1-r} = \frac{8}{1-\left(-\frac{1}{2}\right)} = \mathbf{\frac{16}{3}} \blacktriangleleft \quad \ldots$

$-1 < r < 1$

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Common Errors and Misconceptions

(a) Candidates failed to cross multiply and expand the resulting brackets correctly when answering **Q2.1.1**. Some candidates substituted $t = -2$ into the given expression instead of proving that $t = -2$. These candidates did not understand the question. Some candidates incorrectly assumed this to be an *arithmetic sequence* and generated an equation of differences between the terms. They were not awarded any marks.

(b) Many candidates were able to determine the terms in the sequence and calculate the value of r correctly. However, they did not simplify their answer to b^x as required and instead gave their answer in the form $a.b^x$. Most learners who relied on their calculators to simplify expressions and equations could not reach the required answer in the simplest form. They were not awarded a mark for this.

(c) When answering **Q2.1.3** some candidates were oblivious to the fact that $-1 < r < 1$ for a *converging geometric sequence*. Instead, they incorrectly used a value of r that was outside this interval. Other candidates incorrectly used the finite sum formula, $S_n = \frac{a(r^n - 1)}{r - 1}$, when answering this question.

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34%

2.2 Given $\sum_{p=k}^{117}(4p-1) = 26\,675$

2.2.1 Write down the difference between T_6 and T_{14}. (2)

2.2.2 Calculate the value of k. (5)

[15]

Memo

2.2.1 $T_{14} = 4(k+13)-1 = 4k+51$

$T_6 = 4(k+5)-1 = 4k+19$

$\therefore T_{14} - T_6 = 32$ ◄

OR:

$T_{14} - T_6 = 8d$

$= 8(4)$

$= 32$ ◄

2.2.2 $\sum_{p=k}^{117}(4p-1) = 26\,675$

$n = 117-k+1 = 118-k$

$a = 4k-1$

$d = 4$

$S_n = \frac{n}{2}[2a+(n-1)d] = 26\,675$

$\therefore \frac{118-k}{2}[2(4k-1)+(117-k)(4)] = 26\,675$

$\therefore (118-k)[(4k-1)+2(117-k)] = 26\,675$

$\therefore (118-k)[4k-1+234-2k] = 26\,675$

$\therefore (118-k)(2k+233) = 26\,675$

$\therefore 27\,494+3k-2k^2-26\,675 = 0$

$\therefore 2k^2-3k-819 = 0$

$\therefore (2k+39)(k-21) = 0$

$\therefore$ **k = 21 only** $\left(k \neq -\frac{39}{2}\right)$ ◄

OR:

$n = 117-k+1 = 118-k$

$a = 4k-1$

$d = 4$

$l = 4(117)-1 = 467$

$S_n = \frac{n}{2}[a+l] = 26\,675$

$\therefore \frac{118-k}{2}[(4k-1)+(467)] = 26\,675$

$\therefore \frac{118-k}{2}[4k+466] = 26\,675$

$\therefore (118-k)[2k+233] = 26\,675$

$\therefore -2k^2+3k+27\,494-26\,675 = 0$

$\therefore 2k^2-3k-819 = 0$

$\therefore (2k+39)(k-21) = 0$

$\therefore$ **k = 21 only** $\left(k \neq -\frac{39}{2}\right)$ ◄

(You can also use the quadratic formula if you prefer.)

OR:

This method solves for k by finding the sum of 117 terms and subtracting the preceding terms.

$n = 117 \quad a = 3 \quad d = 4$

$l = T_{117} = 467$

$\therefore S_{117} = \frac{117}{2}[3+467] = 27\,495$

$n = k-1 \quad a = 3 \quad d = 4$

$l = T_{k-1} = 4(k-1)-1 = 4k-5$

$\therefore S_{k-1} = \frac{k-1}{2}[3+4k-5]$

$= \frac{k-1}{2}[4k-2]$

$= (k-1)(2k-1)$

$= 2k^2-3k+1$

$\therefore S_{117} - S_{k-1} = 26\,675$

$\therefore 27\,495-(2k^2-3k+1) = 26\,675$

$\therefore 2k^2-3k-819 = 0$

$\therefore (2k+39)(k-21) = 0$

$\therefore$ **k = 21 only** $\left(k \neq -\frac{39}{2}\right)$ ◄

Common Errors and Misconceptions

(d) In **Q2.2.1** some candidates incorrectly calculated the *common difference* instead of calculating the difference between T_6 and T_{14}.

(e) The errors made when answering **Q2.2.2** showed that candidates had poor understanding of the concept of *sigma notation*. They were unable to calculate the number of terms in the series correctly. Many of them incorrectly indicated that there were $117-k$ terms in the series. The first term of the series was incorrectly calculated as $4(1)-1$ instead of $4(k)-1$. Some of them did not know that the sum of this series of terms was 26 675.

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QUESTION 2: Suggestions for Improvement



(a) Teachers should emphasise the difference between *arithmetic* and *geometric sequences*.

(b) Learners need to be made aware that when a question requires them to 'show that ...', they may not use this information as given. Instead, they must perform some calculations and arrive at the answer given in the statement. Learners should master the simplification of expressions and equations to the simplest form.

(c) Teachers should explain the concept of a *converging geometric series* by generating two *geometric series*, one with the value of r between -1 and 1 and the other having the value of $r > 1$. Learners should observe the value of the sum of the first n terms as more terms are added to the series.

(d) The concepts of S_n and S_∞ should be explained and the difference between them should be demonstrated as a series of terms.

(e) A solid foundation of *sigma notation* should be emphasised in the classroom. Learners should be exposed to both calculating from given *sigma notation*, and writing information from a given pattern into *sigma notation*. This should give them a better understanding of the concept.

(f) Exercises in number patterns should include variables so that learners will be able to attempt higher order questions on this topic.

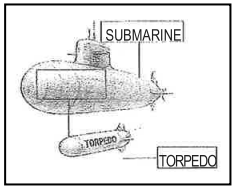
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QUESTION 3 69%

The depth of a torpedo below sea level forms a quadratic pattern, where 0 metres is at sea level.

A submarine tracked a torpedo in one-second intervals.



The depth (in metres) that the torpedo reached is given in the table below.

	Depth (in metres)
At the end of the first second	36
At the end of the first 2 seconds	71
At the end of the first 3 seconds	104

78% 3.1 Calculate the depth of the torpedo at the end of the first 5 seconds. (2)

86% 3.2 Show that the depth of the torpedo at the end of n seconds was $T_n = -n^2 + 38n - 1$. (3)

Memo

3. **36** 71 104 135 164

35 33 31 29

−2 −2 −2



For a quadratic pattern:

$a + b + c$ $4a + 2b + c$ $9a + 3b + c$

$3a + b$ $5a + b$

$2a$

3.1 **The depth of the torpedo after 5 seconds is 164 m.** ◄

3.2 $2a = -2$ $3(-1) + b = 35$ $-1 + 38 + c = 36$

$\therefore a = -1$ $\therefore b = 38$ $\therefore c = -1$

$\therefore T_n = -n^2 + 38n - 1$ ◄

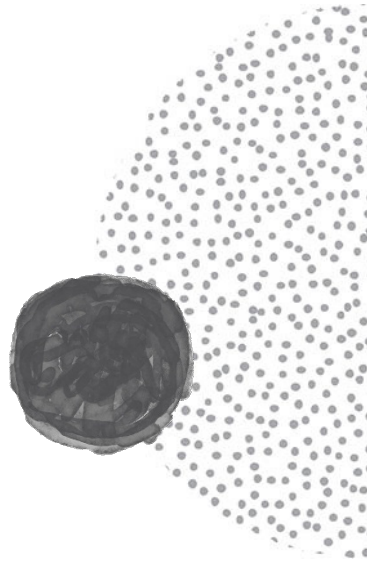
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Common Errors and Misconceptions

(a) Many candidates used the *general term* given in **Q3.2** to answer **Q3.1**. This was not acceptable and they were not awarded any marks in this instance. Some candidates incorrectly calculated the *first differences* as being: −35 ; −33 ; . . . This resulted in an incorrect value of the fifth term.

(b) In **Q3.2** some candidates incorrectly used 2a + b = 35 instead of 3a + b = 35.





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3.3 Calculate the maximum depth that the torpedo reached. (3)

58%

3.4 After how many seconds was the torpedo at 104 m below sea level for the second time? (2)

53%

[10]

Memo

3.3 $-2n + 38 = 0 \quad \therefore n = 19 \quad \therefore T_{19} = -19^2 + 38(19) - 1 = 360$

OR:

$-\frac{b}{2a} = -\frac{38}{2(-1)} = 19$ and $T_{19} = 360$ (see above)

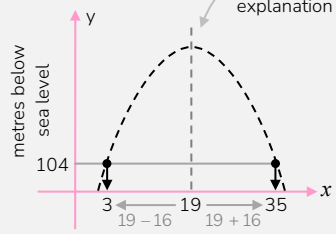
OR:

$T_n = -(n^2 - 38n + 1) = -[(n-19)^2 - 360] = -(n-19)^2 + 360$

$\therefore$ the maximum depth the torpedo reached is 360 m. ◄

3.4 $T_3 = T_{19-16} = T_{19+16} = T_{35}$ (using symmetry)

Visual explanation



OR:

$-n^2 + 38n - 1 = 104$

$\therefore n^2 - 38n + 105 = 0$

$\therefore (n-3)(n-35) = 0$

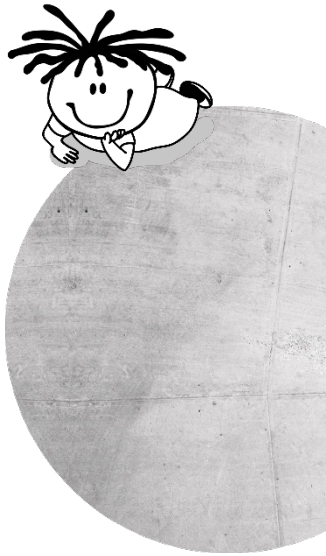
$\therefore n = 3$ or $n = 35$

$\therefore$ the torpedo was 104 m below sea level for the 2nd time after 35s ◄

Common Errors and Misconceptions

(c) In **Q3.3** many candidates could not link maximum depth with a positive value. Some candidates were able to calculate that the maximum depth occurs at n = 19 but then did not proceed to calculate the maximum depth as required in the question.

(d) Many candidates did not realise that they could use the axis of symmetry to answer **Q3.4**. Those who did use the axis of symmetry gave the answer as 32 seconds instead of the correct answer of 35 seconds. Many candidates opted to solve the equation $T_n = 104$. However, they gave both answers instead of the time at which the submarine will be at 104 metres for the second time, namely at 35 seconds.



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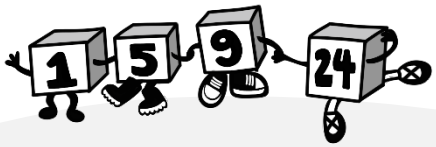
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QUESTION 3: Suggestions for Improvement

(a) Teachers should expose learners to questions on number patterns that are based on real-life contexts.

(b) Teachers must show the link between the *quadratic number pattern* and the *quadratic function* as many concepts of the *quadratic function* are tested in *quadratic number patterns*.

(c) Teachers should ask learners to interpret context-based questions and explain which mathematical concept is required to respond to it. In addition, teachers should encourage learners to ensure that their response is relevant to the context.



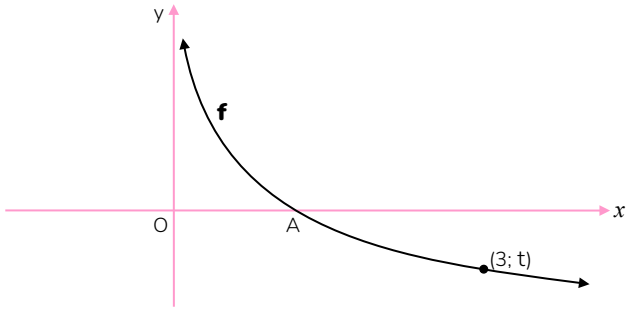
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FUNCTIONS (58%; 53%; 14%): DBE NOVEMBER 2025

QUESTION 4 58%

The graph of $f(x) = \log_{\frac{1}{3}} x$ is drawn below. Point A is the x-intercept of f and (3; t) lies on f.



4.1 Calculate the value of t. (1)

90%

4.2 Write down the coordinates of A. (1)

82%

4.3 Determine the equation of f^{-1}, the inverse of f, in the form y = . . . (2)

83%

Memo

4.1 $f(x) = \log_{\frac{1}{3}} x$

$\therefore f(3) = \log_{\frac{1}{3}} 3 = -1$

$\therefore t = -1$ ◄

4.2 A(1; 0) $\left(\log_{\frac{1}{3}} 1 = 0\right)$ ◄

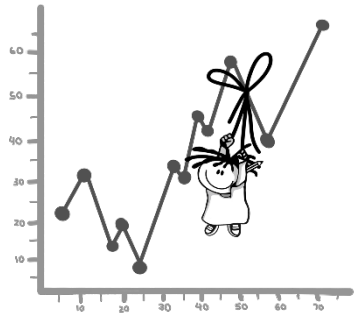
4.3 $x = \log_{\frac{1}{3}} y$

$\therefore f^{-1}(x) = y = \left(\frac{1}{3}\right)^x$ ◄ . . . $c = \log_b a \Leftrightarrow a = b^c$

Common Errors and Misconceptions

(a) Candidates were able to swop x and y when determining the *inverse* in **Q4.3**. However, some of them were unable to write the equation of the *inverse* correctly.

Many wrote the answer as $f^{-1}(x) = x^{\frac{1}{3}}$; they incorrectly switched the *base* and *exponent* in the answer.



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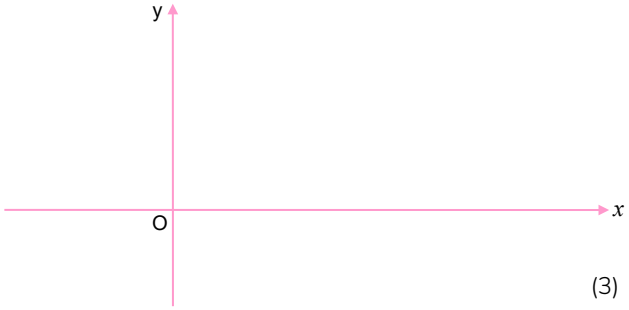
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4.4 Write down the equation of the asymptote of f^{-1}. (1)

45%

4.5 Draw the graph of f^{-1} on the set of axes provided below. Clearly indicate the intercepts with the axes, the coordinates of ONE other point and the asymptotes.

60%



(3)

4.6 The graph of h is obtained when f^{-1} is translated 5 units to the right. Determine the y-values of h where $x > 4$. (2)

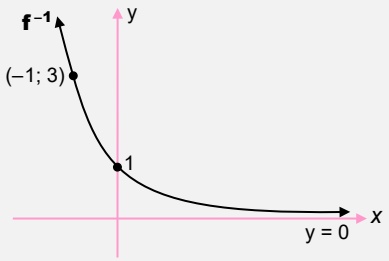
10%

[10]

Memo

4.4 $y = 0$ ◄

4.5

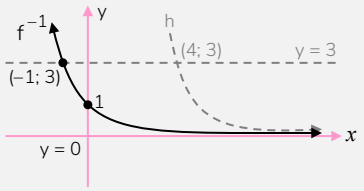


4.6 $h(x) = \left(\frac{1}{3}\right)^{x-5}$

$h(x) > 0$ for all values of x

$h(4) = \left(\frac{1}{3}\right)^{-1} = 3$

$\therefore\ 0 < y < 3$ ◄



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Common Errors and Misconceptions

(b) In **Q4.4** a fair number of candidates incorrectly wrote the equation of the *asymptote* as $q = 0$ or $x = 0$ instead of $y = 0$.

(c) Many candidates were able to plot the points correctly when answering **Q4.5** but they were unable to draw the correct shape.

(d) Many candidates were unable to interpret **Q4.6** correctly. A significant number of candidates who attempted this question, incorrectly wrote the interval in terms of x instead of y.



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QUESTION 4: Suggestions for Improvement

(a) Point-by-point plotting of graphs is important for learners to understand the shape of graphs. However, teachers must teach with conceptual understanding. Emphasis should be placed on the understanding of the *asymptote* of a function.

(b) The general form of functions and their shapes should be emphasised from Grade 10 and revised every time a functions question is worked through in class. In addition, the effects of the parameters a, b, p and q should be thoroughly taught, revised and practised by learners from the introduction of functions in Grade 10 through to the end of the Grade 12 academic year.

(c) Teachers should ensure that learners work with *transformations* in functions from Grade 10. This should include *point transformation*, recognition of the *transformation* applied to one function's equation to result in another and the rules of *reflection*, *horizontal* and *vertical shifts* on the equation of a function.

(d) Learners should be allowed to investigate the *inverse* of a function. They should explore the idea of swapping the x- and y-coordinates and observing how the *inverse* is different from the original function.

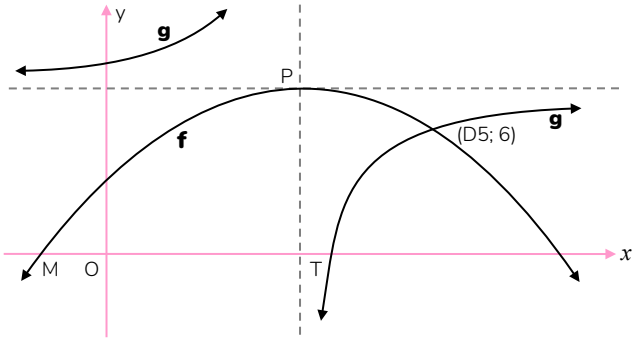
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QUESTION 5 53%

The graphs of $f(x) = ax^2 + bx + c$ and $g(x) = \frac{-4}{x-3} + 8$ are drawn below.

P is the turning point of f and the point of intersection of the asymptotes of g. The graphs intersect at D(5; 6). M and T are x-intercepts of f and g respectively.



5.1 Write down the domain of g. (1)

63%

5.2 Write down the range of f. (1)

42%

5.3 Determine the values of x for which:

32%

5.3.1 $g(x) \leq f(x)$ (2)

5.3.2 $f(x) < 6$ (2)

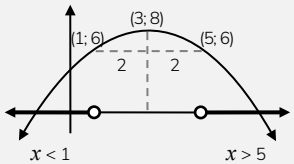
Memo

5.1 $x \in \mathbb{R}, x \neq 3$ ◄

5.2 $y \leq 8$ or $y \in (-\infty; 8]$ ◄

5.3.1 $3 < x \leq 5$ or $x \in (3; 5]$ ◄

5.3.2 $x < 1$ or $x > 5$
or
$x \in (-\infty; 1) \cup (5; \infty)$ ◄



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Common Errors and Misconceptions

(a) In **Q5.1** some candidates wrote the answer as $x \in \mathbb{R}, x = 3$ instead of $x \in \mathbb{R}, x \neq 3$. They did not exclude the *asymptote* from the *domain*. This confirms that some candidates did not understand the concept of *asymptote*.

(b) **Q5.2** required candidates to write down the *range* of the parabola. Many candidates excluded the *turning point* in their answer and wrote the answer as y < 8 or (–∞; 8). This was incorrect.

(c) Many candidates were able to establish the correct *critical values* when answering **Q5.3**. However, they were unable to identify the correct regions from the graphs and state the intervals correctly. In **Q5.3.1** many candidates incorrectly wrote the answer as $3 < x < 5$ or $3 \leq x \leq 5$. In **Q5.3.2** many candidates were confused about using 'and' and 'or' when stating intervals and wrote $x < 1$ *and* $x > 5$. This answer was incorrect. Some candidates used the equation of function f given in **Q5.4** to answer **Q5.3.1** and **Q5.3.2**. They tried to solve the following inequalities algebraically: $\frac{-4}{x-3} \leq -\frac{1}{2}x^2 + 3x + \frac{7}{2}$ and $-\frac{1}{2}x^2 + 3x + \frac{7}{2} < 6$. They were not awarded any marks for their efforts as they did not determine the equation of f before using it.

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5.4 Show that the equation of the parabola is
49% $f(x) = -\frac{1}{2}x^2 + 3x + \frac{7}{2}$ (3)

5.5 Calculate the length of MT. (6)
71%

5.6 Determine the equation of the tangent to f at D. (3)
47%
[18]



Memo

5.4 $y = a(x-3)^2 + 8$

Substitute D(5; 6)

$\therefore\ 6 = a(5-3)^2 + 8$

$\therefore\ 6 = a(2)^2 + 8$

$\therefore\ 4a = -2 \quad \text{and} \quad a = -\frac{1}{2}$

$\therefore\ y = -\frac{1}{2}(x-3)^2 + 8$

$= -\frac{1}{2}(x^2 - 6x + 9) + 8$

$= \mathbf{-\frac{1}{2}x^2 + 3x + \frac{7}{2}}$ ◄

5.5 At M, $f(x) = 0$

$\therefore\ -\frac{1}{2}x^2 + 3x + \frac{7}{2} = 0$

$\therefore\ x^2 - 6x - 7 = 0$

$\therefore\ (x+1)(x-7) = 0$

$\therefore\ x = -1 \text{ or } x = 7$

$\therefore\ \mathbf{x_M = -1}$ ◄

OR: At M, $f(x) = 0$

$\therefore\ 0 = -\frac{1}{2}(x-3)^2 + 8$

$\therefore\ (x-3)^2 = 16$

$\therefore\ x - 3 = \pm 4$

$\therefore\ x = 3 - 4 = -1 \text{ or } x = 3 + 4 = 7$

$\therefore\ \mathbf{x_M = -1}$ ◄

At T, $g(x) = 0$

$\therefore\ \frac{-4}{x-3} + 8 = 0$

$\therefore\ -4 + 8(x-3) = 0$

$\therefore\ -4 + 8x - 24 = 0$

$\therefore\ 8x = 28$

$\therefore\ x_T = \frac{7}{2}$

$\therefore\ \text{MT} = \frac{7}{2} - (-1) = \frac{9}{2} = 4{,}5 \text{ units}$ ◄

5.6 $f'(x) = -x + 3$

$\therefore\ m = f'(5) = -5 + 3 = -2$

$\therefore\ y - 6 = -2(x-5)$ ... $y - y_1 = m(x - x_1)$

$\therefore\ \mathbf{y = -2x + 16}$ ◄



Common Errors and Misconceptions

(d) In **Q5.4** many candidates incorrectly took the value of p to be 3 instead of –3.

(e) When answering **Q5.5** some candidates stated that the coordinates of M were (–1 ; 0) without showing any working. They were not awarded full marks for omitting the necessary working.

(f) Many candidates had difficulty in calculating the *gradient* of the *tangent* in **Q5.6**. A large number of candidates incorrectly calculated the *average gradient* between points D and P. Other candidates incorrectly took the *gradient* of the *tangent* as –1.

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QUESTION 5: Suggestions for Improvement

(a) Learners must be made aware that assuming facts without first proving it is not acceptable when answering questions. In this regard, learners must show all working steps and may not use the result given in a latter question to answer a question that precedes it.

(b) Teachers should pay more attention to establishing the *domain* and *range* from the graph of a given function.

(c) Teachers should demonstrate how to read off answers from a single graph to the following statements: $f(x) = 0$, $f(x) = k$, $f(x) < 0$, $f(x) > 0$, $f(x) \leq 0$, $f(x) \geq 0$, $f(x) < k$, etc. They should start with the *straight-line* graph and then progress to the other graphs in Grade 10. This should help learners understand how to read off answers when a question has a combination of graphs.

(d) Many learners can calculate the *derivative* of a function but they cannot interpret the answer. The concept of *derivative* must be stressed as being the *gradient of a tangent to a curve*. Learners must be exposed to determining the *gradient* of a *tangent* to any curve and not just the *cubic* curve.



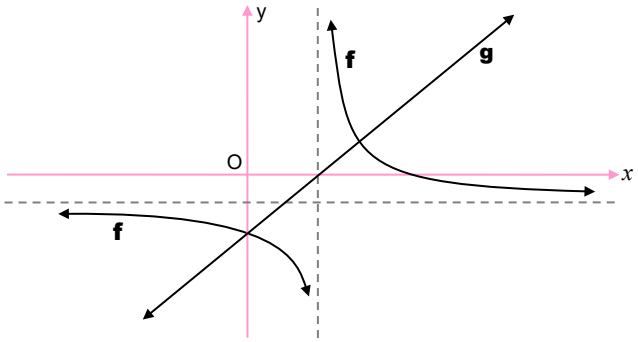
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QUESTION 6 14%

The graphs of $g(x) = x + c$ and $f(x) = \frac{a}{x+p} + q$ are drawn below.

Graph g and the vertical asymptote of f intersect at the x-axis.



6.1 Write down the coordinates of the x-intercept of g in terms of p. (1)
29%

6.2 Graph g intersects the horizontal asymptote of graph f at $x = 1$ and the graph f at $x = 3$. Graphs f and g also intersect on the y-axis. Determine the equation of f. (5)
8%

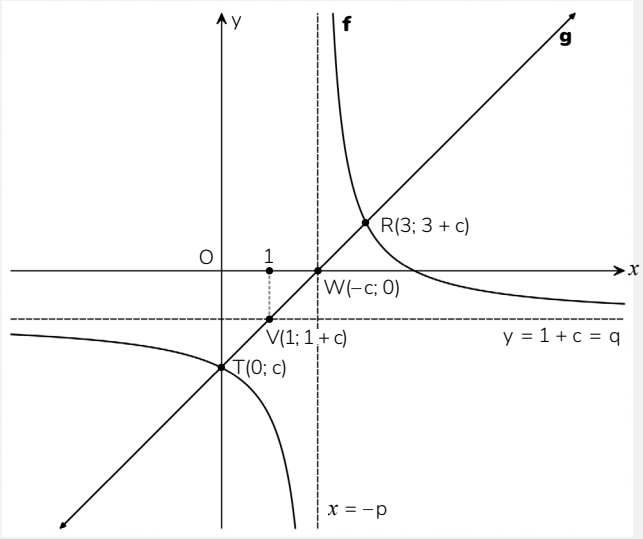
6.3 Describe the transformation that g must undergo to become an axis of symmetry of f that cuts f at two points. (2)
19%

[8]

Memo

6.1 **(–p; 0)** ◄

6.2



R(3; 3 + c) [g(3) = 3 + c] W(–c; 0) [g(–c) = 0]

V(1; 1 + c) [g(1) = 1 + c] T(0; c) [g(0) = c]

$\therefore$ p = c and q = 1 + c

$\therefore f(0) = \frac{a}{0+c} + 1 + c = c$

$\therefore \frac{a}{c} + 1 = 0$

$\therefore \frac{a}{c} = -1$

$\therefore$ a = –c

$\therefore f(3) = \frac{-c}{3+c} + 1 + c = 3 + c$

$\therefore \frac{-c}{3+c} = 2$

$\therefore$ 2c + 6 = –c

$\therefore$ 3c = –6

$\therefore$ c = –2

$\therefore$ a = –c = 2

$\therefore$ p = c = –2

$\therefore$ q = c + 1 = –1

$\therefore f(x) = \frac{2}{x-2} - 1$ ◄



OR:

y-intercept: $c = \frac{a}{p} + q$ ... ❶

At $x = 1$: $1 + c = q$ ... ❷

At $x = 3$: $3 + c = \frac{a}{3+p} + q$ ... ❸

Subst. ❷ into ❶:

$c = \frac{a}{p} + 1 + c$

$\therefore \frac{a}{p} = -1$

$\therefore$ a = –p

Substitute ❷ and a = –p into ❸:

$3 + c = \frac{-p}{3+p} + 1 + c$

$\therefore 2 = \frac{-p}{3+p}$

$\therefore$ 6 + 2p = –p

$\therefore$ 3p = –6

$\therefore$ p = –2

$\therefore$ c = –2 ($m_g = 1$ so OT = OW & –c = –p)

$\therefore$ a = –(–2) = 2

$\therefore$ q = 1 + (–2) = –1

$\therefore f(x) = \frac{2}{x-2} - 1$ ◄

6.3 $g(x) = x - 2$

Shift g 1 unit right: $y = (x - 1) - 2 = x - 3$ ◄

or

Shift g 1 unit down: $y = (x - 2) - 1 = x - 3$ ◄

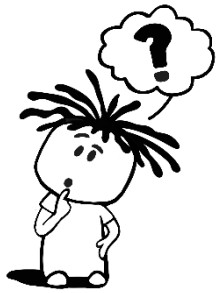
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Common Errors and Misconceptions

(a) In **Q6.1** some candidates incorrectly wrote the coordinates of the x-intercept as (p ; 0) instead of (–p ; 0).

(b) When answering **Q6.2** most candidates were unable to determine the coordinates of the points along the *straight-line* in terms of *variables*. Consequently, they were unable to derive equations that were required to answer the question. A few candidates were able to derive the correct equations, but had difficulty in solving them simultaneously. Some candidates used the fact that the x-coordinate of one point on the straight line was 1 and assumed the x-coordinates of other points on the straight line. This was treated as a breakdown.



QUESTION 6: Suggestions for Improvement

(a) Teachers need to emphasise that learners cannot assume information in a given scenario.

(b) Learners should be exposed to higher-order questions in earlier grades and not only in Grade 12.

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FINANCE (39%): DBE NOVEMBER 2025

QUESTION 7 39%

60% 7.1 A travel company informs Robert that a holiday to a certain destination costs R40 000 now. The company predicts that the cost of this holiday will increase by 7,8% per annum. What will this holiday cost in 5 years' time? (2)

33% 7.2 Sarah opened a savings account that paid interest at a rate of 5,8% p.a., compounded quarterly. She deposited R2 300 into the account on 1 January 2020 and continued to make deposits of R2 300 at the beginning of each quarter thereafter. She made her last deposit on 1 October 2025. Calculate the accumulated amount in the account on 1 January 2026. (4)

Memo

7.1 $A = P(1+i)^n$

$= 40\,000\left(1+\frac{7,8}{100}\right)^5$

$=$ **R58 230,94** ◄



7.2 Sarah made 24 quarterly deposits of R2 300 and then left the money in for an extra quarter.

$F_v = \frac{x\left[(1+i)^n - 1\right]}{i}$ ... with x = R2 300

$n = 6 \times 4 = 24$

$i = \frac{5,8\%}{4} = \frac{5,8}{400} = \frac{0,058}{4}$



$F_v = \frac{2\,300\left[\left(1+\frac{5,8}{400}\right)^{24} - 1\right]}{\frac{5,8}{400}} \times \left(1+\frac{5,8}{400}\right)$

$=$ **R66 411,60** ◄

Common Errors and Misconceptions

(a) In **Q7.1** some candidates incorrectly used the *simple interest* formula instead of the *compound interest* formula. Other candidates swapped the values of A and P in the formula. This was considered a breakdown.



(b) In **Q7.2** many candidates were unable to calculate the correct period of the investment and consequently were unable to calculate the correct number of deposits made. In addition, many candidates did not realise that the last deposit was made one quarter before the investment was withdrawn and therefore the *annuity* earned additional interest for this quarter. Some candidates incorrectly used the *present-value* formula instead of the *future-value* formula.

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36%

7.3 The bank granted Rajesh a loan of R900 000 on 28 February 2024 at an interest rate of 6,8% p.a., compounded monthly.

7.3.1 Rajesh was unable to make the first three payments. He made his first repayment of R10 000 on 30 June 2024. He continued to make monthly repayments of R10 000 at the end of each month thereafter. How long, in completed months, will it take Rajesh to repay the loan from the time the loan was granted? (5)

7.3.2 Calculate the value of the final payment. (4)

[15]

Memo

7.3.1 $900\,000\left(1+\frac{6,8}{1\,200}\right)^{3} = \frac{10\,000\left[1-\left(1+\frac{6,8}{1\,200}\right)^{-n}\right]}{\frac{6,8}{1\,200}}$ *

$\therefore \left(1+\frac{6,8}{1\,200}\right)^{-n} = 0,4812...$

$\therefore -n = \log_{\left(1+\frac{6,8}{1\,200}\right)}(0,4812...)$

$\therefore -n = -129,419...$

$\therefore n = 129,419...$

Rajesh made 130 payments in total, so he paid off his loan 133 months after the loan was granted. ◄

* $P_v = \frac{x\left[1-(1+i)^{-n}\right]}{i}$

OR:

$900\,000 = \frac{10\,000\left[1-\left(1+\frac{6,8}{1\,200}\right)^{-n}\right]}{\frac{6,8}{1\,200}}\left(1+\frac{6,8}{1\,200}\right)^{-3}$

$\therefore \left(1+\frac{6,8}{1\,200}\right)^{-n} = 0,4812...$

$\therefore -n = \log_{\left(1+\frac{6,8}{1\,200}\right)}(0,4812...)$

$\therefore -n = -129,419...$

$\therefore n = 129,419...$

Rajesh made 130 payments in total, so he paid off his loan 133 months after the loan was granted. ◄

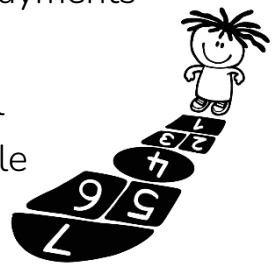
7.3.2 Final payment:

$\left[900\,000\left(1+\frac{6,8}{1\,200}\right)^{132} - 10\,000 \times \frac{\left(1+\frac{6,8}{1\,200}\right)^{129}-1}{\frac{6,8}{1\,200}}\right]\left(1+\frac{6,8}{1\,200}\right)$

= R4 197,21 ◄

Common Errors and Misconceptions

(c) **Q7.3.1** was poorly answered by the majority of the candidates. Some candidates overlooked the fact that the loan would have accrued interest on account of three missed payments. Other candidates incorrectly used the *future-value* formula instead of the *present-value* formula. Some candidates calculated the number of payments required to settle the loan but did not add the three months for which payments were missed when calculating the total time needed to settle the loan.

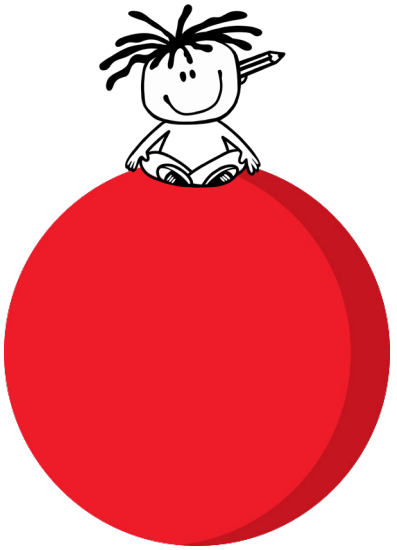


(d) The common errors in **Q7.3.2** were that candidates used the incorrect value of n in the formula selected to calculate the outstanding balance and they failed to add one month's interest to the outstanding balance when calculating the final payment.

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QUESTION 7: Suggestions for Improvement



(a) Learners should be taught to read for understanding in all problems, especially in Financial Mathematics problems. Teachers need to emphasise the importance of this skill.

(b) It may help to have learners draw timelines and identify what happens at different stages of an *annuity* (either present or future valued). Visual representation helps to break up a problem that requires reading for understanding. This also helps with determining the time-period when dates are given in the question.

(c) Drills and practice should be undertaken on different *compounding periods* and the *compound interest* formulae so that learners can familiarise themselves with the number of times that interest is compounded in a specified time frame.

(d) Teachers should teach Financial Mathematics with conceptual understanding and real-life problems.



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CALCULUS (81%; 40%; 25%): DBE NOVEMBER 2025

QUESTION 8 81%

8.1 Determine $f'(x)$ from first principles if it is given that $f(x) = -2x + 3$. (4)

86%

8.2 Determine:

78%

8.2.1 $g'(x)$ if $g(x) = -3x^4 + 2x$ (2)

8.2.2 $\frac{dy}{dx}$ if $y = \frac{2x^4 + 1}{x^2}$ (4)

[10]

Memo

8.1
$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$
$$= \lim_{h \to 0} \frac{\left[-2(x+h) + 3\right] - \left[-2x + 3\right]}{h}$$
$$= \lim_{h \to 0} \frac{\left[-2x - 2h + 3\right] - \left[-2x + 3\right]}{h}$$
$$= \lim_{h \to 0} \frac{-2h}{h}$$
$$= \lim_{h \to 0} -2$$
$$= -2 \quad \blacktriangleleft$$



8.2.1
$$g(x) = -3x^4 + 2x$$
$$\therefore g'(x) = -12x^3 + 2 \quad \blacktriangleleft$$

8.2.2
$$y = \frac{2x^4 + 1}{x^2}$$
$$= \frac{2x^4}{x^2} + \frac{1}{x^2}$$
$$= 2x^2 + x^{-2}$$
$$\therefore \frac{dy}{dx} = 4x - 2x^{-3}$$
$$= 4x - \frac{2}{x^3} \quad \blacktriangleleft$$

Common Errors and Misconceptions

(a) As mentioned in previous reports, the most common errors in **Q8.1** (the *first principles* question) were incorrect notations. A few candidates left out h in the denominator. Some candidates changed the question from a linear ($f(x) = -2x + 3$) to a quadratic ($f(x) = -2x^2 + 3$), possibly because they were only exposed to questions that contained quadratic expressions and not linear expressions. They were not awarded marks for their responses.

(b) Many candidates were unable to write the expression given in **Q8.2.2** in differentiable form.



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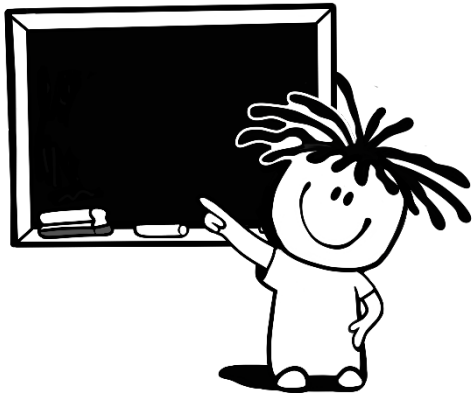
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QUESTION 8: Suggestions for Improvement

(a) As mentioned in previous reports:

- Emphasis should be placed on the use of the correct notation when determining the derivative, either when using *first principles* or the rules.
- Teachers should revise the rules of *exponents* and *surds* when changing an expression into differentiable format.
- Integration and re-emphasis of algebraic concepts, viz. fractions, factorising, inequalities and exponential rules, should be undertaken when working with Calculus.

(b) Teachers need to cover the *derivative* using *first principles* of all the functions prescribed in CAPS and not only focus on the quadratic function.

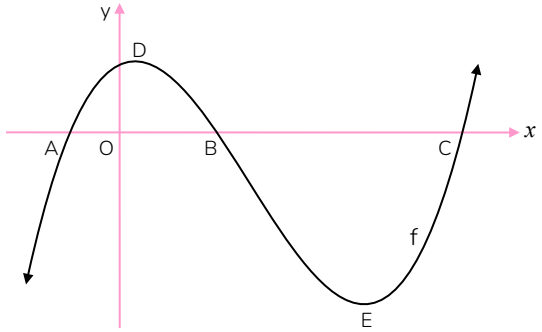


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QUESTION 9 40%

Sketched below is the graph of $f(x) = x^3 - 8x^2 + 5x + 14$. A, B and C are the x-intercepts of f. D and E are the turning points of f.



9.1 Calculate the coordinates of E. (4)

75%

9.2 For which values of x is f concave down? (3)

59%

Memo

9.1 $f(x) = x^3 - 8x^2 + 5x + 14$

$f'(x) = 3x^2 - 16x + 5 = 0$ at D and E

$\therefore (3x - 1)(x - 5) = 0$

$\therefore x = \frac{1}{3}$ or $x = 5$



$f(5) = 5^3 - 8(5)^2 + 5(5) + 14 = -36$

$\therefore$ **E(5; –36)** ➤

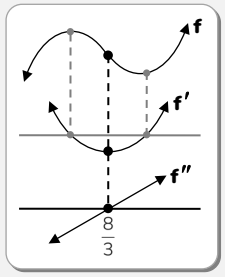
9.2 $f''(x) = 6x - 16$

f is concave down when $f''(x) < 0$.

$f''(x) < 0$

$\therefore 6x - 16 < 0$

$\therefore x < \frac{8}{3}$ ➤



Common Errors and Misconceptions

(a) Many candidates did not explicitly state that $f'(x) = 0$ when calculating the x-coordinates of the turning points. A mark was deducted for this omission.

(b) In **Q9.2** some candidates were able to calculate the x-coordinate of the *point of inflection* correctly but were unable to state the interval for which the graph was *concave down* correctly. They wrote $x > \frac{8}{3}$ instead of $x < \frac{8}{3}$.



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9.3 The coordinates of B are (2; 0). Use the graph to
28% determine the values of x for which $f(x).f''(x) < 0$. (4)

9.4 For which values of t will $y = -11x + t$ intersect f
14% at 3 distinct points? (6)
[17]

Memo

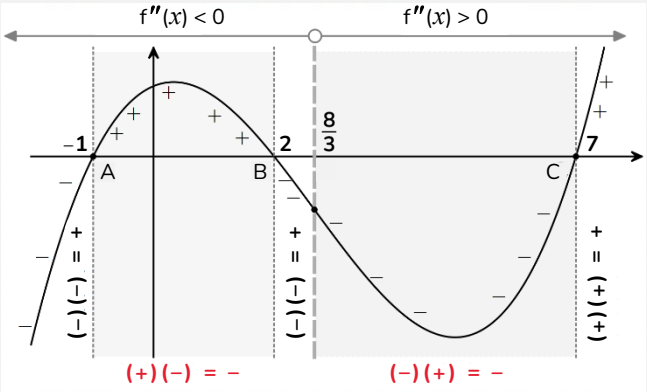
9.3 $f(x) = x^3 - 8x^2 + 5x + 14$

$\therefore f(2) = 0$

$\therefore f(x) = (x-2)(x^2 - 6x - 7)$

$= (x-2)(x-7)(x+1)$

A(–1; 0), B(2; 0) and C(7; 0) are shown on the graph below.



$f(x)$ and $f''(x)$ must have opposite signs for

$f(x).f''(x) < 0$.

$-1 < x < 2$ or $\frac{8}{3} < x < 7$ or $x \in (-1; 2) \cup \left(\frac{8}{3}; 7\right)$ ◄

The + and – signs on the graph show where $y = f(x)$ is + or –.

$f''(x) < 0$ for $x < \frac{8}{3}$ and $f''(x) > 0$ for $x > \frac{8}{3}$

9.4 $f'(x) = 3x^2 - 16x + 5 = -11$

$\therefore 3x^2 - 16x + 16 = 0$

$\therefore (3x-4)(x-4) = 0$

$\therefore x = \frac{4}{3}$ or $x = 4$

$f\left(\frac{4}{3}\right) = \frac{238}{27}$

$\therefore y - \frac{238}{27} = -11\left(x - \frac{4}{3}\right)$

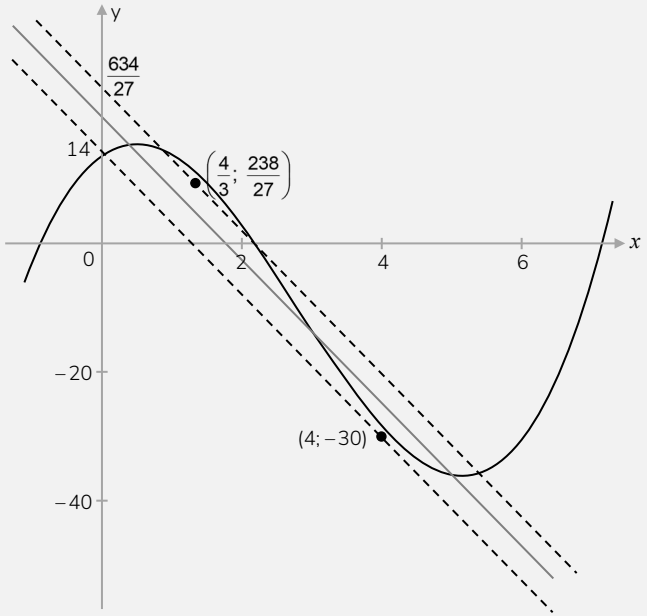
$\therefore y = -11x + \frac{634}{27}$ is a tangent to f

& $f(4) = -30$

$\therefore y - (-30) = -11(x-4)$

$\therefore y = -11x + 14$ is a tangent to f

$\therefore 14 < t < \frac{634}{27}$ $\left(\frac{634}{27} = 23\frac{13}{27} = 23,\dot{4}8\dot{1}\right)$ ◄



https://www.desmos.com/calculator/oyerfq4oof

Common Errors and Misconceptions

(c) Many candidates attempted to solve **Q9.3** by using algebraic methods despite the question advising candidates to use the graph. However, the resulting inequality became too complex for them to solve. As was stated elsewhere in the report, some candidates failed to write down the interval correctly. They included the endpoints of the interval instead of excluding them.

(d) When answering **Q9.4** many candidates did not see the link between the *gradient* of the *tangent* and the *derivative* of the function. Instead, they equated the *gradient* of the *tangent* to the given function. This constituted a breakdown and they were not awarded any marks.

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QUESTION 9: Suggestions for Improvement

(a) Teachers must not accept sloppy notation in school-based assessment tasks. This will force learners to pay attention to the details of their answers.

(b) Teachers need to reinforce the concepts of *concave up* and *concave down*, both from the perspective of the graph and from calculations.

(c) Learners need to be exposed to graphical interpretation questions where they apply their understanding of *gradient*, *concavity*, *positive* and *negative* values of a function as examples.

(d) Teachers should continue to teach graphical interpretation in *cubic* graphs as a follow-on from the interpretation taught in Grade 10 and 11. Both notations should be used from Grade 10 so that learners can translate from one notation to the other with ease.

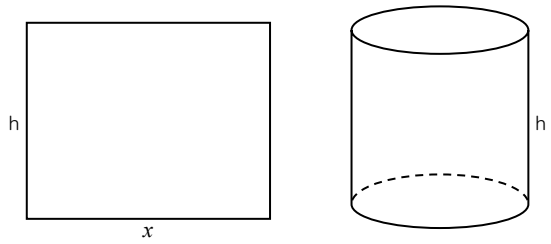


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QUESTION 10 25%

A rectangular metal sheet has dimensions x and h units, with $x > h$, and a perimeter of 50 units. The metal sheet is rolled into a cylinder with two open ends (top and bottom) and height h units.



10.1 Show that the volume of the cylinder is given by
18% $V = \frac{25x^2}{4\pi} - \frac{x^3}{4\pi}$ (3)

10.2 Calculate the value of x that will maximise the volume
32% of the cylinder. (3)
[6]

Memo

10.1 $2x + 2h = 50$
$\therefore 2h = 50 - 2x$
$\therefore h = 25 - x$

$2\pi r = x$
$\therefore r = \frac{x}{2\pi}$

$V = \pi r^2 h$
$= \pi\left(\frac{x}{2\pi}\right)^2(25 - x)$
$= \left(\frac{\pi x^2}{4\pi^2}\right)(25 - x)$
$= \left(\frac{x^2}{4\pi}\right)(25 - x)$
$= \frac{25x^2}{4\pi} - \frac{x^3}{4\pi}$ ◄



10.2 $V = \frac{25x^2}{4\pi} - \frac{x^3}{4\pi}$
$\therefore V' = \frac{50x}{4\pi} - \frac{3x^2}{4\pi}$

Maximum volume when $\frac{50x}{4\pi} - \frac{3x^2}{4\pi} = 0$
$\therefore 50x - 3x^2 = 0$
$\therefore x(50 - 3x) = 0$
$x \neq 0 \quad \therefore 3x = 50$
$x = \frac{50}{3}$ units ◄ $\left(\frac{50}{3} = 16\frac{2}{3} = 16,\dot{6} \approx 16,67\right)$



Common Errors and Misconceptions

(a) Many candidates did not attempt **Q10.1** despite it being a familiar problem. Some of those who did attempt this question used the incorrect formula for the perimeter. They used $P = x + h$ instead of $P = 2x + 2h$. Other candidates incorrectly used x as the diameter of the cylinder. These candidates did not realise that x was the circumference of the cylinder.

(b) In **Q10.2** some candidates equated the volume to zero instead of the *derivative* of the volume to zero, i.e. they solved for x in the equation $V(x) = 0$ instead of $V'(x) = 0$. Many candidates struggled to determine the *derivative* of the volume because the expression contained π. They did not realise that π is a *constant* and instead treated it as a *variable*. Some candidates arrived at two answers for x but did not discard $x = 0$, the extraneous answer.

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QUESTION 10: Suggestions for Improvement

(a) The topic of optimisation cannot be ignored in the teaching plan. As was seen in this examination, learners lose out on obtaining accessible marks if the topic is not covered adequately.

(b) Using physical resources as a teaching tool will improve the conceptual understanding of measurement.

(c) A ready reference chart/worksheet on the formulae for measurement of various shapes should be developed for learners.



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PROBABILITY (25%): DBE NOVEMBER 2025

QUESTION 11 25%

QUESTION 11

11.1 A survey was conducted among female and male learners at a school about which type of cold drink they preferred. The data from the survey is presented in the table below. 48%

	JUICE	ENERGY DRINKS	TOTAL
Female	**a**	**b**	**c**
Male	36	54	**f**
Total	**e**	**d**	210

11.1.1 The events male and preferring juice are independent. Show that e = 84. (3)

Memo

11.1

	JUICE	ENERGY DRINKS	TOTAL
Female	a = 48	b = 72	c = 120
Male	36	54	f = 90
Total	e = 84	d = 126	210

11.1.1 P(male) × P(preferring juice) = P(male and preferring juice)

$$\therefore \frac{90}{210} \times \frac{e}{210} = \frac{36}{210} \quad \ldots$$

P(A) . P(B) = P(A and B) for independent events

$$\therefore \frac{3e}{7} = 36$$

$$\therefore e = 7 \times 12 = 84 \checkmark$$

Common Errors and Misconceptions

(a) In **Q11.1.1** many candidates failed to correctly apply the *independent* rule: P(M and J) = P(M) × P(J) to calculate that the value of e was 84 as given in the question. A number of candidates used e = 84 and then proved that the events male and choosing juice were *independent*. They were not awarded marks for this response.





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11.1.2 Calculate the probability that a female learner, chosen at random from the group, will like energy drinks. (3)

Memo

11.1.2 This question can be interpreted in two different ways, so there are two possible solutions.

P(learner, chosen at random, is female and likes energy drinks)

$= \frac{72}{210}$

$= \frac{12}{35}$

or, the other interpretation:

P(female, chosen at random, likes energy drinks)

$= \frac{72}{120}$

$= \frac{3}{5}$ ◄

Common Errors and Misconceptions

(b) Many candidates were able to correctly calculate the values in the table when answering **Q11.1.2**. However, they were unable to determine the probability correctly. They read off the incorrect values in the table.





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11.2 **14%** At a kiosk, 120 people buy either a cup of coffee or a bottle of water. The chance of rain on any given day is 75%. The chance of a person buying a cup of coffee on a rainy day is three times the chance of the person buying coffee on a non-rainy day.

The probability of a person buying coffee on any given day is $\frac{7}{12}$.

Calculate the number of cups of coffee that will be sold on a non-rainy day. (4)

Memo

11.2 P(person buys a cup of coffee on a non-rainy day) $= x$.

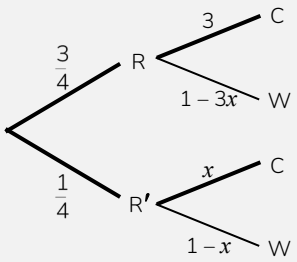
P(person buys a cup of coffee on any given day) $= \frac{7}{12}$

$$\therefore \left(\frac{3}{4}\right)(3x) + \left(\frac{1}{4}\right)(x) = \frac{7}{12}$$

$$\therefore \frac{9x}{4} + \frac{x}{4} = \frac{7}{12}$$

$$\therefore \frac{10x}{4} = \frac{7}{12}$$

$$\therefore x = \frac{7}{30}$$



$\frac{7}{30} \times 120 = 28$

$\therefore$ **28 cups of coffee will be sold on a non-rainy day.** ◄

OR:

Let x be the no. of cups of coffee bought on a non-rainy day.

P(person buys coffee on any given day)

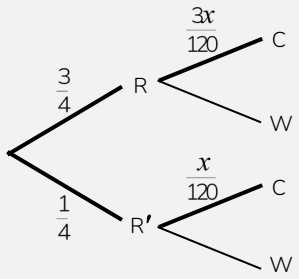
$$= \frac{9x}{480} + \frac{x}{480}$$

$$= \frac{10x}{480}$$

$$= \frac{x}{48}$$

$$\therefore \frac{x}{48} = \frac{7}{12}$$

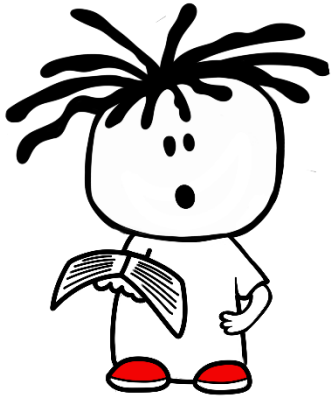
$$\therefore x = 28$$



$\therefore$ **28 cups of coffee will be sold on a non-rainy day.** ◄

Common Errors and Misconceptions

(c) Many candidates did not realise that they could have answered **Q11.2** by making use of a *tree-diagram* and therefore they did not answer the question.



11.3 **11%** Eight runners compete in a race where there are no tied finishes. Bongi and Andrew are two of the competitors.

11.3.1 Calculate the total number of possible ways in which the 8 runners can finish the race if Bongi finishes in a position immediately after Andrew. (2)

Memo

11.3.1

	1	2	3	4	5	6	7	8
1	A	B	–	–	–	–	–	–
2	–	A	B	–	–	–	–	–
3	–	–	A	B	–	–	–	–
4	–	–	–	A	B	–	–	–
5	–	–	–	–	A	B	–	–
6	–	–	–	–	–	A	B	–
7	–	–	–	–	–	–	A	B

The 8 runners can finish in 7! = 5 040 ways with Bongi (B) immediately after Andrew (A). ◄

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11.3.2 Calculate the probability that TWO OR MORE runners finish the race after Andrew and before Bongi. (4)

[16]

TOTAL: 150

Memo

11.3.2 Andrew first ... $5 \times 6!$

	1	2	3	4	5	6	7	8
1	A	–	–	B	–	–	–	–
2	A	–	–	–	B	–	–	–
3	A	–	–	–	–	B	–	–
4	A	–	–	–	–	–	B	–
5	A	–	–	–	–	–	–	B

Andrew second ... $4 \times 6!$

	1	2	3	4	5	6	7	8
1	–	A	–	–	B	–	–	–
2	–	A	–	–	–	B	–	–
3	–	A	–	–	–	–	B	–
4	–	A	–	–	–	–	–	B

Andrew third ... $3 \times 6!$

	1	2	3	4	5	6	7	8
1	–	–	A	–	–	B	–	–
2	–	–	A	–	–	–	B	–
3	–	–	A	–	–	–	–	B

Andrew fourth ... $2 \times 6!$

	1	2	3	4	5	6	7	8
1	–	–	–	A	–	–	B	–
2	–	–	–	A	–	–	–	B

Andrew fifth ... $1 \times 6!$

	1	2	3	4	5	6	7	8
1	–	–	–	–	A	–	–	B

$(1 + 2 + 3 + 4 + 5)(6!) = 15 \times 6!$

P(TWO or MORE runners finish after Andrew and before Bongi)

$= \frac{15 \times 6!}{8!}$

$= \frac{15}{56}$ ◄

OR, using the complement:

8 runners can finish the race in 8! ways.

In half of these ways, Bongi finishes before Andrew.

$\therefore$ P(Bongi finishes before Andrew) $= \frac{1}{2}$

Andrew finishes immediately before Bongi in 7! ways. (from 11.3.1)

$\therefore$ P(Andrew finishes immediately before Bongi) $= \frac{7!}{8!} = \frac{1}{8}$

Andrew finishes before Bongi with ONE runner between them in $6 \times 6!$ ways.

	1	2	3	4	5	6	7	8
1	A	–	B	–	–	–	–	–
2	–	A	–	B	–	–	–	–
3	–	–	A	–	B	–	–	–
4	–	–	–	A	–	B	–	–
5	–	–	–	–	A	–	B	–
6	–	–	–	–	–	A	–	B

$\therefore$ P(Andrew finishes before Bongi with ONE runner between them) $= \frac{6 \times 6!}{8!} = \frac{3}{28}$

P(TWO or MORE runners finish the race after Andrew and before Bongi)

$= 1 - \frac{1}{2} - \frac{1}{8} - \frac{3}{28}$

$= \frac{15}{56}$ ◄



Common Errors and Misconceptions

(d) **Q11.3.2** required candidates to establish different counting options to solve the problem. This proved to be difficult for many candidates.



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QUESTION 11: Suggestions for Improvement

(a) Learners need to be taught the difference between *mutually exclusive* and *independent* events and the rules that pertain to each of these concepts. This should be thoroughly drilled in Grades 10 and 11.

(b) Teachers need to expose learners to different contexts, diagrams and problems in which *independent* events can be tested.

(c) As mentioned in previous reports:

- Teaching basic concepts cannot be overlooked. When learners understand the basic concepts well enough, then the more complex concepts are easier to grasp.
- Reading for understanding must be a regular practice in the classroom. This should equip learners with the skills to deal with word problems in assessment tasks.

(d) Teachers need to teach both *tree diagrams* and *Venn diagrams* thoroughly. These concepts should be examined in school-based assessment tasks throughout the FET phase.

(e) Teach learners the *Fundamental Counting Principle* in such a way that they will be able to base their answers on their reasoning, rather than on any rule. The concept of the *factorial* needs to be explained thoroughly.

(f) When teaching learners about the number of options available for a code or set of items, it is a good idea for learners to draw lines or boxes to represent each space that is available. Thereafter, learners need to be taught to recognise how many options are available for each position in the code or list of items. It is important to stress to learners that they should put an '×' between these numbers so that they can arrive at the correct solution using the *Fundamental Counting Principle*.

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