higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(First Paper)
NQF LEVEL 2

(10501042)

21 February 2020 (Y-Paper)
13:00–16:00

Nonprogrammable scientific calculators may be used.

This question paper consists of 11 pages, 2 addenda and 1 formula sheet.

015Q1S2021

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│                                 │
│         TIME: 3 HOURS           │
│         MARKS: 100              │
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INSTRUCTIONS AND INFORMATION

1.   Answer all the questions.

2.   Read all the questions carefully.

3.   Number the answers according to the numbering system used in this question paper.

4.   Answer QUESTION 2.3 on ADDENDUM A and QUESTION 2.4.1 on ADDENDUM B.

5.   Leave at least THREE lines open after each question.

6.   Start each section on a new page.

7.   Diagrams are not drawn to scale.

8.   Round off answers to TWO decimal places unless stated otherwise.

9.   Write neatly and legibly.

QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 $\sqrt{2}$:

    A   Nonreal irrational number
    B   Rational integer number
    C   Real irrational number
    D   Number that can be written in the form $\dfrac{a}{b}$; where $a, b \in Z$ and $b \neq 0$

1.1.2 The factors for $a^2 - 4h^2$:

    A $a(a - 4h^2)$
    B $(a - 2h)(a + 2h)$
    C $(a - 2h)(a - 2h)$
    D $(a - 4h)(a + 4h)$

1.1.3 $2x^{-\frac{3}{5}}$ in surd form:

    A $2\sqrt[5]{x^3}$
    B $(2x^5)^{-3}$
    C $\dfrac{1}{\sqrt[5]{2x^3}}$
    D $\dfrac{2}{\sqrt[5]{x^3}}$

1.1.4 $9^{-1}x^5 \times 9^2 x^{-3}$ in simplified form:

    A $9^3 x^8$
    B $9^0 x^2$
    C $-162x^{-2}$
    D $9x^2$

1.1.5 Which ordered pair is the solution for $y = -2x - 5$?

    A   Only $(1; 7)$
    B   Only $(-3; 1)$
    C   Both $(1; -7)$ and $(-3; 1)$
    D   Only $(1; -7)$

                                                     (5 × 1)   (5)

1.2 Convert the following decimal number to the form $\frac{a}{b}$; where $a, b \in Z$ and $b \neq 0$ (simplify to the simplest form):

$0,45\dot{3}$ (3)

1.3 Simplify the following by using the rules of surds and give the answer with a rational denominator (show ALL steps):

$$\frac{6x^4\sqrt{2x^8} - 2\sqrt{8x^{16}}}{\sqrt{10x^{16}}}$$

(5)

1.4 Simplify the following by using the laws of exponents (leave the answers with positive exponents and in surd form where applicable):

1.4.1 $2x^2y^3 \times 3x^5y^{-4}$ (2)

1.4.2 $\dfrac{(-2x^{-2}y^0z^{-1})^2 \times (x^0y)^3}{(xy^{-4}z^3)^{-1}}$ (3)

1.4.3 $\dfrac{18^x \times 8^{x-2}}{9^{x+1} \times 4^{2x-3}}$ (3)

1.5 Given: $A_T = A_O + A_O \times \dfrac{r}{100} \times t$

1.5.1 Make A_O the subject of the formula. (2)

1.5.2 If $r = 5$, $A_T = 3\,000$ and $t = 4$, calculate A_O. (1)

1.6 The sequence below is made by adding blocks to form a pattern. The first three patterns are given. The first shape comprises five blocks.

$T_1 = 5$ $T_2 = ?$ $T_3 = ?$
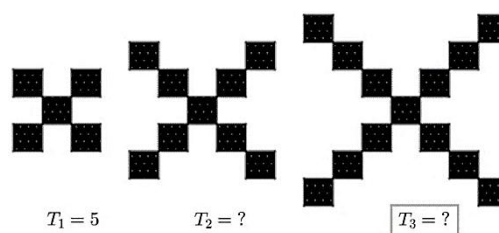
1.6.1 How many blocks are required to build the fourth pattern? (1)

1.6.2 One pattern in the sequence is described as $T_n = 161$.

Determine the value of n. (3)

1.6.3 Determine S_{12} which is the sum of the blocks in the first 12 patterns of the sequence. (2)

[30]

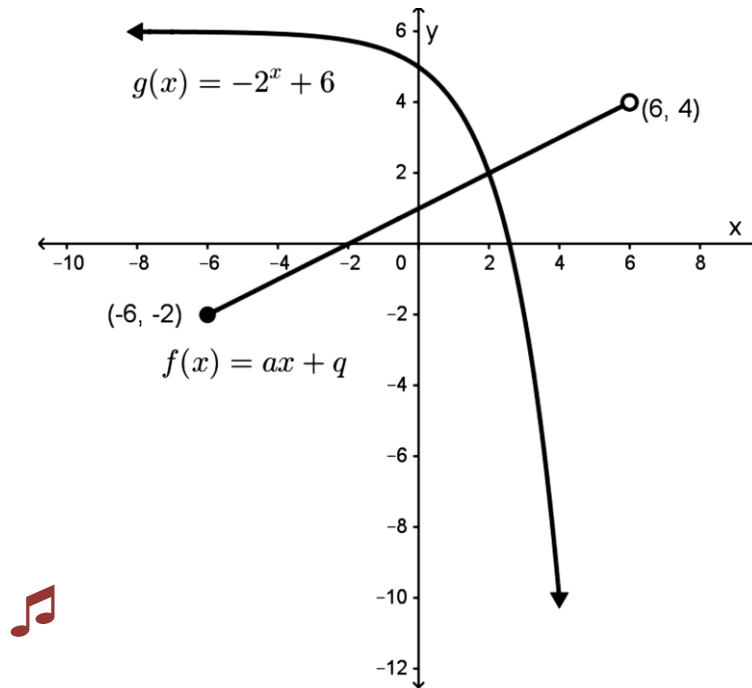## QUESTION 2

2.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (2.1.1–2.1.6) in the ANSWER BOOK.

The diagram below represents the graphs of $f(x) = ax + q$ and $g(x) = -2^x + 6$.

2.1.1 Which ONE of the following statements correctly describes the horizontal asymptote for the graph $g(x)$:

A $y = 6$
B $y \in R$
C $x = 6$
D $x = 4$

2.1.2 Which ONE of the following sets describes the range of graph $g(x)$ the best:

A $y \in [-6;6)$ where $y \in R$
B $y \in [-2;4)$ where $y \in R$
C $y \in (-\infty;6]$ where $y \in R$
D $y \in (-\infty;6)$ where $y \in R$

2.1.3   Which ONE of the following statements regarding graph $g(x)$ is true:

A $g(x)$ is a function.

B $g(x)$ is discontinuous.

C $g(x)$ has an amplitude of 6.

D $g(x)$ is a semihyperbola.

2.1.4   In the graph $f(x): y = ax + q$ an increase in the q-value will cause a …

A   horizontal transformation in the graph to the left.
B   horizontal transformation in the graph to the right.
C   vertical transformation in the graph upwards.
D   vertical transformation in the graph downwards.

2.1.5   Which ONE of the following domain-and-range pairs corresponds to the given constraints as illustrated on $f(x): y = ax + q$:

A   Domain: $x \in (-6; 6]$ where $x \in R$ and range: $y \in (-6; 4)$ where $y \in R$

B   Domain: $x \in (-6; 6]$ where $x \in R$ and range: $y \in (-8; 8)$ where $y \in R$

C   Domain: $x \in [-6; 6)$ where $x \in R$ and range: $y \in [-2; 4)$ where $y \in R$

D   Domain: $x \in [-6; 6)$ where $x \in Z$ and range: $y \in [-6; 4)$ where $y \in Z$

2.1.6   Consider $f(x): y = ax + q$.

The x-intercept is at the point…

A $(0; 1)$
B $(1; 0)$
C $(0; -2)$
D $(-2; 0)$

(6×1) (6)

2.2 The following diagram represents the graph $y = \dfrac{a}{x} + q$: ♪
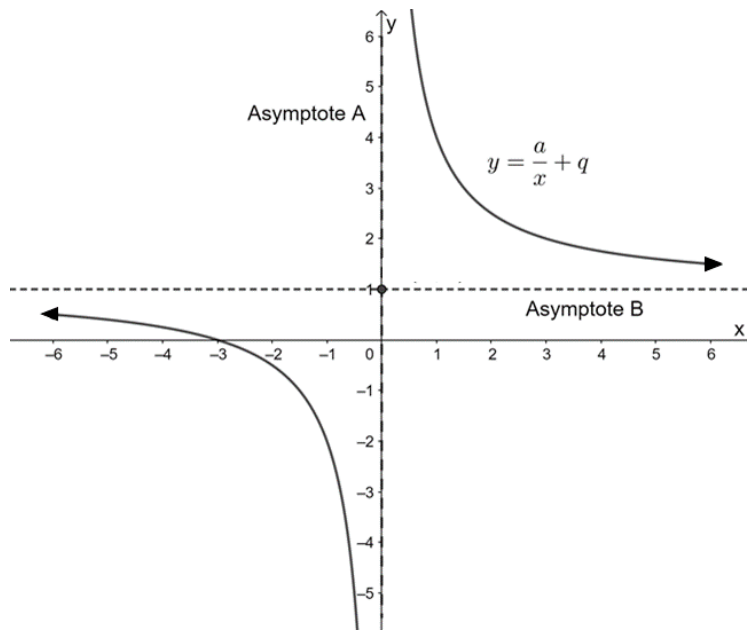
2.2.1 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (a–e) in the ANSWER BOOK. ♪

(a) This is an exponential graph.
(b) The graph is discontinuous.
(c) The domain for this graph is $x \in R$.
(d) In the equation $y = \dfrac{a}{x} + q$ the q-value represents the vertical asymptote.
(e) The graph is a nonfunction.

(5 × 1) (5)

2.2.2 Determine the values of a and q in the equation $y = \dfrac{a}{x} + q$ for the graph. (2)

2.2.3 Write down the equations for the asymptotes of the graph. ♪ (2)

2.3 Given $f(x) = -x^2 + 4$ and $h(x) = 2x$.

Sketch the graphs of $f(x)$ and $h(x)$ for the domain $x \in R$ using the table method. Clearly show coordinates of turning points and the x- and y-intercepts. Draw both graphs on the same system of axes on ADDENDUM A (attached). Complete the table on the addendum to assist you in plotting the graph. ♪ (5)

2.4   Given: $y = -\dfrac{1}{2}x + 3$

      2.4.1   Sketch the graph for the domain $[x \mid x \in R; -2 \le x < 8]$ by using the table method. Clearly show coordinates of the endpoints and the nature of the points. Draw the graph on ADDENDUM B (attached). (3)

      2.4.2   Write down the range for $y = -\dfrac{1}{2}x + 3$. ♫ (2)

[25]

QUESTION 3

3.1   Simplify each of the following:

      3.1.1 $(a+b)^2$ ♫ (1)

      3.1.2 $(x-3y)(x^2 + 3xy + 9y^2)$ (2)

3.2   Factorise each of the following:

      3.2.1 $9x^3 - 16xy^2$ (2)

      3.2.2 $6x - 9 + 6xy - 9y$ (2)

      3.2.3 $4a^2 - 4a + 1$ (2)

3.3   Express the following in its simplest form:

$$\dfrac{63x^2y - 7x^2y^3}{7x^2y}$$ ♫ (2)

3.4   Solve for x:

      3.4.1 $x - (x-2) + 2(3-x) = 0$ (2)

      3.4.2 $\dfrac{x+2}{5} - 3 = 2 - \dfrac{1-3x}{3}$ (3)

      3.4.3 $(2^{x+1})^2 = (2^2)^3$ ♫ (2)

3.5   Given: $4 \geq 3 - 8x > -11$ where $x \in R$.

      3.5.1   Solve the inequality $4 \geq 3 - 8x > -11$. (3)

      3.5.2   Represent the solution in interval notation. (1)

3.6   Solve the following system of linear equations algebraically:

$$2x = 3y - 4$$
$$y = x - 3$$
(3)

[25]

QUESTION 4

4.1   Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–H) next to the question number (4.1.1–4.1.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
4.1.1	Amount of money spent or used to buy or do something	A	fixed expense
		B	variance
4.1.2	Itemised summary of expected income and expenses over a specified period	C	balance sheet
4.1.3	Expense that varies from month to month	D	variable expense
4.1.4	Financial statement described as a snapshot of a company's financial position	E	budget
		F	cheque
4.1.5	Difference between the actual amount and the budgeted amount in a budget	G	expenses
		H	stokvel

(5×1) (5)

4.2   The table below shows Adriaan's financial statement for one month.

ADRIAAN'S BUDGET			
INCOME	**Projected**	**Actual**	**Variance**
Allowance	R6 500,00	R6 600,00	R100,00
Tips as waiter	R300,00	R105,00	-R195,00
TOTAL:	R6 800,00	R6 705,00	-R95,00
EXPENSES	**Projected**	**Actual**	**Variance**
Housing	R2 300,00	R2 300,00	R0,00
Transport	R400,00	R350,00	R50,00
Personal hygiene	R165,00	R265,00	-R100,00
Clothing	R455,00	R525,00	-R70,00
Entertainment	R120,00	R55,00	R65,00
Monthly savings bicycle	R70,00	R65,00	R5,00
Food	R2 350,00	R2 500,00	-R150,00
Books and stationary	R450,00	R150,00	R300,00
Gym membership	R110,00	R110,00	R0,00
Long-term investment	R25,00	R25,00	R0,00
TOTAL:	R6 445,00	R6 320,00	R125,00
Surplus/Deficit	R355,00	R385,00	R 30,00

4.2.1   Adriaan's accountant told him that the variance of R300 under *Books and Stationery* in his expenses section is favourable.

Explain why the accountant says this.   (1)

4.2.2   Choose the correct word from those given in brackets. Write the word next to the question number (4.2.2) in the ANSWER BOOK and give a reason for the answer.

The amount of -R95 in the income column is (favourable/unfavourable).   (2)

4.2.3   Will Adriaan have an actual surplus or deficit at the end of the month? How much will it be?   (2)

4.2.4   Three items in the budget are considered as fixed.

What do these items have in common?   (1)

4.3   Martha wants to buy a computer on the Internet which is advertised for R5 600. There is an option of paying a 10% deposit and then making 24 monthly payments using a hire-purchase agreement where interest is calculated at 15% per annum simple interest.

    4.3.1   Determine the amount that she will still owe after she has paid the 10% deposit. (2)

    4.3.2   Calculate what Martha's monthly payments will be on the balance as determined in QUESTION 4.3.1 if the hire-purchase agreement charges an interest rate of 15 % per annum simple interest. (3)

    4.3.3   What amount must Martha deposit for a period of TWO years at 7% compound interest to accumulate to R5 600 after TWO years? (4)

[20]

TOTAL: 100

ADDENDUM A

EXAMINATION NUMBER:

CENTRUM NUMBER:

2.3

x	-3	-2	-1	0	1	2	3
$f(x) = -x^2 + 4$							

x	-2	-1	0	1	2
$h(x) = 2x$					

(5)
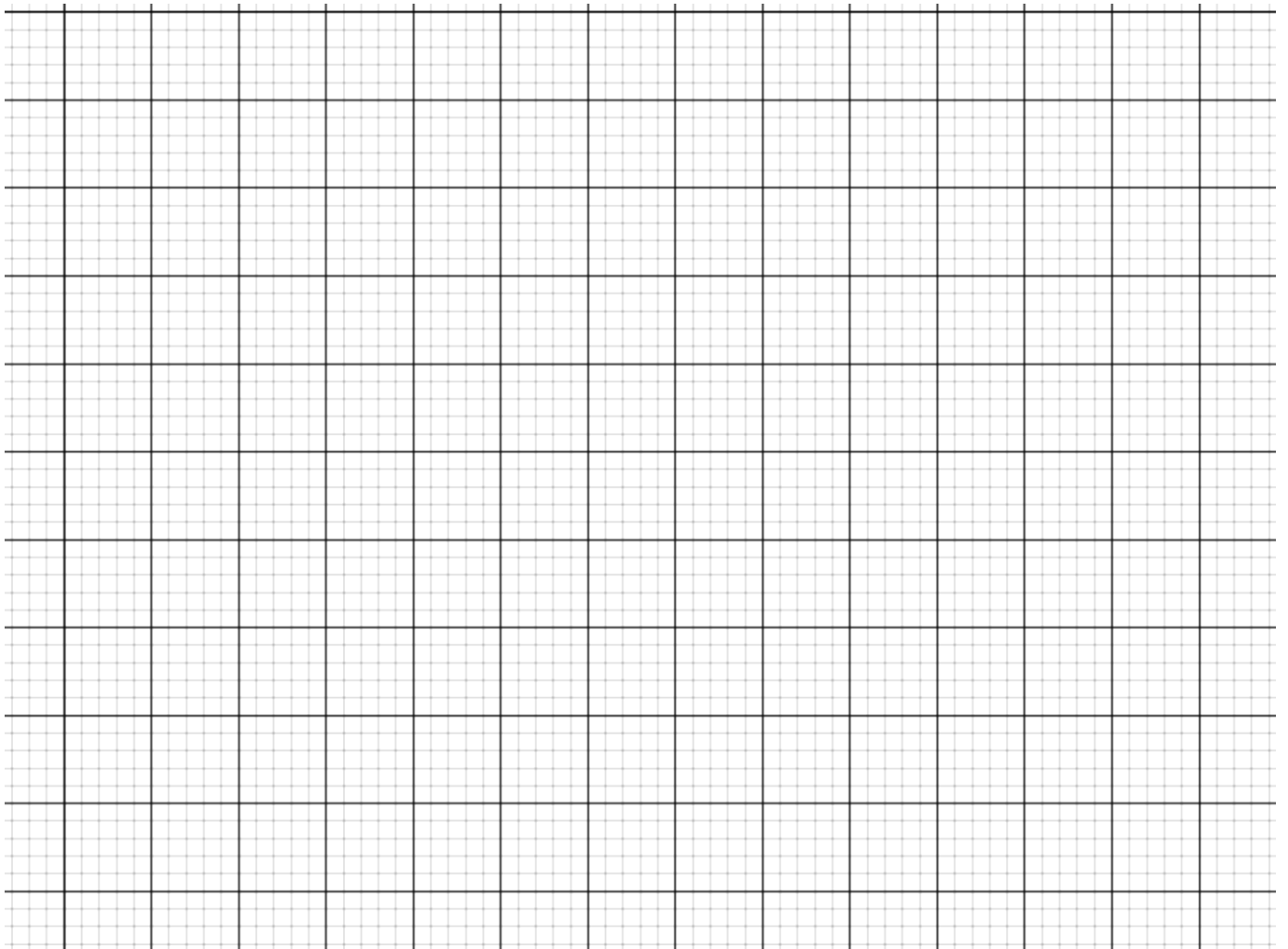
ADDENDUM B

EXAMINATION NUMBER:

CENTRUM NUMBER:

2.4.1

(3)
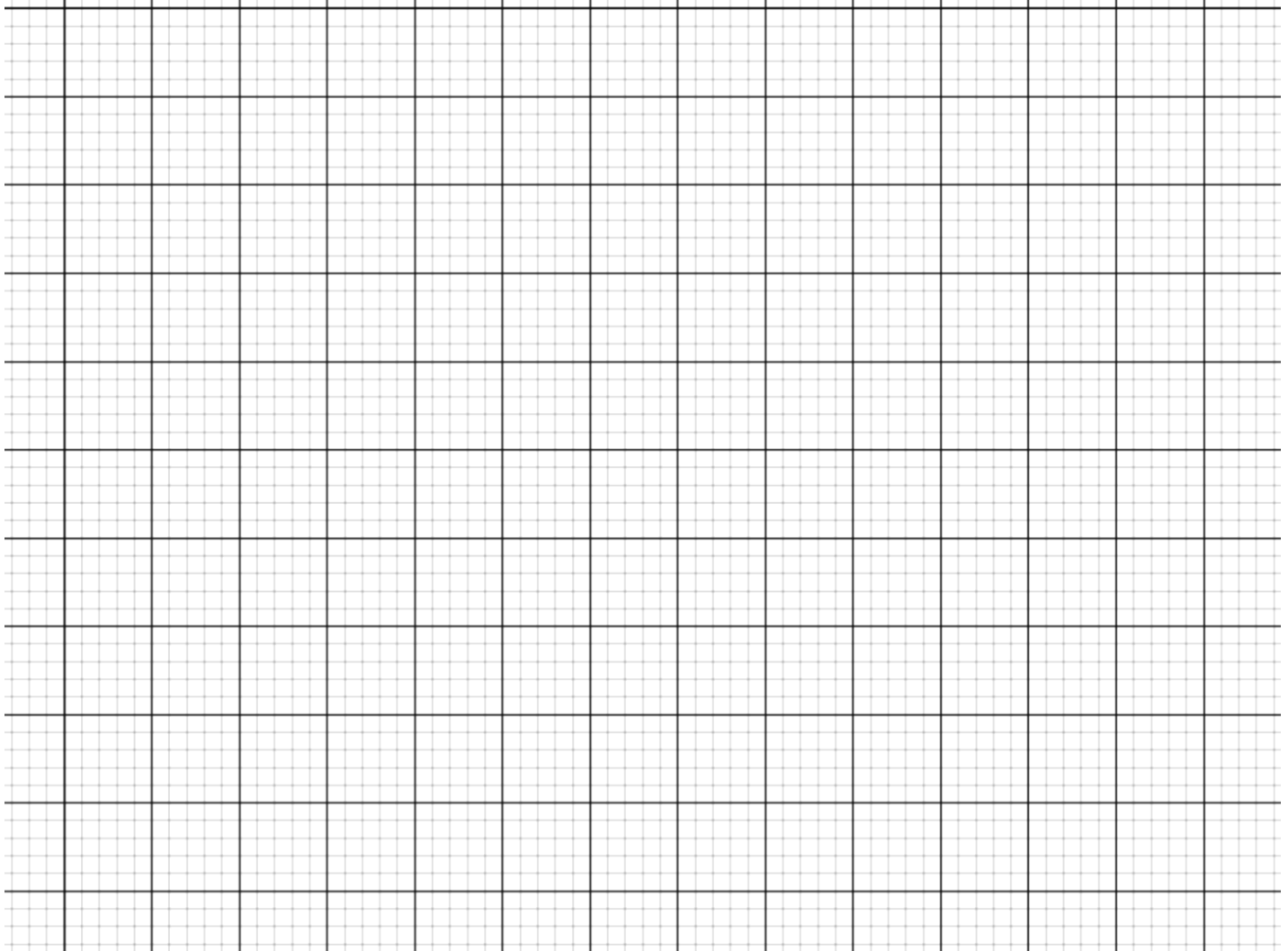
MATHEMATICS L2

FORMULA SHEET

1) $a^m \times a^n = a^{m+n}$

2) $a^m \div a^n = a^{m-n}$

3) $(a^m)^n = a^{m \times n}$

4) $(a^m b^n)^p = a^{mp} . b^{np}$

5) $\left(\dfrac{a^m}{b^n}\right)^p = \dfrac{a^{mp}}{b^{np}}$

6) $a^{-n} = \dfrac{1}{a^n}$

7) $a^0 = 1$

8) $\sqrt[n]{a^m} = a^{\frac{m}{n}}$

9) $T_n = a + (n-1)d$

10) $S_n = \dfrac{n}{2}\left[2a + (n-1)d\right]$

11) $S_n = \dfrac{n}{2}(a + l)$

12) $I = A_0 \times \dfrac{r}{100} \times t$ or $I = \dfrac{Prt}{100}$ or $A_t = P(1 + in)$

13) $A_t = A_o(1 + \dfrac{r}{100 \times m})^{t \times m}$ or $A_t = P(1 + i)^n$

14) $i = \dfrac{r}{100}$