



KING DAVID HIGH SCHOOL LINKSFIELD

PRELIMINARY EXAMINATION

AUGUST 2023

MATHEMATICS: PAPER I

Time: 3 hours

Total: 150 marks

Name: _____

Teacher: _____

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 28 pages and an information sheet of 2 pages. Please check that your paper is complete.
2. Read the questions carefully.
3. **Answer all the questions on the question paper and hand it in at the end of the examination.**
4. Two blank pages have been included at the end of the exam paper. If you run out of space, use these pages. Make sure that you indicate when you make use of this space.
5. Diagrams are not necessarily drawn to scale.
6. You may use an approved non-programmable and non-graphical calculator, unless stated otherwise. Ensure that your calculator is in **DEGREE** mode.
7. Clearly show ALL calculations, diagrams, etc. that you use in determining your answers. **Answers only will NOT necessarily be given full marks.**
8. Round off to one decimal place unless stated otherwise.
9. It is in your best interest to write legibly and present your work neatly.
10. **DO NOT USE TIPPEX.**

SECTION A	Q1 [12]	Q2 [16]	Q3 [8]	Q4 [19]	Q5 [9]	Q6 [13]		
77 marks								
SECTION B	Q7 [15]	Q8 [11]	Q9 [16]	Q10 [16]	Q11 [7]	Q12 [8]	TOTAL [150]	%
73 marks								

SECTION A**QUESTION 1**

a) Given: $x(x - 5) = a$.

Solve for x if:

1) $a = 0$ (2)

2) $a = x - 5$ (3)

b) Solve for x , showing all working:

$x^2 - 4x \geq 21$ (4)

- c) Determine the value of x if:

$$5.3^x = 10 \qquad (3)$$

[12]

QUESTION 2

a) Solve for x :

$$\log_2 x + \log_2 (x + 1) = 1 \quad (5)$$

b) Given: $f(x) = \sqrt{2x + 1}$.

1) What is the domain of $f(x)$? (1)

2) If $g(x) = 2x - 1$, solve $f(x) = g(x)$. (5)

c) Match the answers from column B to column A.

Given: $f(x) = 2x + 8$.

(5)

Column A	Column B
1) $f^{-1}(x)$	A) $y = \frac{1}{2x+8}$
2) $f\left(\frac{1}{x}\right)$	B) $y = 2x^0$
3) $\frac{1}{f(x)}$	C) $y = \frac{2}{x} + 8$
4) $f(-x)$	D) $y = -2x + 8$
5) $f'(x)$	E) $y = \frac{1}{2}x - 4$

1) _____

2) _____

3) _____

4) _____

5) _____

[16]

QUESTION 3

- a) Determine the n^{th} term for the following sequence:

2; 7; 12; 17; 22; ... (2)

- b) Given: $3 + \frac{3}{2} + \frac{3}{4} + \frac{3}{8} + \dots$

Determine the sum of the first twenty terms of the series. (3)

- c) If $S_n = -n^2 + 2n$, determine the sum of the last 4 terms of the series if there are 17 terms. (3)

[8]

QUESTION 4

a) Using first principles, determine $f'(x)$ if $f(x) = -x^2$. (4)

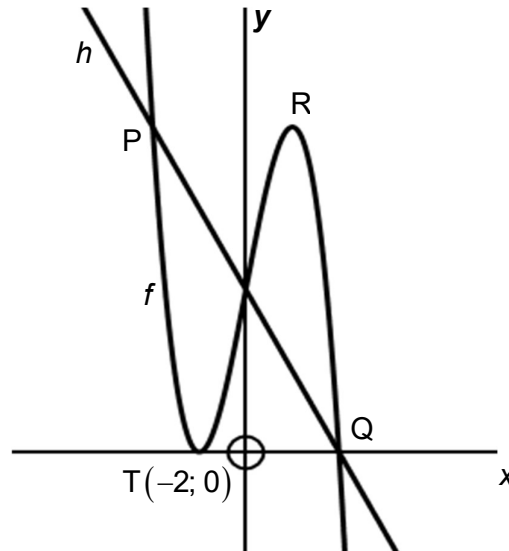
b) Determine $f'(x)$ if $f(x) = \sqrt[3]{x} + \frac{1}{x^3}$. (4)

- c) The graphs of $f(x) = -x^3 + 12x + 16$ and $h(x) = -4x + 16$ are drawn.

The graphs intersect at points P and Q.

$f(x)$ has turning points at R and $T(-2; 0)$.

T and Q are the x-intercepts of the graph of $f(x)$.



- 1) Determine the coordinates of Q. (3)

- 2) Calculate the coordinates of R. (4)

- 3) Determine the point where $f(x) + 4$ changes concavity. (4)

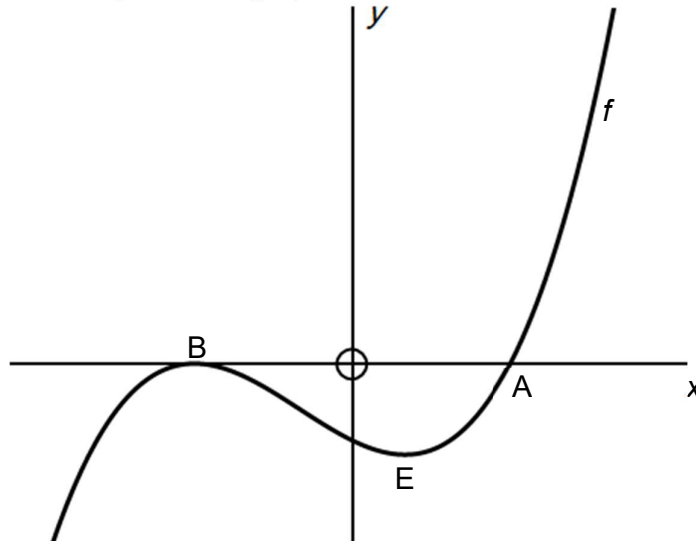
[19]

QUESTION 5

The figure below shows the graph of $f(x) = (x-1)(x+1)^2 = x^3 + x^2 - x - 1$.

B and E are the turning points of the graph.

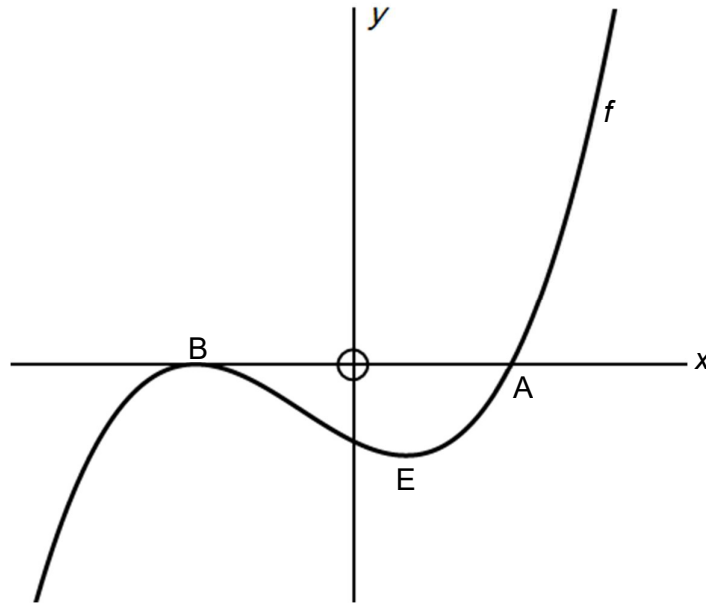
A and B are the x-intercepts of the graph.



a) Write down the length of AB. (1)

b) Determine the equation of the tangent to f at $x = 3$. (4)

- c) On the graph below, draw $y = f''(x)$. (2)



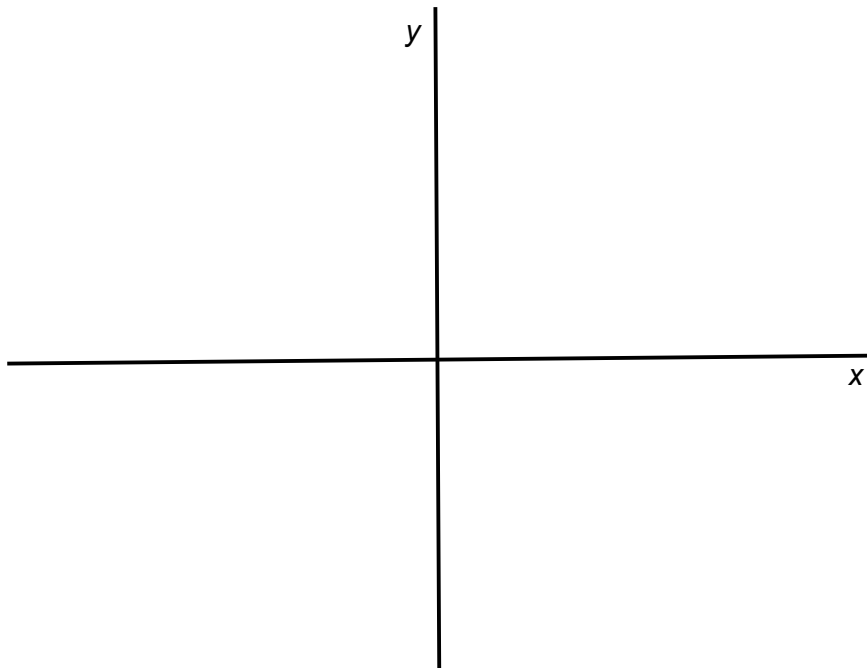
- d) For which values of x will $f''(x) \cdot f(x) < 0$? (2)

[9]

QUESTION 6

a) Given: $y + 2 - \frac{4}{x+1} = 0$.

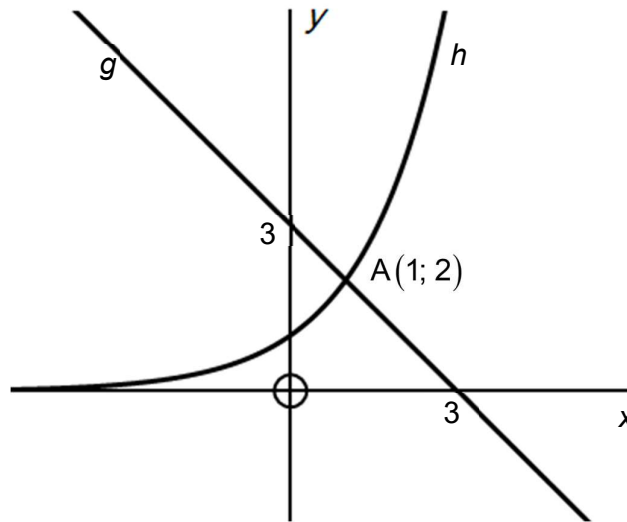
- 1) Sketch the graph on the axes below. Indicate all intercepts with the axes as well as the asymptotes. (4)



- 2) Write down the equation of the axis of symmetry for the graph with $m < 0$. (2)

- b) The graph below shows the function $g(x) = -x + 3$ and $h(x) = b^x$.

The two functions intersect at $A(1; 2)$.



- 1) Determine the value of b . (1)
- 2) Write down the equation of inverse function in the form:
 $h^{-1}(x) = \dots$ (2)
- 3) Determine the range of $h(x) - 5$. (1)
- 4) Using the graphs, determine the values of x for which:
 $-2^x \cdot x + 6 \cdot 2^{x-1} > 0$ (3)

[13]

SECTION A: 77 marks

SECTION B**QUESTION 7**

Jake wants to purchase a car, priced at R420 000.

The bank requires a 10% deposit and will then approve his loan.

The loan must be repaid over a 6-year period in equal monthly instalments and the interest is charged at 16% p.a., compounded monthly.

Payments will be made at the end of every month.

a) Determine the loan amount after Jake paid the deposit. (1)

b) Determine his monthly payments on the loan. (4)

c) What is the balance outstanding on the loan at the **end** of two years? (4)

- d) Jake decides to increase his monthly payments to R15 000, in the month **after** he made the 24th payment.

How many payments will he still need to make to settle the loan?

(You may assume that the interest remains unchanged and that the final payment might be a different amount.)

(6)

[15]

QUESTION 8

- a) In an arithmetic sequence it is given that:

$$T_5 = 2T_2 + 1$$

$$T_4 - T_2 = 8.$$

Determine T_{10} .

(6)

b) Solve for x if: $\sum_{r=1}^{12} r(x+4) = 66 - 4x$. (5)

[11]

QUESTION 9

a) Consider the digits: 3; 4; 7; 8; 9.

1) How many 5-digit codes can be created with NO repetition? (2)

2) How many 4-digit numbers, greater than 5000, can be created with NO repetition? (3)

3) How many 5-digit codes can be created which must **start** with 4 and must **end** with 7 and repetition IS allowed? (2)

- b) Events M and N are independent.

$$P(\text{not } M) = 0,2 \text{ and } P(N) = 0,7 .$$

	M	Not M	Total
N	x		
Not N			
Total			150

Determine the value of x **and** fill in the missing values in the table.

Show all necessary calculations.

(5)

c) The probability of getting an A for mathematics is $2x$.

The probability of not getting an A for mathematics is $3x^2$.

Calculate in how many of your next 15 mathematics tests you will achieve an A.

(4)

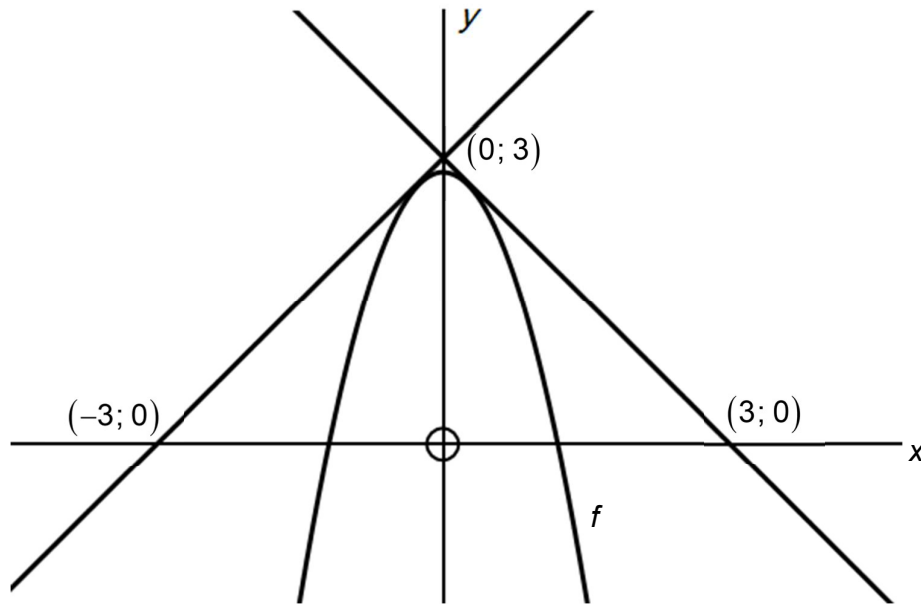
[16]

QUESTION 10

- a) Determine the coordinates of the points at which $f(x) = -2x^2 + k$; $0 \leq k \leq 3$ **touches** the two straight lines.

Show all your working.

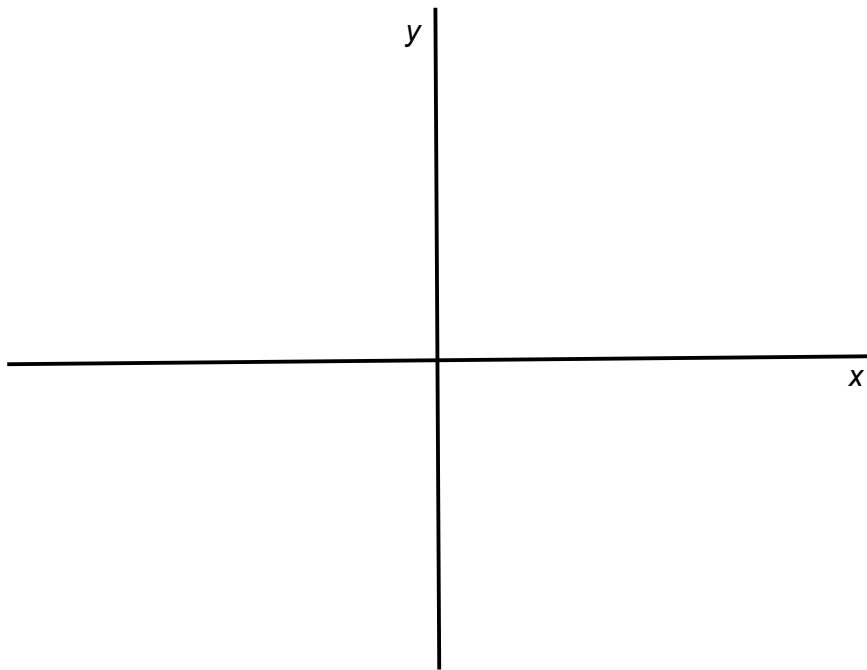
(6)



b) Given that $f(x)$ and $g(x)$ are both parabolas, and:

$$f(x) = -g(x); \quad f(0) = -3; \quad f(2) = f(6) = 0; \quad f'(a) = 0; \quad f(a) = 5.$$

- 1) Sketch the graph of $g(x)$, showing all intercepts with the axes and the turning point. (4)

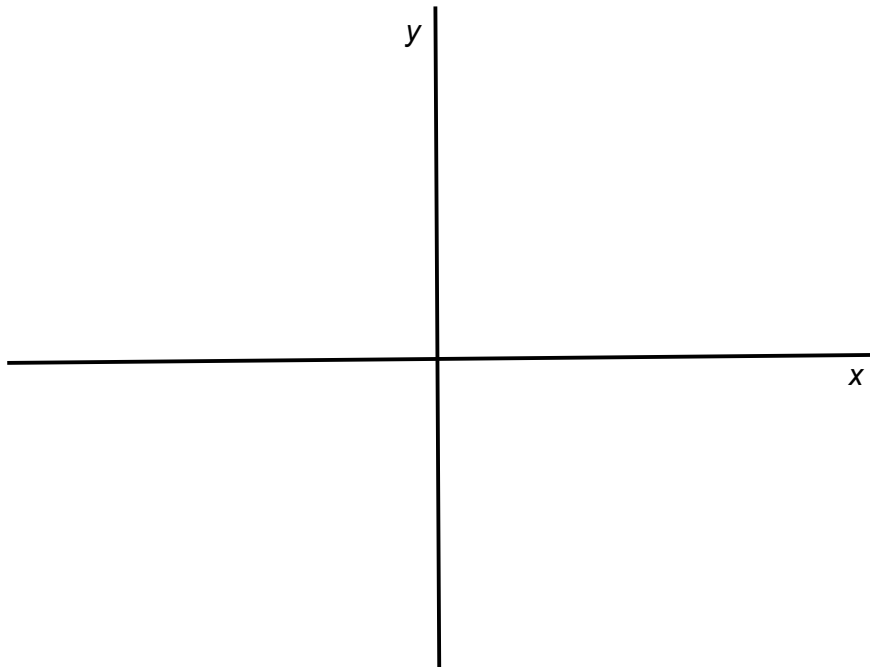


- 2) Hence, if $h'(x) = g(x)$, state the values of x for which $h(x)$ will be increasing, **without** determining the equation of $h(x)$. (2)

c) Given: $\log_3 y + \log_3 x = 2$.

Use your knowledge of logarithms to sketch the graph, paying attention to any restrictions.

(4)



[16]

QUESTION 11

Given the quadratic sequence: 34; 42; 48; 52; 54; ...

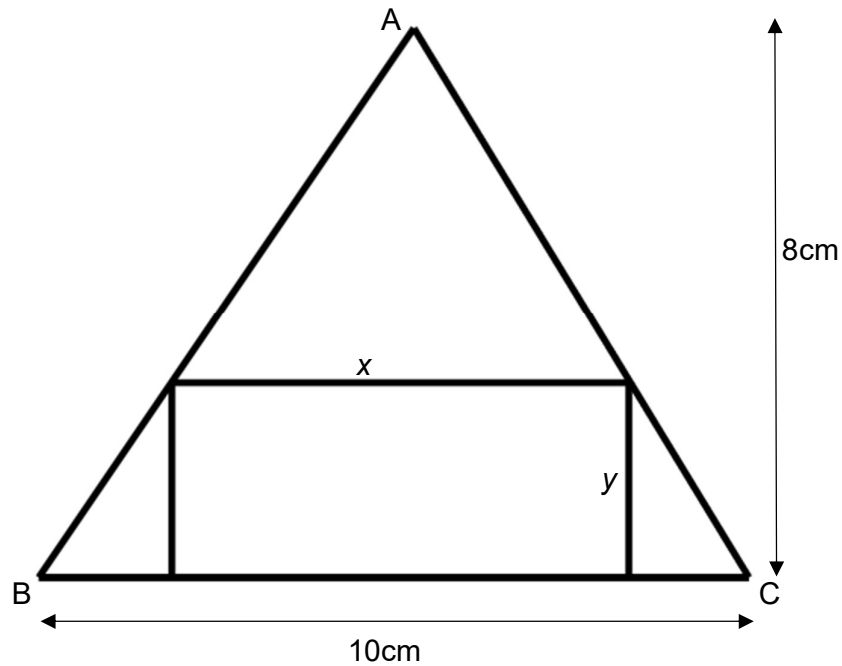
Determine the value of k for which the k^{th} term of the quadratic sequence will be equal to the k^{th} term in the row of first differences. (7)

[7]

QUESTION 12

A rectangle with length x and breadth y is inscribed in $\triangle ABC$, with $AB = AC$.

The base of the triangle is 10cm and the height is 8cm.



Determine the dimensions of the rectangle with a maximum area.

(8)

QUESTION 12 (extra space if needed)

[8]

SECTION B: 73 marks

TOTAL: 150 marks

**EXTRA SPACE. CLEARLY INDICATE THE QUESTION NUMBER. ALSO
INDICATE WITHIN THE QUESTION THAT YOU HAVE USED THIS SPACE!**

**EXTRA SPACE. CLEARLY INDICATE THE QUESTION NUMBER. ALSO
INDICATE WITHIN THE QUESTION THAT YOU HAVE USED THIS SPACE!**