



DURBAN GIRLS' COLLEGE

MATHEMATICS PAPER 1

TIME: 3 HOURS

150 MARKS

EXAMINER: Mrs C Jacobsz

MODERATORS: Ms M Eastes, Mrs T Thorne and Mrs V Rixon

**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

- This question paper consists of 10 pages.
- All questions must be answered in the answer book provided.
- Read questions carefully.
- Answer all questions and show all working.
- Number your answers exactly as the questions are numbered.
- Do not redraw diagrams.
- All answers must be given correct to **one decimal place**, where necessary, unless stated otherwise.
- Approved calculators may be used, unless stated otherwise.

**FORMULAE**

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

$$A = P(1 + in) \quad A = P(1 - in) \quad A = P(1 + i)^n \quad A = P(1 - i)^n$$

$$P(A) = \frac{n(A)}{n(B)} \quad P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

Marking Grid ( for Educators' use only )

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Marks Earned									
Total marks	28	9	8	3	13	9	8	9	6

	Q10	Q11	Q12	Q13	Q14	Q15	TOTAL
Marks Earned							
Total marks	6	17	11	8	5	10	150

SECTION A [70 marks]

Question 1

1.1 Solve for  $x$ :

1.1.1.  $(x + 2)(3x - 5) = 0$  , if  $x \in \mathbb{Z}$  (2)

1.1.2.  $3x^2 - 4x - 2 = 0$  ( correct to ONE decimal place) (3)

1.1.3.  $x - 2 = \sqrt{8 - x}$  (4)

1.1.4.  $x - 3 = \frac{2x^2 + x - 6}{x + 2}$  (4)

1.1.5.  $2^{x+1} + 2^{x+2} = 48$  (4)

1.2 Solve the following equations simultaneously:

$$y - x = 4$$

$$y = 2x^2 + 6x - 8 \quad (5)$$

1.3 Solve for  $x$ :  $(x - 2)(x - 1) < 6$  (4)

1.4 The roots of a quadratic equation are:  $x = \frac{3 \pm \sqrt{-m-4}}{2}$

For which values of  $m$  are the roots equal? (2)

[28 marks]

Question 2

2.1 Simplify:  $\frac{6^{n+3} \cdot 3^{1+n}}{18^{n+2}}$  (3)

2.2 Simplify, without the use of a calculator:  $2\sqrt{8a}(\sqrt{2a} + 3\sqrt{18a})$  (3)

2.3 Express  $p$  as a power of 2:

$$p = 2^k + 2^k + 2^k \dots \dots \dots (2048 \text{ times}) \quad (3)$$

[9 marks]

### Question 3

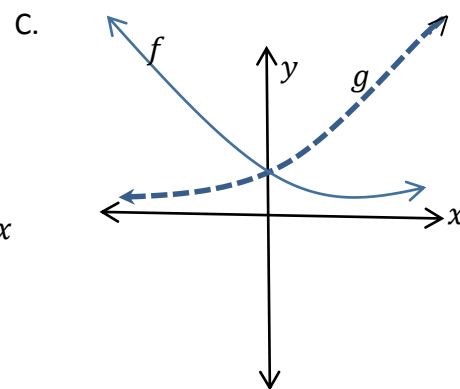
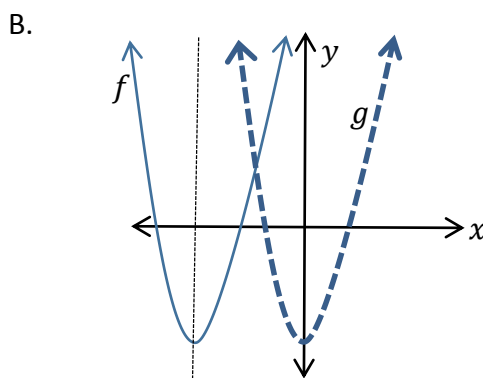
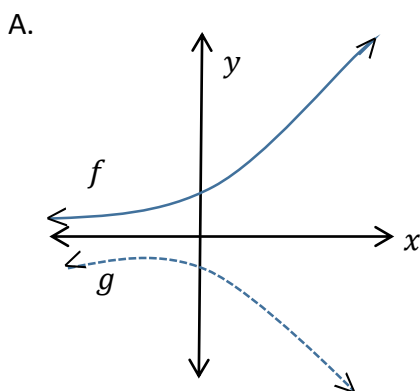
Given:  $f(x) = \frac{4}{x+1} - 2$

- 3.1 Write down the equations of the asymptotes of  $f$ . (2)
- 3.2 Calculate the x-intercept of  $f$ . (2)
- 3.3 Write down the range of  $f$ . (2)
- 3.4 if  $y = x + k$  is an equation of the line of symmetry of  $f$ , calculate the value of  $k$ . (2)

[8 marks]

### Question 4

A function  $f(x)$  is shown below and its transformation to  $g(x)$ . Match the letter from the drawing, to the number of the transformation that occurred.



- 1)  $g(x) = f(x + 2)$   
4)  $g(x) = f(x) - 2$

- 2)  $g(x) = f(-x)$   
5)  $g(x) = f(x - 2)$

- 3)  $g(x) = -f(x)$  (3)

[3 marks]

### Question 5

Consider the following number pattern:  $-7; 0; 9; 20; \dots$

- 5.1 Show that the general term of the number pattern is given by  $T_n = n^2 + 4n - 12$ . (4)
- 5.2 Which term of the quadratic number pattern is equal to 128? (4)
- 5.3 Determine the general term of the first differences. (2)
- 5.4 Between which TWO terms of the pattern will the first difference be 599? (3)

[13 marks]

## Question 6

- 6.1 Mrs Barnsley's daughter is 2 years old today. Mrs Barnsley would like to start saving so that she can give her daughter R20 000 on her 18<sup>th</sup> birthday, in 16 years' time. A bank offers her 9,8% interest compounded monthly.
- 6.1.1 Calculate the amount of money she should deposit in the account now in order for her to achieve this goal. (2)
- 6.1.2 Calculate the effective interest rate if the nominal interest rate is 9,8% p.a. compounded monthly. (2)
- 6.2 You decide to open an investment account with a deposit of R50 000 earning 6% p.a compounded quarterly, for the first 5 years. Thereafter the interest rate changes to 7,5% pa compounded semi-annually. The investment company says your money will double in 12 years, calculate if their prediction is true or not, show all necessary working. (5)

[9 marks]

SECTION B [80 marks]

Question 7

Exactly 10 years ago Sershni invested R35 000 in an account earning 6,8% per annum, compounded monthly.

7.1 Without Sershni making any transactions into the account, how much will she receive if she withdraws her money today? (2)

7.2 Sershni withdrew R15 000 three years after making the initial deposit. She then re-invested the R15 000 back into the account 2 years later. (i.e. five years after making the initial deposit.

Calculate the difference between the final amount Sershni will now receive after 10 years, and the amount she received in 7.1. when she had made no transactions on the account after the initial deposit. (6)

[8 marks]

Question 8

8.1 The **quadratic sequence**  $1; 2x - 1; 5x - 2; 25; 8x + 17; \dots$  is given.

Calculate the value of  $x$ . (4)

8.2 Find the  $n^{th}$  term ( $T_n$ ) for the following sequence and hence find which term has the value of  $\frac{78\,125}{21}$  ?

$$\frac{5}{3}; \frac{25}{6}; \frac{125}{9}; \frac{625}{12}; \dots \quad (5)$$

[9 marks]

Question 9

Draw rough, neat sketch graphs of the following functions, on separate system of axes.

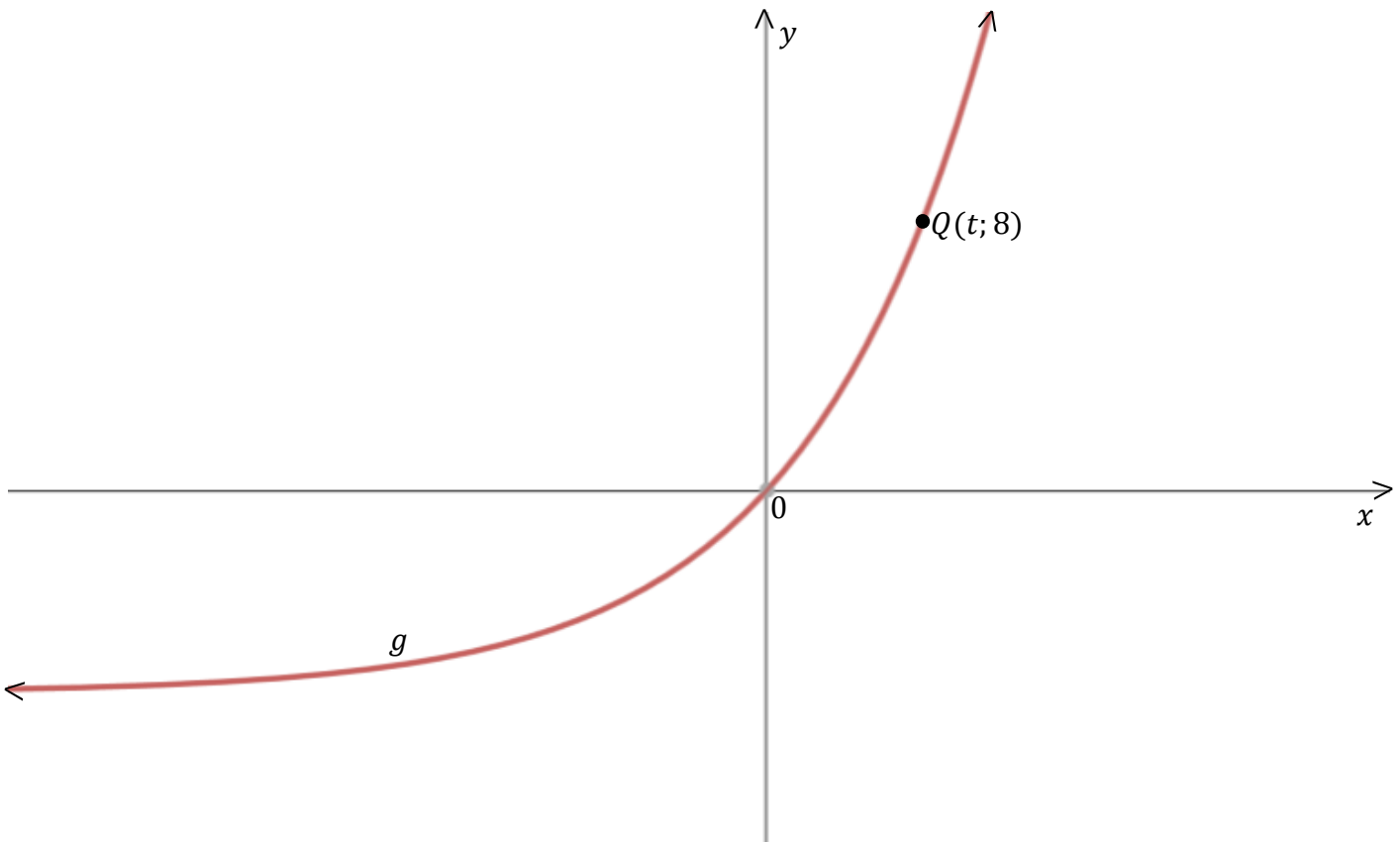
9.1  $y = a^{x+p} + q$  where  $0 < a < 1$ ;  $p > 0$  and  $q < 0$ . (3)

9.2  $y = ax^2 + bx + c$  where  $a > 0$ ;  $b < 0$  and  $(b^2 - 4ac) < 0$  (3)

[6 marks]

Question 10

The graph of  $g(x) = 3^x - 1$  passes through the origin as shown below.  $Q(t; 8)$  is a point on  $g$ .



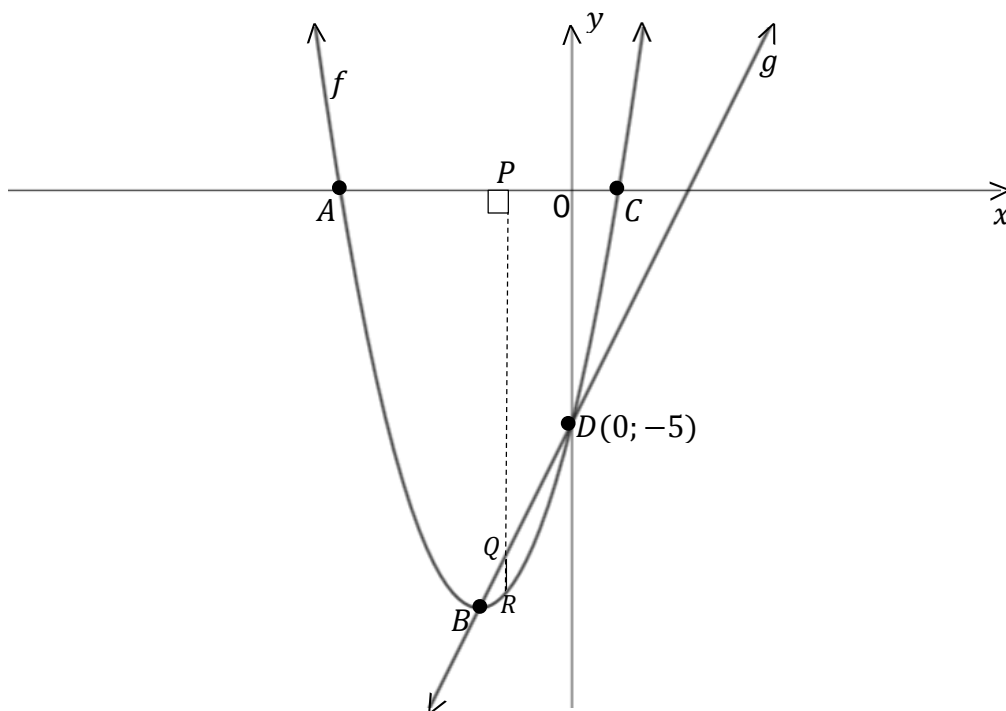
- 10.1 Determine the value of  $t$ . (2)
- 10.2 Give the equation of the asymptote of  $h(x)$  if  $h(x) = g(x) + 1$  (1)
- 10.3 If the graph of  $g$  is shifted 2 units to the right to give the function  $p$ , write down the equation of  $p$ . (1)
- 10.4 If the graph of  $g$  is reflected about the  $x$ -axis to give the function  $k$ , write down the equation of  $k$ . (2)

[6 marks]

### Question 11

The graph of  $f(x) = x^2 + bx + c$  and the straight line  $g$  are sketched below.  $B$  and  $D$  are the points of intersection of  $f$  and  $g$ .  $C(1; 0)$  is the  $x$ -intercept and  $B$  the turning point of  $f$ .

The axis of symmetry of  $f$  is  $x = -2$ .



- 11.1 Write down the co-ordinates of  $A$ . (1)
- 11.2 Show that the equation of  $f(x) = x^2 + 4x - 5$ . (3)
- 11.3 Calculate the the co-ordinates of  $B$ , the turning point of  $f$ . (2)
- 11.4 Calculate the equation of  $g$  in the form of  $y = mx + c$ . (2)
- 11.5 For which values of  $x$  will:
- 11.5.1  $f(x) \geq 0$  (2)
- 11.5.2  $g(x) - f(x) > 0$  (2)
- 11.6 For which values of  $r$  will  $f(x) = r$  have equal roots? (1)
- 11.7  $P$  is a point on the  $x$ -axis such that  $PR$  is perpendicular to the  $x$ -axis.  $PR$  intersects  $g(x)$  at  $Q$ . Calculate the **maximum length** of  $QR$ . (4)

[17 marks]

### Question 12

There are 15 girls and 25 boys in an English class. During each English lesson, two learners are randomly chosen to do an oral.

- 12.1 Represent this situation in a tree diagram showing all possible outcomes. (4)
- 12.2 Calculate the probability that a boy and a girl are chosen to do an oral in any particular order. (3)
- 12.3 Calculate the probability that at least one of the learners chosen is a male. (2)
- 12.4 Are the events, picking a boy first and picking a girl second, independent or dependent? Justify your answer. (2)

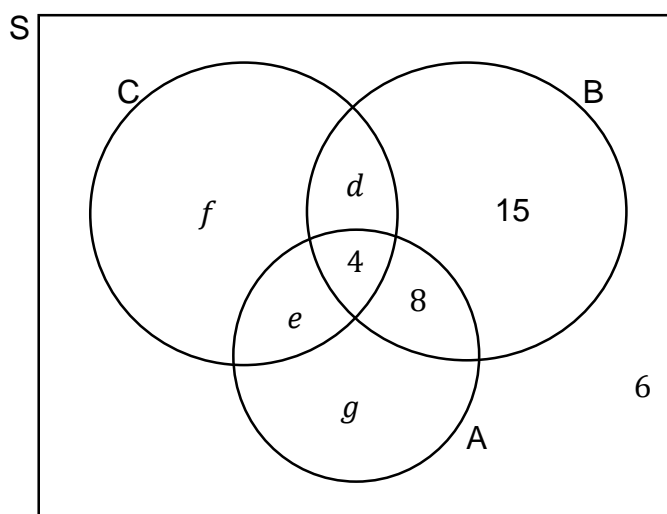
[11 marks]

### Question 13

Research was conducted about driving under the influence of alcohol. There are three methods that are used to measure alcohol levels in a person. Method A is measured by the alcohol content of your Breath (A), method B is the blood-alcohol concentration (B) and method C is a certificate issued by doctors (C). Information obtained from traffic authorities in 54 countries on the methods that are used to measure alcohol levels in a person, are summarised below.

- 4 countries use all three methods ( A, B and C).
- 12 countries use the alcohol content of breath (A) and blood-alcohol concentration (B).
- 9 countries use blood-alcohol concentration (B) and certificates issued by doctors (C).
- 8 countries use the alcohol content of breath (A) and certificates issued by doctors (C).
- 21 countries use the alcohol content of breath (A).
- 32 countries use blood-alcohol concentration (B).
- 20 countries use certificates issued by doctors (C).
- 6 countries use none of these methods.

Below is a partially completed Venn diagram representing the above information.



- 13.1 Use the above information and the Venn diagram to determine the values of  $d$ ,  $e$ ,  $f$  and  $g$ . (4)



13.2 For a randomly selected country, calculate:

13.2.1  $P(A \text{ and } B \text{ and } C)$  (1)

13.2.2  $P(A \text{ or } B \text{ or } C)$  (1)

13.2.3  $P(\text{only } C)$  (1)

13.2.4  $P(\text{that a country uses two methods only})$  (1)

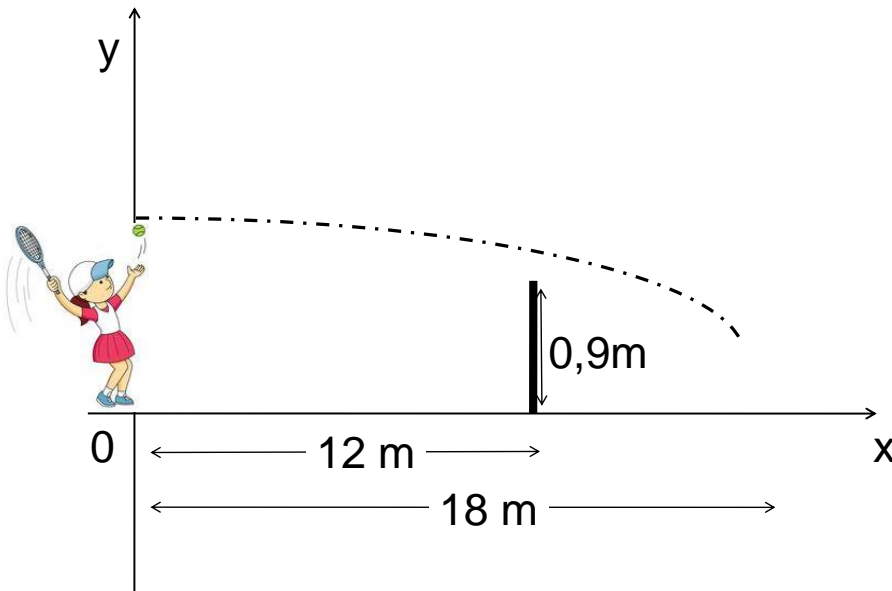
[ 8 marks ]

Question 14

Leigh-Anne is playing tennis. The height of the ball ( $y$ ) above the ground, before bouncing,

is given by the equation:  $y = -0,005x^2 - 0,05x + 2,5$

The origin is the point where Leigh-Anne is standing and  $x$  is the horizontal distance covered by the ball (in metres).



14.1 What is the height of the ball as Leigh-Anne serves? (1)

14.2 The net is 0,9 m high and 12 m away from the service point.

Show that the ball passes over the net. (2)

14.3 For the serve to be 'in', it must land between the net and the service line, which is 18 m from Leigh-Anne's service position.

Showing all working, determine whether Leigh-Anne's serve is 'in'. (2)

[ 5 marks ]

TURN OVER FOR QUESTION 15

### Question 15

15.1 Given:

$$* H = ax^2 + bx + c$$

$$* b^2 - 4ac = 0$$

$$* a + 5 = c$$

$$* 5a + 5 = 3c - 2$$

15.1.1 Determine the value of  $b$  when  $b > 0$ . (5)

15.1.2 How many solutions would you get for  $H = 0$ ? (1)

15.2 Given:  $(x - b)^2 = 15$ .

Determine the numerical value of  $3x^2 - 6bx + 3b^2 + 4$  (4)

[10 marks]