



Province of the  
**EASTERN CAPE**  
EDUCATION

# **NATIONAL SENIOR CERTIFICATE**

**GRADE 11**

**NOVEMBER 2023**

**TECHNICAL MATHEMATICS P1**

**MARKS: 150**

**TIME: 3 hours**



This question paper consists of 13 pages, including a  
2-page information sheet and an answer sheet.

**INSTRUCTIONS AND INFORMATION**

Read the following instructions carefully before answering the questions.

1. This question paper consists of EIGHT questions.
2. Answer ALL the questions.
3. Answer QUESTION 5.5 on the ANSWER SHEET that is provided. Write your name and the school's name in the spaces provided and then hand in the DIAGRAM SHEET with your ANSWER BOOK.
4. Clearly show ALL calculations, diagrams, graphs, et cetera, that you have used in determining your answers.
5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
6. If necessary, ALL answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Diagrams are NOT necessarily drawn to scale.
9. Write neatly and legibly.

**QUESTION 1**

1.1 Simplify the following completely **WITHOUT** using a calculator.

1.1.1  $(5\sqrt[3]{3} - x^5)^0$  (1)

1.1.2  $x^{\frac{1}{2}}(3 - x)$  (2)

1.1.3  $(\sqrt{3} - 3)(\sqrt{3} + 3)$  (3)

1.1.4  $\frac{\log_2 32^{\frac{1}{5}} + \log_2 27^{\frac{1}{3}}}{\log_2 6 + \log_7 x^0}$  (6)

1.2 Consider:  $y = \sqrt[x]{\frac{3^{x-1} - 7 \cdot 3^{x+1}}{6 \cdot 9^x}}$

1.2.1 Prove that  $y = \frac{1}{3} \times \left(-\frac{31}{9}\right)^{\frac{1}{x}}$  (5)

1.2.2 Hence, show that for  $y \in \text{real numbers}$  then  $x \notin \text{even numbers}$ . (1)

1.3 Consider binary numbers  $X = 100000_2$  and  $Y = 111_2$

1.3.1 Write  $X$  and  $Y$  in decimal form. (2)

1.3.2 Hence or otherwise, determine  $(X - Y)$  in binary form. (2)

- 1.4 The picture shown is a vernier calliper, an instrument that is used to take accurate measurement readings between two graduation markings on a linear scale. It can accurately measure up to 0,1 mm.



- 1.4.1 Determine, in mm, the reading of the vernier calliper instrument if the thickness of a wool trend is  $\frac{1}{12}$  cm. (2)
- 1.4.2 Hence or otherwise, write the vernier calliper reading in **scientific notation**. (2)
- [26]

**QUESTION 2**

2.1 Given:  $\log 2 = x$ ,  $\log 7 = y$  and  $\log 10 = z$

2.1.1 Write down the numerical value of  $z$  (1)

2.1.2 Show that  $x + y - 2z = \log 0,14$  (5)

2.2 Solve for  $x \in \mathbb{R}$ , WITHOUT using a calculator:

2.2.1  $3^{x+1} \cdot 3^{x-3} = 1$  (4)

2.2.2  $\sqrt{48} - x^2\sqrt{3} = \sqrt{27}$  (6)

2.2.3  $10^x = 30$ ; given that  $\log 3 = 0,48$  (4)

2.3 Show that:

$$2^{2x} \cdot 7^{x-1} - 5 \cdot 28^x = -34 \cdot 2^{2x} \cdot 7^{x-1} \quad (5)$$

2.4 The formula used to convert degrees Celsius (C) to degrees Fahrenheit (F) is:

$$C = \frac{5(F-32)}{9}$$

2.4.1 Make the F the subject of the formula. (2)

2.4.2 Convert  $2^\circ\text{C}$  to F. (2)

**[29]**

**QUESTION 3**3.1 Solve for  $x$ :

$$3.1.1 \quad x(x-2)=0 \quad (2)$$

$$3.1.2 \quad x^2 + x\left(3 - \frac{5}{x}\right) = 0 \quad (\text{Correct to ONE decimal place}) \quad (4)$$

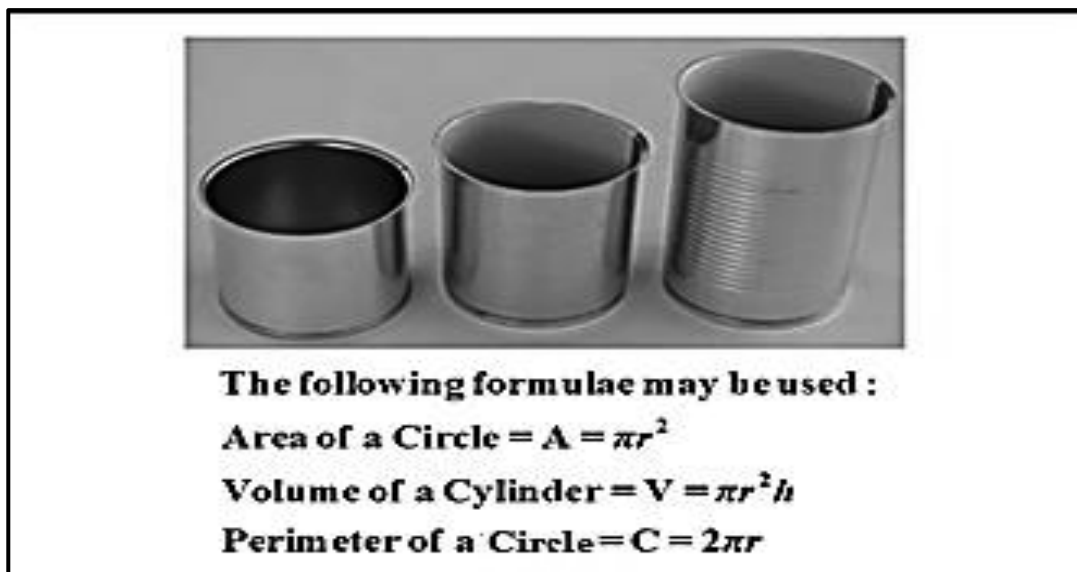
$$3.1.3 \quad -7x^2 - 3x + 4 > 0 \quad (\text{Represent the solution set on a NUMBER LINE}) \quad (4)$$

3.2 Solve for  $x$  and  $y$  simultaneously in the following equations:

$$y - \frac{x}{2} + 1 = 0 \quad \text{and} \quad x^2 + 3y^2 = 2xy + 4 \quad (6)$$

3.3 Three different types of cylindrical cans shown in the picture below are given special codes according to their ratios of heights to diameters of the tops or bottoms.

An A1 round can type has a standard height = 73 mm and diameter = 62 mm.



3.3.1 Write down the length of a radius of a standard A1 cylindrical can. (1)

3.3.2 Determine the perimeter of the top side of a standard A1 can. (1)

3.3.3 Calculate the volume of a standard A1 can. (2)

3.3.4 Show that  $A = \frac{C^2}{4\pi}$  (3)

3.3.5 Hence or otherwise, determine the diameter of a steel can whose area is 5 665,36 mm<sup>2</sup>. (3)

**[26]**

**QUESTION 4**

- 4.1 Without solving the equation, determine the nature of roots of:

$$f(x) = (x - \sqrt{3})(\sqrt{2}x - 1) \quad (3)$$

- 4.2 Consider:  $g(x) = 1 \pm \sqrt{\frac{x+1}{x-1}} + 2$

- 4.2.1 Determine the value of  $x$  for which  $g$  is undefined. (1)

- 4.2.2 Determine the value of  $x$  for which  $g$  has equal roots. (3)

- 4.2.3 Write down the values of  $\frac{x+1}{x-1}$  for which  $g$  will be non-real. (1)  
[8]

**QUESTION 5**

Given the functions  $f$  and  $g$  defined by  $f(x) = -\frac{2}{x} - 2$  and  $g(x) = -\sqrt{16 - x^2}$

A and B are points through which the asymptote of  $f$  cuts the graph of  $g$ .

- 5.1 Write down the equations of asymptotes of  $f$ . (2)

- 5.2 Determine the  $x$ -intercepts of  $g$ . (2)

- 5.3 Write down the  $x$ -intercept of  $f$ . (3)

- 5.4 Determine the  $y$ -intercept of  $g$ . (1)

- 5.5 Sketch the graphs of  $f$  and  $g$  on the ANSWER SHEET provided. Clearly indicate the intercepts and the asymptotes  $f$  and  $g$ . (6)

- 5.6 Use your graph to indicate the points where the two functions are equal. Label the points A, B and C. (1)

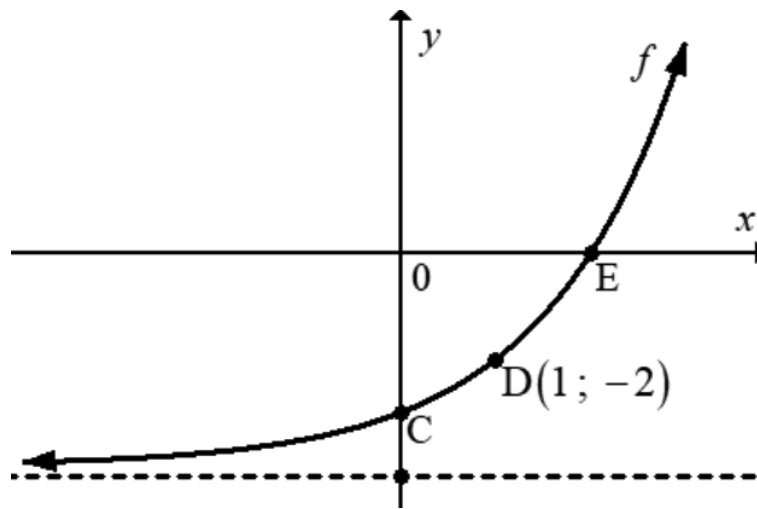
- 5.7 Write down the domain of  $f$ . (1)

- 5.8 Determine the values of  $x$  for which  $g(x)$  is below the line  $y = -2$  (4)  
[20]

**QUESTION 6**

The sketch below represents the graph of function  $f$  defined by  $f(x) = a^x - 4$ .

The graph passes through point C, D (1; -2) and E. Points C and E are the intercept of  $f$ .



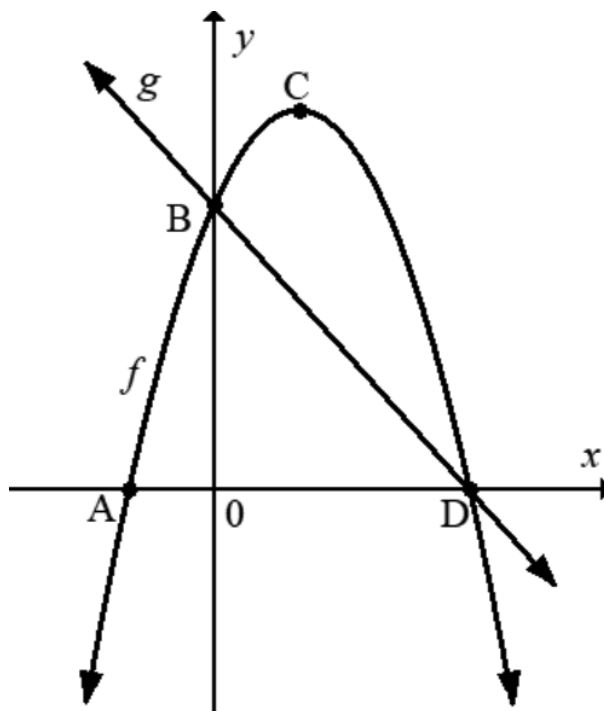
- 6.1 Write down the equation of an asymptote of  $f$ . (1)
- 6.2 Write down the coordinates of C, the  $y$ -intercept of  $f$ . (2)
- 6.3 Determine the numerical value of  $a$ . (3)
- 6.4 Write down the range of  $f$ . (1)
- 6.5 Determine the coordinates of E, the  $x$ -intercept of  $f$ . (2)
- 6.6 Write down the coordinates of K, the image of point D (1; -2) if the graph of  $f$  is reflected about the  $x$ -axis. (2)

**[11]**

**QUESTION 7**

The sketch below represents the graphs of functions  $f$  and  $g$  defined by  $f(x) = (6 - 2x)(x + 1)$  and  $g(x) = -2x + 6$ .

- A and D are the  $x$ -intercepts of  $f$ .
- B is the common  $y$ -intercept for both  $f$  and  $g$ .
- C is the turning point of  $f$ .
- B and D are the points where the two graphs cut each other.



- 7.1 Write down the coordinates of points, **A** and **D**. (2)
- 7.2 Write down the coordinates of **B**. (2)
- 7.3 Determine the coordinates of **C**. (3)
- 7.4 Write down the values of  $x$  for which  $f(x) = g(x)$ . (2)
- 7.5 Determine the function  $h(x)$  in the form:  $h(x) = (a + 2x)(x - b)$  if  $h(x)$  results from shifting  $f$  2 units to the right. (2)
- 7.6 Calculate the area of  $\triangle BOD$ . (2)

**[13]**

**QUESTION 8**

- 8.1 Calculate 7,8 % of R2 567. (1)
- 8.2 Determine the effective annual interest rate of 7,8% compounded monthly. (3)
- 8.3 The value of farm machinery bought at the beginning of the year in 2017 depreciated over the years at a rate of 7,2% per annum, compounded quarterly on a reducing balance method to R800 000.  
Determine the initial cost of the machinery when it was new. (5)
- 8.4 A school invested a sum of R320 000 in an investment account to buy a school bus costing R950 000.
- The interest rate for the first three years of the investment is 5% per annum.
  - At the end of the third year, the school deposited a further R400 000 into the account.
  - The interest rate then increased to 5,8% for the remaining years of the investment.
- 8.4.1 Calculate the amount that was in the investment account at the end of the third year. (3)
- 8.4.2 Determine how long it will take the investment to reach the required amount of R950 000. (5)
- [17]**

**TOTAL: 150**

## INFORMATION SHEET: TECHNICAL MATHEMATICS

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

$$x = -\frac{b}{2a}$$

$$y = \frac{4ac - b^2}{4a}$$

$$a^x = b \Leftrightarrow x = \log_a b, \quad a > 0, a \neq 1 \text{ and } b > 0$$

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

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

$$A = P(1 - i)^n$$

$$i_{eff} = \left(1 + \frac{i}{m}\right)^m - 1$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$\int kx^n dx = \frac{kx^{n+1}}{n+1} + C, \quad n, k \in \mathbb{R} \text{ with } n \neq -1 \text{ and } k \neq 0$$

$$\int \frac{k}{x} dx = k \ln x + C, \quad x > 0 \text{ and } k \in \mathbb{R}; k \neq 0$$

$$\int k a^{nx} dx = \frac{k a^{nx}}{n \ln a} + C, \quad a > 0; a \neq 1 \text{ and } k, a \in \mathbb{R}; k \neq 0$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad M\left(\frac{x_2 + x_1}{2}, \frac{y_2 + y_1}{2}\right)$$

$$y = mx + c \quad y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\tan \theta = m$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\text{In } \triangle ABC: \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\text{area of } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$$

$$\pi \text{ rad} = 180^\circ$$

$$\text{Angular velocity} = \omega = 2\pi n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Angular velocity} = \omega = 360^\circ n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \pi D n \quad \text{where } D = \text{diameter and } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \omega r \quad \text{where } \omega = \text{angular velocity and } r = \text{radius}$$

$$\text{Arc length} = s = r\theta \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$\text{Area of a sector} = \frac{rs}{2} \quad \text{where } r = \text{radius, } s = \text{arc length}$$

$$\text{Area of a sector} = \frac{r^2\theta}{2} \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

$$4h^2 - 4dh + x^2 = 0 \quad \text{where } h = \text{height of segment, } d = \text{diameter of circle and } x = \text{length of chord}$$

$$A_T = a(m_1 + m_2 + m_3 + \dots + m_n) \quad \text{where } a = \text{width of equal parts, } m_1 = \frac{o_1 + o_2}{2}$$

$$o_n = n^{\text{th}} \text{ ordinate and } n = \text{number of ordinates}$$

**OR**

$$A_T = a \left( \frac{o_1 + o_n}{2} + o_2 + o_3 + \dots + o_{n-1} \right) \quad \text{where } a = \text{width of equal parts, } o_n = n^{\text{th}} \text{ ordinate}$$

and  $n = \text{number of ordinates}$

## ANSWER SHEET

NAME AND SURNAME: .....

SCHOOL: .....

## QUESTION 5.5

