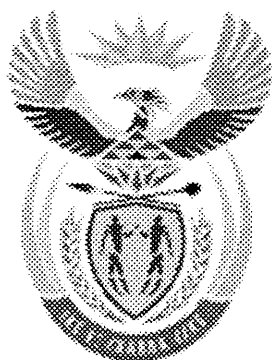


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# higher education & training

Department:  
Higher Education and Training  
REPUBLIC OF SOUTH AFRICA

T1370(E)(N23)T  
NOVEMBER 2011

NATIONAL CERTIFICATE

**MATHEMATICS N3**

(16030143)

**23 November (X-Paper)**  
**09:00 – 12:00**

● Non-programmable calculators may be used.

Graph paper is NOT required.

This question paper consists of 6 pages and a 2-page formula sheet.

**DEPARTMENT OF HIGHER EDUCATION AND TRAINING**  
**REPUBLIC OF SOUTH AFRICA**  
NATIONAL CERTIFICATE  
MATHEMATICS N3  
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 correctly according to the numbering system used in this question paper.
  4. Show ALL calculations and intermediary steps and simplify where possible.
  5. Questions may be answered in any order, but subsections of questions may NOT be separated.
  6. ALL answers must be approximated accurately to THREE decimal places.
  7. Diagrams are not drawn to scale.
  8. TWO formula sheets are attached. The list is not necessarily complete. Any other applicable formula may be used.
  9. Write neatly and legibly.
-

**QUESTION 1**

1.1 Simplify WITHOUT using a calculator:

1.1.1  $\sqrt[4]{16 \times 81}$  (2)

1.1.2  $\frac{\frac{1}{3} + \frac{1}{4}}{\frac{4}{5} + \frac{5}{6}}$  (3)

1.1.3  $\frac{2 \times 3^x - 3^{x-2}}{5 \times 3^x}$  (3)

1.2 Factorise fully into prime factors:

1.2.1  $50x^2 - 8$  (3)

1.2.2  $(a + b)x^2 - 2ax - 2bx + a + b$  (3)

1.3 Prove that  $x - 3$  is the factor of the following equation:

$f(x) = 6x^3 - 13x^2 - 19x + 12$  (3)

1.4 Simplify the following fractions:

1.4.1  $\frac{x^2 - 2x}{x^2 + x} \times \frac{x^3 - x}{2x^2 + x - 1}$  (3)

1.4.2  $\frac{3x}{2} + \frac{x}{3} \div \frac{2x}{5} - \frac{4x}{3}$  (3)

[23]

**QUESTION 2**

2.1 Solve for  $x$ :

2.1.1  $\frac{2}{x} + \frac{2}{x-1} = \frac{1}{x}$  (3)

2.1.2  $\sqrt{6+x} = x$  (3)

2.1.3  $x^2 + 2x = 6$  [by completing the square] (3)

2.1.4  $\log_5 25 = 3 \log_x 36 - \log_3 27$  (3)

- 2.2 Make 'r' the subject of the formula:

$$A = P \left( 1 + \frac{r}{100} \right)^n \quad (2)$$

- 2.3 Make 'n' the subject of the formula:

$$P^n V^n = C \quad (2)$$

- 2.4 A rectangle has a length of 10 m and a width of 3 m. If the length and the width are increased by  $x$  m, the area doubles.

Calculate the new length and width.

(4)  
[20]

### QUESTION 3

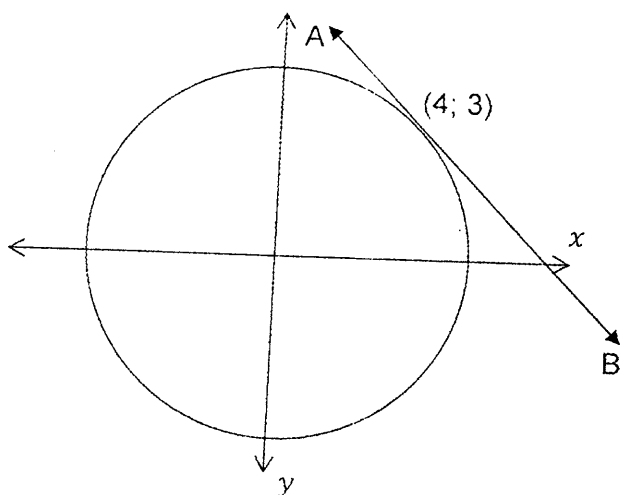
- 3.1 Sketch the graphs of the following equations in the ANSWER BOOK. Each graph must be drawn on its own system of axes. Label the graphs fully and name the type of graph below each sketch.

3.1.1  $400 = 16y^2 + 25x^2$  (3)

3.1.2  $xy = -8$  (3)

3.1.3  $y = x^3 - 9x$  (4)

- 3.2 In the following sketch AB is a tangent to a circle with its centre at the origin.



3.2.1 Determine the equation of the circle. (2)

3.2.2 Calculate the gradient of line AB. (3)

3.2.3 Determine the equation of the line AB. (3)

3.3 Given that a line segment passes through the points (-2; -2) and (7; 5):

3.3.1 Calculate the length of the line segment. (2)

3.3.2 Determine the co-ordinates of the midpoint of the line. (2)

[22]

#### QUESTION 4

4.1 Differentiate from first principles:  
 $f(x) = 3x^2$  (3)

4.2 Given that  $f(x) = 2x^3 - 3x^2 + 6x - 4$

Determine the gradient of the tangent to the curve at the point where  $x = 2$ . (3)

4.3 Determine the co-ordinates of the local turning points  $f(x)$ :

$$f(x) = x^3 - x^2 - x$$

(5)  
 [11]

#### QUESTION 5

5.1 Simplify to ONE trigonometric ratio of  $x$ :

$$\frac{\sin(360^\circ - x) \times \sec(360^\circ - x)}{\tan(180^\circ - x) \times \operatorname{cosec}(360^\circ - x)} \quad (3)$$

5.2 Simplify by making use of basic trigonometric identities:

5.2.1  $\sec \theta - \tan \theta \cdot \sin \theta$  (3)

5.2.2  $\frac{(1 - \sin \theta)(1 + \sin \theta)}{\cos \theta}$  (2)

5.3 Calculate the exact value WITHOUT using the calculator:

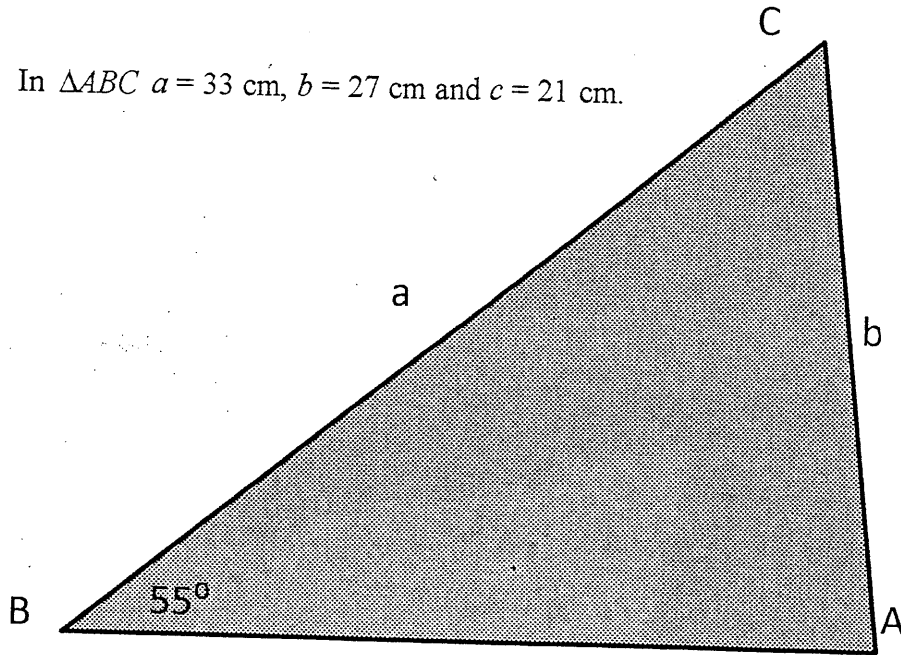
$$\frac{\sin 150^\circ \cdot \cos 330^\circ - \tan 240^\circ}{-\cos 210^\circ - \tan 120^\circ} \quad (4)$$

5.4 Calculate the values of 'x' that will satisfy the following equation:

$$0^\circ \leq x \leq 360^\circ$$

$$2 \sec x - 5 = 0 \quad (4)$$

5.5 In  $\triangle ABC$   $a = 33$  cm,  $b = 27$  cm and  $c = 21$  cm.

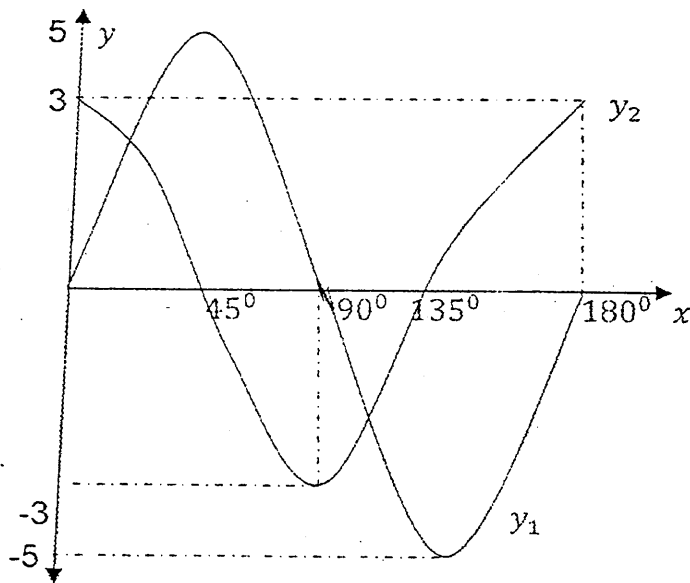


Calculate the following:

5.5.1 The magnitude of  $\hat{A}$  by using the cosine rule. (3)

5.5.2 The magnitude of  $\hat{C}$  by using the sine rule. (2)

5.6 Determine the equations of the following trigonometric graphs:



(3)  
[24]

TOTAL: 100

FORMULA SHEET

Any applicable formula may also be used.

1. Factors/ Faktore

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

3. Quadratic formula/  
Kwadratiese formule

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

4. Parabola/ Parabool

$$y = ax^2 + bx + c$$

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

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

2. Logarithms/ Logaritmes

$$\log ab = \log a + \log b$$

$$\log \frac{a}{b} = \log a - \log b$$

$$\log_b a = \frac{\log_c a}{\log_c b}$$

$$\log a^m = m \log a$$

$$\log_b a = \frac{1}{\log_a b}$$

$$\log_a a = 1 \therefore \ln e = 1$$

$$a^{\log_a t} = t \therefore e^{\ln m} = m$$

5. Circle/ Sirkel

$$x^2 + y^2 = r^2$$

$$D = \frac{x^2}{4h} + h$$

$$x = \sqrt{4Dh - 4h^2}$$

6. Straight line/ Reguitlyn

$$y - y_1 = m(x - x_1)$$

Perpendicular:

$$\text{Loodreg: } m_1 \cdot m_2 = -1$$

Parallel lines:

$$\text{Eweydige lyne: } m_1 = m_2$$

Distance:

$$\text{Afstand: } D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Midpoint:

$$\text{Middelpunt: } P = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Angle of inclination:

$$\text{Hellingshoek: } \theta = \tan^{-1} m$$

## 7. Differentiation/ Differensiasie

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

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

Max/Min  
Maks/Min

For turning points:

$$\text{Vir draaipunte: } f'(x) = 0$$

## 8. Trigonometry/ Trigonometrie

$$\sin\theta = \frac{y}{r} = \frac{1}{\text{cosec}\theta}$$

$$\cos\theta = \frac{x}{r} = \frac{1}{\text{sec}\theta}$$

$$\tan\theta = \frac{y}{x} = \frac{1}{\text{cot}\theta}$$

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

$$1 + \tan^2\theta = \text{sec}^2\theta$$

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

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

$$\text{cot}\theta = \frac{\cos\theta}{\sin\theta}$$

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

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