



# higher education & training

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Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL CERTIFICATE**

**MATHEMATICS N3**

**(16030143)**

**20 November 2019 (X-Paper)**

**09:00–12:00**

**Programmable calculators are NOT allowed.**

**This question paper consists of 7 pages and a formula sheet of 2 pages.**

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**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 according to the numbering system used in this question paper.
  4. Questions may be answered in any order, but keep sub sections together.
  5. Show ALL calculations and intermediate steps.
  6. ALL graph work in the question paper must be done in the ANSWER BOOK.
  7. ALL final answers must be accurately rounded off to THREE decimals.
  8. Diagrams are NOT drawn to scale.
  9. Write neatly and legibly.
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**QUESTION 1**

1.1 Factorise the following as far as possible in prime factors:

$$16x^2 + 4y - y^2 - 4 \quad \star \quad (4)$$

1.2 Determine the value of  $p$  if  $f(x) = 2x^2 + px - 5$  gives a remainder of 6 when divided by  $2x + 1$  (5)

1.3 Simplify the following expression:

$$\frac{m^2 + m - 2}{3m^2 - 2m - 1} \times \frac{m^2 + m - 6}{9m^2 + 6m + 1} \times \frac{4m - 12}{3m + 1} \quad \star \quad (5)$$

**[14]**

**QUESTION 2**

2.1 Solve for  $x$ :

2.1.1  $\ln(1 - 2x) - \ln(x + 2) = 0$

2.1.2  $\log_b x = \frac{3}{\log_5 b}$

$(2 \times 3)$  (6)

2.2 Simplify the following expressions:


2.2.1 
$$\frac{\sqrt{x} - \frac{1}{\sqrt{x}}}{\sqrt{x} + \frac{1}{\sqrt{x}}} \times \frac{x + 1}{2x - 2} \quad \star \quad (4)$$

2.2.2 
$$\frac{(a + b)^{\frac{3}{2}}}{(a - b)^{\frac{1}{2}}} \times \sqrt{(a^2 - b^2)} \quad (3)$$

**[13]**

**QUESTION 3**

- 3.1 The perimeter of a rectangle is 18 cm and the length of its diagonal is  $3\sqrt{5}$  cm.

Determine the dimensions of the rectangle. 


(6)

- 3.2 Make  $n$  the subject of the following:

$$S = \frac{a(r^n - 1)}{r - 1}$$

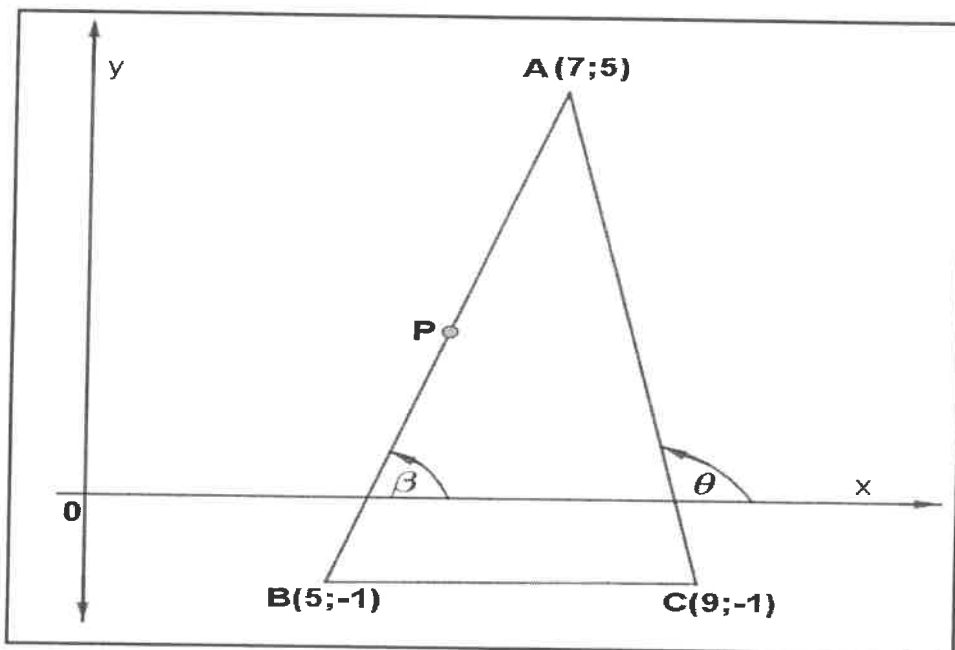
(4)

- 3.3 Solve for  $x$  by completing the square:

  $x^2 + 5x - 3 = 0$

(5)  
[15]**QUESTION 4**

Consider FIGURE 1 below.  $\triangle ABC$  has the vertices  $A(7;5)$ ,  $B(5;-1)$  and  $C(9;-1)$ .  $P$  is the midpoint of  $AB$ . Let the angle of inclination of  $AC$  be  $\theta$  and the angle of inclination of  $AB$  be  $\beta$ .

**FIGURE 1**


Determine:

- 4.1 The co-ordinates of  $P$  the midpoint of  $AB$ .



(2)

- 4.2 The gradient of lines  $AC$  and  $AB$  

(4)

- 4.3 The size of  $\hat{BAC}$  (3)
- 4.4 The equation of the line that passes through point A which is perpendicular to AC. Leave the answer in the gradient-intercept form. (3)
- 4.5 Show that triangle ABC is an isosceles triangle.  (5)
- [17]

### QUESTION 5

- 5.1 Sketch the graph of  $16x^2 + 100y^2 = 400$  in the ANSWER BOOK. All values at the points of intersection with axes must be shown. (3)
- 5.2 Determine  $\frac{dy}{dx}$  of  $y = (\sqrt{x} - 4)^2$  by means of using rules of differentiation.  (5)
- Leave the final answer with positive exponents and in surd form where applicable.
- 5.3 Consider the following function:  $f(x) = \frac{1}{3}x^3 - \frac{1}{2}x^2$
- 5.3.1 Make use of differentiation to determine the co-ordinates of the turning points of  $f(x)$   (5)
- 5.3.2 Calculate the  $x$ - and  $y$ -intercepts of  $f(x)$  (3)
- 5.3.3 Hence, sketch the graph of  $f(x)$  and show the calculated values in QUESTION 5.3.1 and QUESTION 5.3.2 on the graph. (4)
- [20]

### QUESTION 6

- 6.1 Use basic trigonometric identities to prove that:

$$\cot x = \frac{2 \sin^2 x}{2 \tan x - 2 \sin x \cos x} \quad \text{} \quad (6)$$

6.2 FIGURE 2 represents  $\triangle ABC$ . Determine the size of the acute angle  $\hat{BAC}$  if the area of  $\triangle ABC = 6\sqrt{3} \text{ m}^2$ ,  $b = 8 \text{ m}$  and  $c = 3 \text{ m}$ .

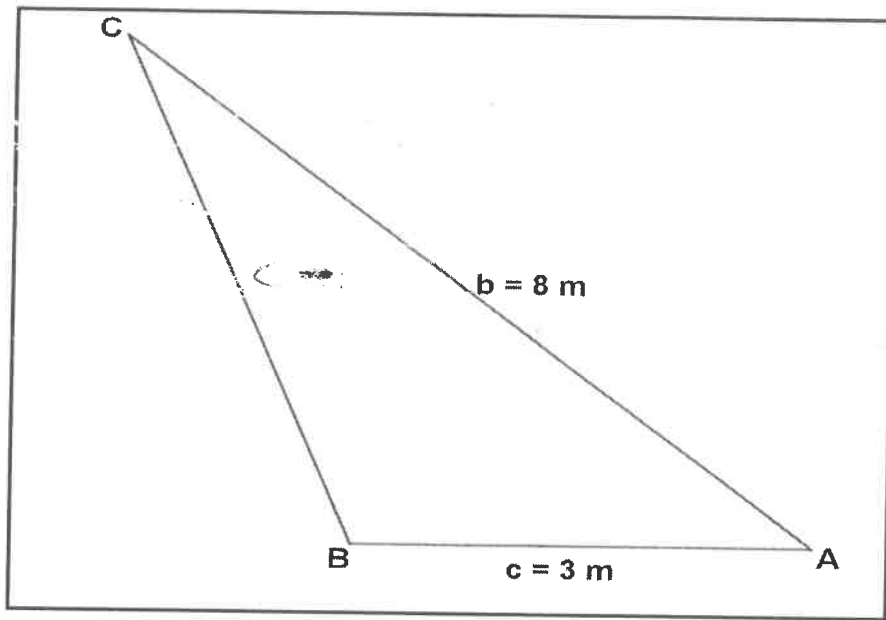


FIGURE 2

(3)

6.3 Consider FIGURE 3 which represents  $\triangle PQR$ .  $RS = 10 \text{ m}$ ,  $\hat{PSQ} = 68^\circ$  and  $\hat{PRS} = 40^\circ$

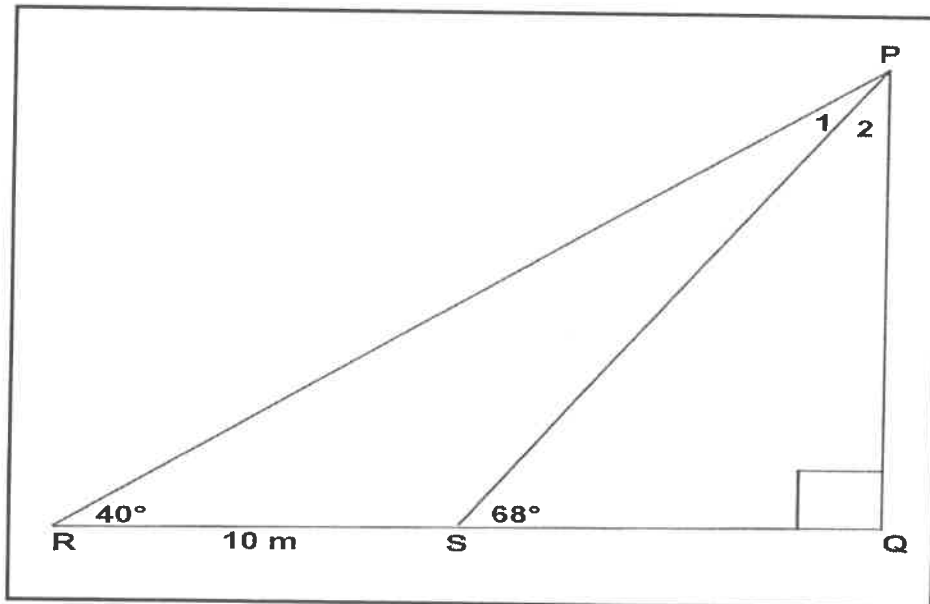


FIGURE 3

Determine:

6.3.1 The length of PS



6.3.2 The length of PQ

(2 × 3) (6)

**8. Trigonometry**

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

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

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

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

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

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


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

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

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

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

$$\text{Area of } \triangle ABC = \frac{1}{2} ac \sin B$$

6.4 Given: The equations of the graphs  $f(x) = 2 \cos x$  and  $g(x) = 4 \sin x - 2$ . 

6.4.1 Draw the graph of the given equations on the same set of axes for  $0^\circ \leq x \leq 180^\circ$ . Show all intercepts on the axes and the co-ordinates of all turning points. (5)

6.4.2 Read, from the sketch, the value(s) of  $x$  for which  $f(x) = g(x)$  for  $x \in [90^\circ; 180^\circ]$  (1)



[21]

TOTAL: 



**MATHEMATICS N3****FORMULA SHEET**

Any applicable formula may also be used.

**1. Factors**

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

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

**3.****quadratic formula**

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

**4. Parabola**

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

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

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

**5. Circle**

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

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

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

**2. Logarithms**

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

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

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

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

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

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

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

**6. Straight line**

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

Perpendicular:  $m_1 \cdot m_2 = -1$

Parallel lines:  $m_1 = m_2$

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

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

Angle of inclination:  $\theta = \tan^{-1} m$

**7. Differentiation**

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

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

Max/Min

For turning points:  $f'(x) = 0$