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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
MATHEMATICS N3
TIME: 3 HOURS
MARKS: 100

August 2010

NOTE: Diagrams are not drawn to scale.

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. Simplify where possible.
5. Questions may be answered in any sequence. Subsections of questions may NOT be separated.
6. All the final answers must be approximated accurately to THREE decimal places.
7. The formula sheets (attached) are not necessarily complete. Any other applicable formula may be used.
8. Write neatly and legibly.

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QUESTION 1

1.1 Simplify without using the calculator:

1.1.1
$$\frac{7^{2x+1} - 7^{2x-1}}{7^{2x-1}} \quad (3)$$

1.1.2
$$2^{-3} + \frac{1}{4} \div \frac{2}{7} \quad (3)$$

1.1.3
$$\log_5 16 + \log_5 4 - \log_5 32 - \log_5 2 \quad (3)$$

1.2 Prove that $p - q$ is not a factor of:

$$f(p) = p^3 + (q + 3)p^2 - p(3q + 3) + 3q \quad (3)$$

1.3 Fully factorise in prime factors:

1.3.1
$$m^{36} - 16n^4 \quad (2)$$

1.3.2
$$25x^2 - (10x + 2)^2 \quad (2)$$

1.3.3
$$24bx - 8dx - 6by + 2dy \quad (3)$$

1.4 Simplify the following fractions:

1.4.1
$$\frac{\frac{1}{\sqrt{x}} + \frac{2}{\sqrt{x}}}{\frac{7}{\sqrt{x}} - \frac{3}{\sqrt{x}}} \quad (3)$$

1.4.2
$$\frac{2x}{x^2 - 16} + \frac{1}{4 - x} \quad (3)$$

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QUESTION 2

2.1 Solve for x :

2.1.1
$$\frac{5}{\sqrt{x}} - \sqrt{x} = \sqrt{x+2} \quad (3)$$

2.1.2
$$3^{x^2} \times 3^{5x} \times 3^6 = 1 \quad (3)$$

2.1.3
$$2 \log_b 4 = \log_b 4^x + \log_b 1 \quad (3)$$

PTO

2.2 Make x the subject of the formula:

2.2.1 $P_1 + P_2 = R^x$ (2)

2.2.2 $D = h + \frac{x^2}{h}$ (2)

2.2.3 $x^2 + \frac{bx}{a} = -\frac{c}{a}$ by completing the square (3)

2.3 Prove without solving the equation that $x - 2$ is a solution of:

$\sqrt{2x + 5} - \sqrt{x - 1} = \sqrt{x + 2}$ (3)

2.4 A number multiplied by three is five times another number. The difference between the two numbers is 40. Calculate the two numbers. (4)
[23]

QUESTION 3

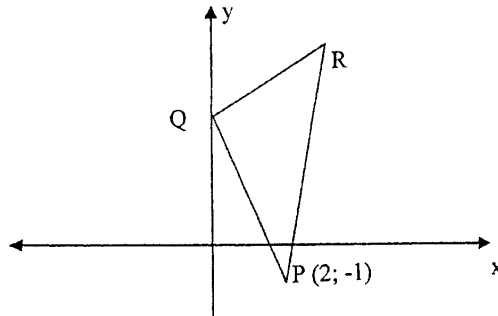
3.1 Sketch the graphs represented by the following equations in the ANSWER BOOK. Each graph must be drawn on its own system of axes. Show ALL values at the points of intersection with the system of axes where applicable. Name the type of graph below each sketch.

3.1.1 $4x^2 + 25y^2 = 100$ (3)

3.1.2 $y = 2x^2 - 18$ (3)

3.1.3 $xy = 4$ (Show coordinates of two points through which the graph passes in each quadrant) (3)

- 3.2 In the sketch below, P (2; -1), Q and R are points in the Cartesian plane. The equation of QR is defined by $x - 2y + 6 = 0$ and the equation of PR is $3x - y - 7 = 0$.



- 3.2.1 Prove that $\hat{PQR} = 90^\circ$. (3)
- 3.2.2 Determine the equation of line PQ. (3)
- 3.2.3 Determine the length of PQ. (2)
- 3.2.4 Calculate the midpoint of line PQ. (2)
- 3.3 Calculate the points of intersection of the parabola and the straight line:
- $$y = -x^2 + 2x + 3$$
- $$y - x = 3$$
- (4)
[23]

QUESTION 4

- 4.1 Differentiate from first principles:
- $$y = 5x^2$$
- (3)
- 4.2 Determine $\frac{dy}{dx}$ by using the rules of differentiation:
- (Leave the answer with positive exponents and in surd form.)
- $$y = \frac{4}{x} + 6\sqrt{x}$$
- (3)
- 4.3 Determine the coordinates of the local turning points of the following function:
- $$y = x^3 - 6x^2 + 9x$$
- (4)
[10]

PTO

QUESTION 5

5.1 Simplify to one trigonometric ratio:

$$\frac{\sin(180^\circ - \beta) \times \cos(360^\circ - \beta)}{\cot(360^\circ - \beta) \times \sin(180^\circ + \beta)} \quad (3)$$

5.2 Make use of basic trigonometric identities to prove that:

$$\sec^4 \theta - \sec^2 \theta = \tan^2 \theta + \tan^4 \theta \quad (3)$$

5.3 Calculate the values of α that will satisfy the following trigonometric equation for $0^\circ \leq \alpha \leq 360^\circ$:

$$3 \sin \alpha = \cos \alpha \quad (4)$$

5.4 Determine the exact value without using the calculator:

$$\frac{\sec 150^\circ \times \tan 225^\circ + \cos 330^\circ}{\cot 225^\circ} \quad (4)$$

5.5 Sketch the graphs represented by the following trigonometric equations. Each graph must be drawn on its own system of axes for $0^\circ \leq x \leq 180^\circ$:

$$y_1 = \sin 2x$$

$$y_2 = 3 \cos 2x$$

All values at the points of intersection with the system of axes and coordinates of the turning point must be shown. (5)

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TOTAL: 100