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## education

Department:
Education
PROVINCE OF KWAZULU-NATAL

## NATIONAL SENIOR CERTIFICATE

## GRADE 12

## MATHEMATICS P1

## SEPTEMBER 2019

PREPARATORY EXAMINATIONS

MARKS: 150

TIME: 3 hours
N.B. This question paper consists of $\mathbf{1 0}$ pages and an information sheet.

## INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 13 questions.
2. Answer ALL questions.
3. Clearly show ALL calculations, diagrams, graphs, et cetera that you have used in determining your answers.
4. Answers only will not necessarily be awarded full marks.
5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. Number the answers correctly according to the numbering system used in this question paper. Write neatly and legibly.

## QUESTION 1

1.1 Solve for $x$ :

$$
\begin{equation*}
\text { 1.1.1 } \quad x(4-x)=0 \tag{2}
\end{equation*}
$$

1.1.2 $2 x^{2}+5 x=1$ (rounded off to 2 decimal places)
1.2 Given: $\sqrt{x-2}=2-x$
1.2.1 $\quad$ Solve for $x$.
1.2.2 Hence, or otherwise, determine the value(s) of $p$ if $\sqrt{p^{2}-p-2}=2+p-p^{2}$
1.3 Solve: $-2 x^{2}+5 x \leq 0$
1.4 If $2^{x+1}+2^{x}=3^{y+2}-3^{y}$, and $x$ and $y$ are integers, calculate the value of $x+y$.

## QUESTION 2

The first four terms of a quadratic sequence are $8 ; 15 ; 24 ; 35 ; \ldots$
2.1 Write down the next TWO terms of the quadratic sequence.
2.2 Determine the $n^{\text {th }}$ term of the sequence.

## QUESTION 3

The first three terms of an arithmetic sequence are $2 p-3 ; p+5 ; 2 p+7$.
3.1 Determine the value(s) of $p$.
3.2 Calculate the sum of the first 120 terms.
3.3 The following pattern is true for the arithmetic sequence above:
$T_{1}+T_{4}=T_{2}+T_{3}$
$T_{5}+T_{8}=T_{6}+T_{7}$
$T_{9}+T_{12}=T_{10}+T_{11}$
$\therefore T_{k}+T_{k+3}=T_{x}+T_{y}$
3.3.1 Write down the values of $x$ and $y$ in terms of $k$.
3.3.2 Hence, calculate the value of $T_{x}+T_{y}$ in terms of $k$ in simplest form.

## QUESTION 4

4.1 Given: $\sum_{k=1}^{\infty} 5\left(3^{2-k}\right)$
4.1.1 Write down the value of the first TWO terms of the infinite geometric series.
4.1.2 Calculate the sum to infinity of the series.
4.2 Consider the following geometric sequence:
$\sin 30^{\circ} ; \cos 30^{\circ} ; \frac{3}{2} ; \ldots ; \frac{81 \sqrt{3}}{2}$
Determine the number of terms in the sequence.

## QUESTION 5

Given $f(x)=\frac{-4}{2-x}-1$
5.1 Write down the equations of the vertical and horizontal asymptotes of $f$.
5.2 Determine the intercepts of the graph of $f$ with the axes.
5.3 Draw the graph of $f$. Show all intercepts with the axes as well as the asymptotes of the graph.

## QUESTION 6

In the diagram, the graphs of $f(x)=-x^{2}+5 x+6$ and $g(x)=x+1$ are drawn below.
The graph of $f$ intersects the $x$-axis at B and C and the $y$-axis at A .
The graph of $g$ intersects the graph of $f$ at B and S . PQR is perpendicular to the $x$-axis with points P and Q on $f$ and $g$ respectively. M is the turning point of $f$.

6.1 Write down the co-ordinates of A.
6.2 S is the reflection of A about the axis of symmetry of $f$. Calculate the coordinates of S .
6.3 Calculate the coordinates of B and C.
6.4 If $\mathrm{PQ}=5$ units, calculate the length of OR .
6.5 Calculate the:
6.5.1 Coordinates of M.
6.5.2 Maximum length of $P Q$ between $B$ and $S$.

## QUESTION 7

In the diagram, the graph of $g(x)=\log _{5} x$ is drawn.

7.1 Write down the equation of $g^{-1}$, the inverse of $g$, in the form $y=\ldots$
7.2 Write down the range of $g^{-1}$.
7.3 Calculate the value(s) of $x$ for which $g(x) \leq-4$.

## QUESTION 8

8.1 A car depreciated at the rate of $13,5 \%$ p.a. to R250 000 over 5 years according to the reducing balance method. Determine the original price of the car, to the nearest rand.
8.2 Melissa takes a loan of R950 000 to buy a house. The interest is $14,25 \%$ p.a. compounded monthly. His first instalment will commence one month after taking out the loan.
8.2.1 Calculate the monthly repayments over a period of 20 years.
8.2.2 Determine the balance on the loan after the $100^{\text {th }}$ instalment.
8.2.3 If Melissa failed to pay the $101^{\text {st }}, 102^{\text {nd }}, 103^{\text {rd }}$ and $104^{\text {th }}$ instalments, calculate the value of the new instalment that will settle the loan in the same time period.

## QUESTION 9

9.1 Determine $f^{\prime}(x)$ from first principles given $f(x)=x^{2}-\frac{1}{2} x$.
9.2 Determine:
9.2.1 $\frac{d}{d x}\left[3 x^{4}+\sqrt[5]{x}+a^{2}\right]$
9.2.2 $\frac{d y}{d x}$, if $x y=x+x^{2}-1$.
[12]

## QUESTION 10

In the diagram, the graph of $f(x)=x^{3}+5 x^{2}-8 x-12$ is drawn. A and B are the turning points and C the $y$-intercept of $f . g(x)=m x+c$ is a tangent to the graph of $f$ at C .

D is the intersection of $f$ and $g$.

10.1 Calculate the:
10.1.1 $\quad$ co-ordinates of the $x$-intercepts of $f$.
10.1.2 co-ordinates of B.
10.1.3 $x$ - coordinate of the point of inflection of $f$.
10.2 Determine the:
10.2.1 equation of the $g$.
10.2.2 values of $x$ for which $f^{\prime}(x) . g^{\prime}(x)>0$.

## QUESTION 11

In the diagram below, $\triangle \mathrm{ABC}$ is an equilateral triangle with sides $d$ units long. P and S are points on sides $A B$ and $A C$ respectively. $Q$ and $R$ are points on $B C$ such that $P Q R S$ is a rectangle. $B Q=R C=2 y$ units.

11.1 Show that the area of the rectangle PQRS is given by $A=2 \sqrt{3} y(d-4 y)$.
11.2 Determine the maximum area of the rectangle in terms of $d$.

## QUESTION 12

A bag contains 12 blue balls, 10 red balls and 18 green balls. 2 balls are chosen at random without replacement.

Determine the probability:
12.1 if the two balls chosen at random are green.
12.2 if the two balls chosen at random are blue and red.

## QUESTION 13

The digits $1,2,3,4,5,6,7,8,9$ are used to form 3 - digit codes, eg. 567, 218, etc.

Determine the number of different codes that can be formed:
13.1 if repetition is allowed.
13.2 such that the code is greater than 500 and repetition is NOT allowed.
13.3 such that the middle digit is 5 and repetition is allowed.

## INFORMATION SHEET: MATHEMATICS

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

$$
\begin{aligned}
& A=P(1+n i) \quad A=P(1-n i) \quad A=P(1-i)^{n} \quad A=P(1+i)^{n} \\
& T_{n}=a+(n-1) d \quad \mathrm{~S}_{n}=\frac{n}{2}(2 a+(n-1) d) \\
& T_{n}=a r^{n-1} \quad S_{n}=\frac{a\left(r^{n}-1\right)}{r-1} ; \quad r \neq 1 \quad S_{\infty}=\frac{a}{1-r} ;-1<r<1 \\
& F=\frac{x\left[(1+i)^{n}-1\right]}{i} \quad P=\frac{x\left[1-(1+i)^{-n}\right]}{i} \\
& f^{\prime}(x)=\lim _{h \rightarrow 0} \frac{f(x+h)-f(x)}{h} \\
& d=\sqrt{\left(x_{2}-x_{1}\right)^{2}+\left(y_{2}-y_{1}\right)^{2}} \quad \mathrm{M}\left(\frac{x_{1}+x_{2}}{2} ; \frac{y_{1}+y_{2}}{2}\right) \\
& y=m x+c \quad y-y_{1}=m\left(x-x_{1}\right) \quad m=\frac{y_{2}-y_{1}}{x_{2}-x_{1}} \quad m=\tan \theta
\end{aligned}
$$

$$
(x-a)^{2}+(y-b)^{2}=r^{2}
$$

$$
\text { In } \triangle A B C: \quad \frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C} \quad a^{2}=b^{2}+c^{2}-2 b c \cdot \cos A \quad \text { area } \triangle A B C=\frac{1}{2} a b \cdot \sin C
$$

$$
\sin (\alpha+\beta)=\sin \alpha \cdot \cos \beta+\cos \alpha \cdot \sin \beta \quad \sin (\alpha-\beta)=\sin \alpha \cdot \cos \beta-\cos \alpha \cdot \sin \beta
$$

$$
\cos (\alpha+\beta)=\cos \alpha \cdot \cos \beta-\sin \alpha \cdot \sin \beta \quad \cos (\alpha-\beta)=\cos \alpha \cdot \cos \beta+\sin \alpha \cdot \sin \beta
$$

$\cos 2 \alpha=\left\{\begin{array}{l}\cos ^{2} \alpha-\sin ^{2} \alpha \\ 1-2 \sin ^{2} \alpha \\ 2 \cos ^{2} \alpha-1\end{array} \quad \sin 2 \alpha=2 \sin \alpha \cdot \cos \alpha\right.$
$\bar{x}=\frac{\sum f \cdot x}{n}$
$\mathrm{P}(A)=\frac{n(\mathrm{~A})}{n(\mathrm{~S})}$
$\hat{y}=a+b x$

$$
\sigma^{2}=\frac{\sum_{i=1}^{n}\left(x_{i}-\bar{x}\right)^{2}}{n}
$$

$$
\mathrm{P}(\mathrm{~A} \text { or } \mathrm{B})=\mathrm{P}(\mathrm{~A})+\mathrm{P}(\mathrm{~B})-\mathrm{P}(\mathrm{~A} \text { and } \mathrm{B})
$$

$$
b=\frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^{2}}
$$

