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# **KWAZULU-NATAL PROVINCE**

**EDUCATION**  
**REPUBLIC OF SOUTH AFRICA**

## **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**MATHEMATICS P1**

**COMMON TEST**

**JUNE 2023**

**MARKS: 150**

**TIME: 3 hours**

**N.B. This question paper consists of 11 pages,  
and an information sheet.**

## INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 11 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 the following equations.

1.1.1  $x^2 - 2x = 0$  (3)

1.1.2  $5x^2 = -11x + 3$  (give your answer to 2 decimal places) (3)

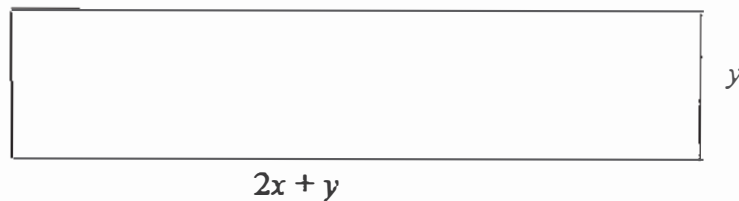
1.1.3  $x^2 - 2x \leq 8$  (4)

1.1.4  $\sqrt{\frac{2^{2023} + 2^{2022}}{2^{2022}}} + x^2 - x = x$  (4)

1.2 The roots of a quadratic equation are:

$x = \frac{10 \pm \sqrt{-m-8}}{2}$ , for which values of  $m$  are the roots non real? (2)

1.3 A rectangle has a length of  $(2x + y)$  metres and a width of  $y$  metres as shown in the diagram. The perimeter of the rectangle is 24 metres and the area is  $32\text{m}^2$ .



1.3.1 Show that the expression for the perimeter is:  $24 = 4x + 4y$  (1)

1.3.2 Show that the expression for the area is :  $32 = y^2 + 2xy$  (1)

1.3.3 Determine the dimensions of the rectangle if  $x > 0$ . (6)

**[24]**

**QUESTION 2**

$T_n = -2n^2 + 40n + 103$  is the general term of a quadratic sequence.

2.1 Determine  $T_1$  the first term of the quadratic sequence. (2)

2.2 Determine the second difference of this quadratic sequence. (2)

2.3 Which term of the quadratic sequence has a value of 301? (3)

2.4 Which term is the largest term in this quadratic sequence? (2)

**[9]**

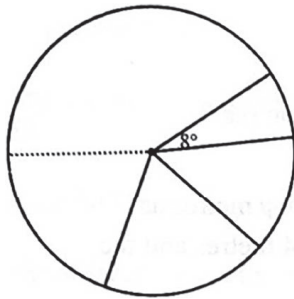
**QUESTION 3**

- 3.1 The following sequence is a combination of arithmetic and geometric sequence: 3 ; 3 ; 9 ; 6 ; 15 ; 12 ; .....

3.1.1 Write down the next two terms. (2)

3.1.2 Determine  $T_{20} - T_{21}$  (5)

- 3.2 The given circle is completely divided into  $n$  sectors in such a way that the angles are in arithmetic sequence. If the smallest angle is  $8^\circ$  and the largest angle is  $52^\circ$ , calculate  $n$ , the number of sectors.



(4)

- 3.3 George is currently 115 kilograms and his doctor has advised him to take up a healthy eating plan so as to lose some of the weight in order to maintain a healthy body. His new diet will enable him to lose 5 kilograms in the first week, thereafter he would lose  $\frac{3}{4}$  of the previous week's weight loss each week.

3.3.1 If he follows the new eating plan, how many kilograms will he lose on the eighth day? Give your answer correct to 3 decimal places. (2)

3.3.2 If he follows the new eating plan indefinitely, write his weight loss in sigma notation. (2)

3.3.3 If he follows the new eating plan indefinitely, what will his new weight eventually be? (3)

**[18]**

**QUESTION 4**

The graph of  $h(x) = \frac{a}{3-x} + p$  passes through points  $(2; -5)$  and  $(0; -1)$ .

- 4.1 Write down the equation of the vertical asymptote of  $h$ . (1)
- 4.2 Write down the domain of  $h$ . (2)
- 4.3 Determine the values of  $a$  and  $q$ . (6)
- 4.4 Draw the graph of  $h$ , showing the intercepts with the axes as well as the asymptotes. (3)

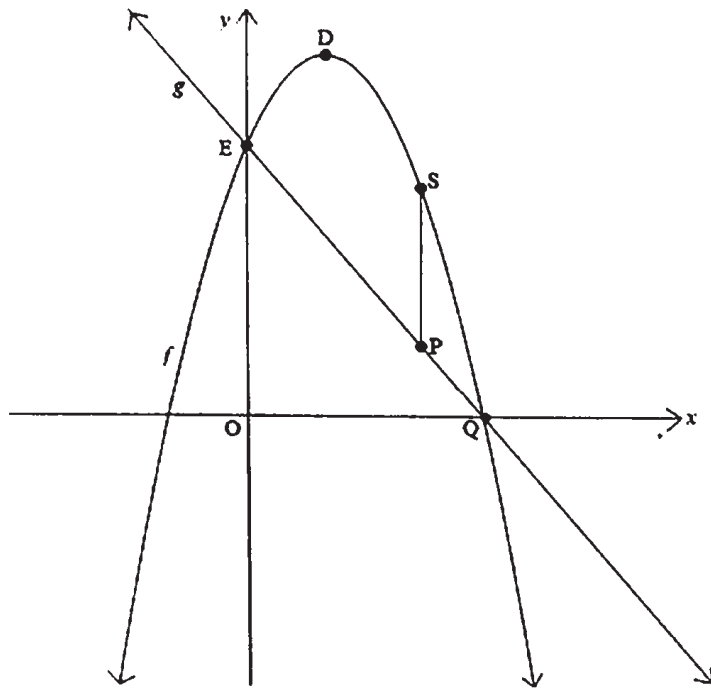
**[12]**

## QUESTION 5

The graphs of  $f(x) = -2(x-3)(x+1)$  and  $g(x) = mx + c$  are drawn below.

Q is the  $x$  - intercept of both graphs and E is the  $y$  - intercept of both graphs.

D is the turning point of  $f$ . SP is parallel to the  $y$  - axis.

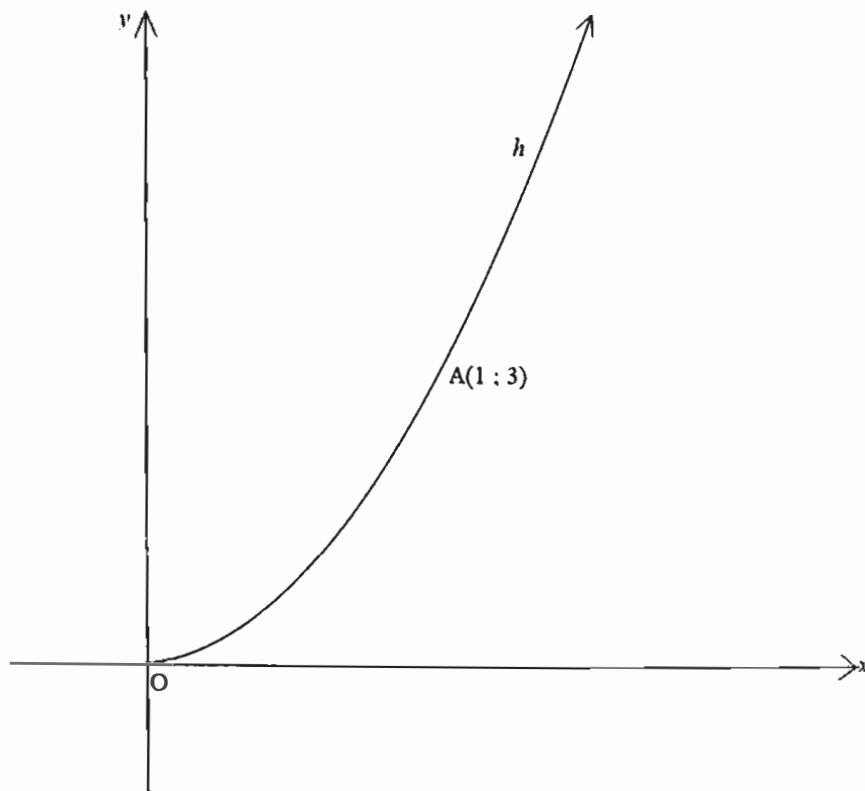


- 5.1 Show that the coordinates of E are  $(0;6)$  (1)
- 5.2 Determine the coordinates of D, the turning point of  $f$ . (4)
- 5.3 If  $h(x) = -f(x+3)$ , determine the coordinates of the turning point of  $h$ . (2)
- 5.4 Write down the coordinates of Q (1)
- 5.5 Determine the equation of  $g$ . (3)
- 5.6 Determine the value of  $x$ , for which the length of SP between E and Q is a maximum. (3)
- 5.7 Determine the value of  $k$  for which  $f'(x) = k$  has one negative and 1 positive roots. (1)

[15]

**QUESTION 6**

The graph of  $h(x) = ax^2$  for  $x \geq 0$  is drawn below. Point A (1;3) lies on the graph of  $h$ .



- 6.1 Determine the value of  $a$ . (2)
- 6.2 Determine the equation of  $h^{-1}$  the inverse of  $h$  in the form  $y = \dots\dots\dots$  (2)
- 6.3 Draw the graph of  $h^{-1}$ , showing the coordinates of another point. (2)
- 6.4 Is  $h^{-1}$  a function? Motivate your answer. (2)

**[8]**



**QUESTION 7**

- 7.1 Convert a nominal interest rate of 7,12% p.a. compounded quarterly to a yearly effective interest rate. (3)
- 7.2 A transport company purchases a new lorry to the value of R 1 250 000.
- 7.2.1 Calculate the trade-in value of the lorry in 6 years' time if the lorry's value decreases at 11% p.a. on a reducing balance. (2)
- 7.2.2 Calculate the value of a new lorry in 3 years' time if the inflation rate remains at 7,5% over the next 3 years. (2)
- 7.2.3 How much money will the company need in order to replace the lorry in 3 years' time, if the old lorry will be used as a trade-in towards buying the new lorry. (2)
- 7.2.4 The company decides to save money in a sinking fund. They deposit equal amounts at the beginning of each year starting immediately. The last deposit is made at the end of the third year. Interest is calculated at 9,6% p.a. compounded monthly.
- (a) How many deposits will the company make? (1)
- (b) How much will the company deposit each time? (5)

**[15]****QUESTION 8**

- 8.1 Given:  $f(x) = 3x^2 + 2x$
- 8.1.1 Determine  $f'(x)$  from first principles. (5)
- 8.1.2 Determine the average gradient of  $f(x)$  between  $x = -1$  and  $x = 2$  (3)
- 8.2 Determine the following:
- 8.2.1  $g'(x)$  if  $g(x) = (7x - 1)(3 - x)$  (2)
- 8.2.2  $\frac{dy}{dx}$  if  $\frac{y}{\sqrt{x}} = 5\sqrt{x} + \frac{1}{2\sqrt{x}} - \frac{6}{x}$  (4)

**[14]**

**QUESTION 9**

Given:  $f(x) = (x-3)(x-3)(x+2) = x^3 - 4x^2 - 3x + 18$

9.1 Write down the  $y$ -intercept of  $f$ . (1)

9.2 Write down the co-ordinates of the  $x$  intercepts of  $f$ . (3)

9.3 Determine the co-ordinates of the turning points of  $f$ . (4)

9.4 Draw the graph of  $f$ , clearly indicating the intercepts with the axes and the co-ordinates of the turning points. (3)

9.5 Determine the equation of a tangent to  $f$  with a gradient of  $-3$  at the point where  $x$  is an integer. (4)

**[15]**

**QUESTION 10**

In 2020, the scientists stated that the number of people infected with the Covid 19 Virus in a certain country was given by the equation  $N(t) = -\frac{1}{2}t^3 + 3t^2$ , where  $N(t)$  was the number of infected people in thousands and  $t$  was the number of months.

10.1 How many people were infected at the beginning? (at zero months). (1)

10.2 At what rate was the virus spreading in the second month? (2)

10.3 After how many months did the virus reach its peak? (4)

10.4 How many people were infected when the virus reached its peak? (2)

**[9]**

**QUESTION 11**

- 11.1 A study on the favorite cell phone of Grade 11 and Grade 12 learners at Greendale High School yielded the following results.

	<b>I PHONE</b>	<b>SAMSUNG</b>	<b>TOTAL</b>
<b>GRADE 11</b>	a	d	50
<b>GRADE 12</b>	b	c	100
<b>TOTAL</b>	60	90	150

- 11.1.1 Are events Samsung and Grade 11 learners mutually exclusive? Motivate your answer. (2)
- 11.1.2 If the learners' preference for cell phones is independent of their grade, determine the value of d. (4)
- 11.2 During a TV Game Show, contestants have to answer randomly generated questions within a fixed time:
- The probability of the first question being answered correctly is 0,8.
  - Whenever a question is answered correctly, the next question is more difficult and the probability of a correct answer is reduced by 0,1.
  - This means that the probability of getting the second answer correct is 0,7.
  - Whenever the question is answered incorrectly, the next question is of the same standard and the probability of it being answered correctly remains unchanged.
- 11.2.1 After how many consecutive correct answers will the probability of getting the next question correct, be zero? (1)
- 11.2.2 Calculate the probability of getting the second answer correct (4)

**[11]****TOTAL MARKS = 150**

**INFORMATION SHEET: MATHEMATICS**  
**INLIGTING BLADSY**

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

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

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

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

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

$$T_n = a + (n-1)d$$

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}; \quad r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; \quad -1 < r < 1$$

$$F = \frac{x[(1+i)^n - 1]}{i}$$

$$P = \frac{x[1 - (1+i)^{-n}]}{i}$$

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

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

$$M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

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

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

$$m = \tan \theta$$

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

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

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad \text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

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

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

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

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

$$\cos 2\alpha = \begin{cases} \cos^2 \alpha - \sin^2 \alpha \\ 1 - 2\sin^2 \alpha \\ 2\cos^2 \alpha - 1 \end{cases}$$

$$\sin 2\alpha = 2\sin \alpha \cdot \cos \alpha$$

$$\bar{x} = \frac{\sum f \cdot x}{n}$$

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

$$P(A) = \frac{n(A)}{n(S)}$$

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

$$\hat{y} = a + bx$$

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