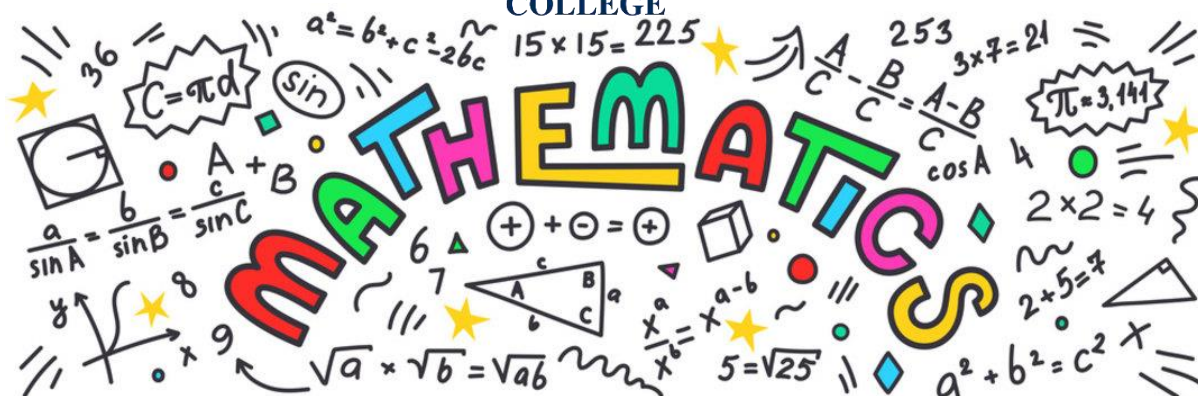




ST PETER'S
COLLEGE



PRELIMINARY EXAMINATION 2024
GRADE12: PAPER 1

EXAMINER: B. de Beer

TIME: 3 hours

MODERATORS: N. Lindsay, S. Dlamini, R.Obermeyer,
O. Diabetsoe

MARKS: 150

SESSION: ONE

DATE: 22 JULY 2024

NAME:	MATH TEACHER:
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Read the following instructions carefully.

1. This paper consists of 19 pages (including the cover page and additional working space) and questions as well as a 2-page formula sheet. Please check that your paper is complete.
2. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
3. Clearly show **ALL** calculations, diagrams, graphs, etc. that you have used in determining your answers. **Answers only will NOT necessarily be awarded full marks.**
4. Diagrams are not necessarily drawn to scale.
5. If necessary, round off answers to **ONE** decimal place, unless otherwise stated.

	SECTION A							SECTION B						
Question	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Actual Mark														
Possible Mark	11	14	11	13	10	9	9	17	14	15	13	8	6	150
Marker's Signature														

SECTION A

Solve for x :

(a) $\log_{3x-7}(x^2 - 2x - 3) = 1$ (4)

(b) $2x = \lim_{x \rightarrow 5} \frac{x^2 - 25}{x - 5}$ (3)

(c) $4^x = \frac{8^{4m} \cdot 4^{3m}}{2^{16m-2}}$ in terms of m . (4)

(a) Solve for p and q simultaneously: $p^2q^2 - 2pq - 8 = 0$ and $\log_2(p + 5) = 3$. (5)

(b) For which values of k will $2x^2 + (k - 1)x + 8 = 0$ have real, unequal roots? (5)

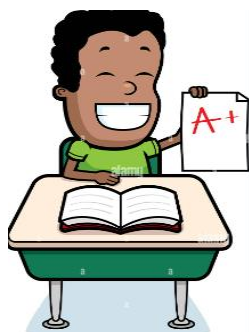
(c) Calculate the value of p if $(k + 2)$ is a factor of $f(k) = k^{50} - p^{25}$. (4)

- (a) $3; p; 25; \dots$ is a quadratic sequence. The sequence of first differences is $9; t; \dots$. Calculate p and t . (4)
- (b) In an arithmetic sequence, the fifth term has a value of 0 and the fourteenth term has a value of -36 .
- (1) Show that $a = 16$ and $d = -4$. (4)
- (2) Hence, find the value of p if $T_{23} + T_{23-p} = -96$. (3)

Siphokazi bought a house. She paid a deposit of R 102 000 which is equivalent to 12% of the selling price of the house. She obtained a loan from the bank to pay the balance of the selling price. The bank charges 9% p.a, compounded monthly.

- (a) Determine the selling price of the house. (2)
- (b) The period of the loan is 20 years, and she starts repaying the loan one month after it was granted. Calculate her monthly instalment. (4)
- (c) How much interest will she pay over a period of 20 years? Round your answer correct to the nearest rand. (2)
- (d) Calculate the balance on the loan, immediately after the 85th instalment. (3)
- (e) What is the interest in the 86th month? (2)

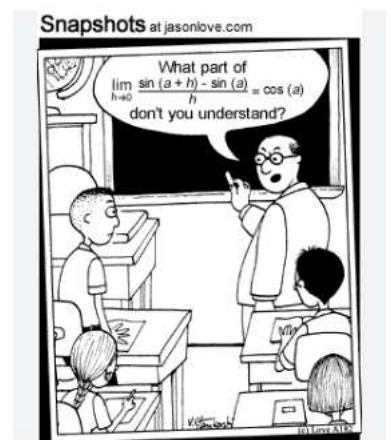
- (a) The following information is given of $k(x) = \frac{a}{x+p} + q$.
- Range: $y \in \mathbb{R}, y \neq -3$.
 - Domain: $x \in \mathbb{R}, x \neq -1$.
 - $(2;6)$ lies on $k(x)$.
- (1) Write down the equation of the symmetrical axis with a negative gradient. (3)
- (2) Show that the a-value is equal to 27. (2)
- (b) Consider the graph of $g(x) = -2x^2 - 9x + 5$. Determine the equation of the tangent to the graph of g at $x = -1$. (5)



<https://c8.alamy.com/comp/HP4DCG/a-happy-cartoon-student-with-his-grades-HP4DCG.jpg>

(a) Let $k(x) = 6x^2$. Find $k'(1)$ from first principles. (5)

(b) Given: $g(t) = 6\sqrt[3]{t} - \frac{t}{2}$, determine $g'(t)$. (4)



<https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.resourceaholic.com%2F2014%2F09%2Fdifferentiation.html&psig>

The graph of g is defined by the equation $g(x) = \sqrt{2x}$.

(a) Write down the equation of g^{-1} , the inverse of g in the form $y = \dots$ (4)

(b) If $p(x) = x - 4$ is drawn on the same set of axes of $g(x)$, determine algebraically the point(s) of intersection of p and g . (5)



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SUB-TOTAL SECTION A: 77

SECTION B

Question 8

17 Marks

- (a) If $\sum_{t=1}^5 (t + k) = 10a$, determine k in terms of a . (4)
- (b) The Bloukrans River Bridge is home to the highest commercial bungee-jumping site in the world. At full stretch the bungee rope is 160 metres long. After the initial drop of 160 metres, the jumper usually rises up by two-thirds of the distance previously fallen, then falls down to the full stretch of the rope again. If the jumper continues bouncing in this way until becoming stationery, calculate the total vertical distance covered by the jumper. (6)



<https://banner2.cleanpng.com/20190222/ugk/kisspng-bungee-jumping-adrenaline-mug-zazzle-extreme-sport-science-5c7025b2058053.9014824315508535540225.jpg>

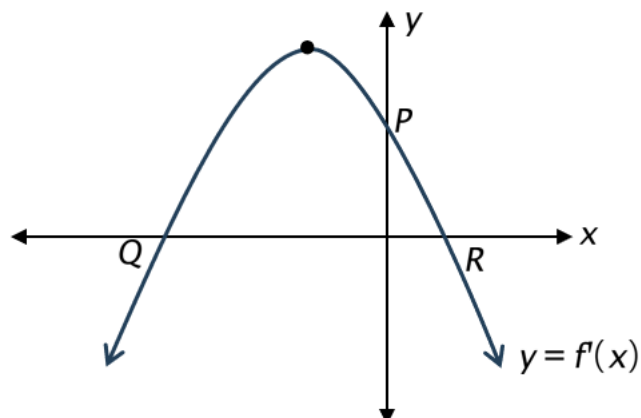
- (c) The diagram shows a number of concentric circles. The radii of the 3 largest circles are 16; $\frac{16}{\sqrt{7}}$ and $\frac{16}{7}$ respectively.



If smaller concentric circles are drawn following the above pattern:

- (1) Show that the areas of the circles form a converging geometric pattern. (4)
- (2) Calculate the probability, that if a dart is thrown to the diagram above, that it would hit the black outer ring, given that the dart lands somewhere on the ring. (3)

- (a) Sketched below is the graph of $f'(x)$, the derivative of $f(x) = -2x^3 - 3x^2 + 12x + 20$.

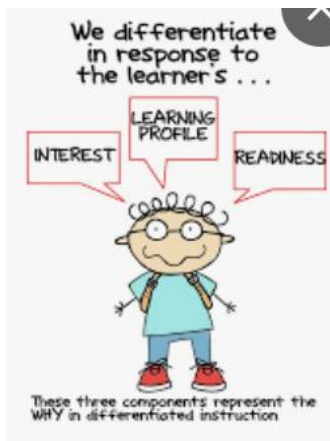


- (1) Determine the coordinates of P. (2)
- (2) Determine the x-coordinates of Q and R. (3)
- (3) For which values of x will $f(x)$ be increasing? (1)
- (4) For which value of x will $f(x)$ concave up? (1)

- (b) At a certain scientific lab, the number of viruses (N), in thousands, are grown with regards to the increase in temperature (t in $^{\circ}\text{C}$). These numbers are represented by the formula $N(t) = -0,1t^3 + 2,4t^2 - 8,4t + 8$.

(1) Calculate the rate of change of the number of viruses at $t = 5^{\circ}\text{C}$. (3)

(2) Determine the temperature at which the number of viruses will grow most rapidly. (2)



https://www.google.com/imgres?imgurl=https%3A%2F%2Fi.pinimg.com%2F736x%2Ff9%2Fb8%2F6d%2Ff9b86ddbc98cac0cbba8cc9a9bd29f94.jpg&tbid=SxSd0LIUhGzq_

- (c) Given the following information of a cubic function.

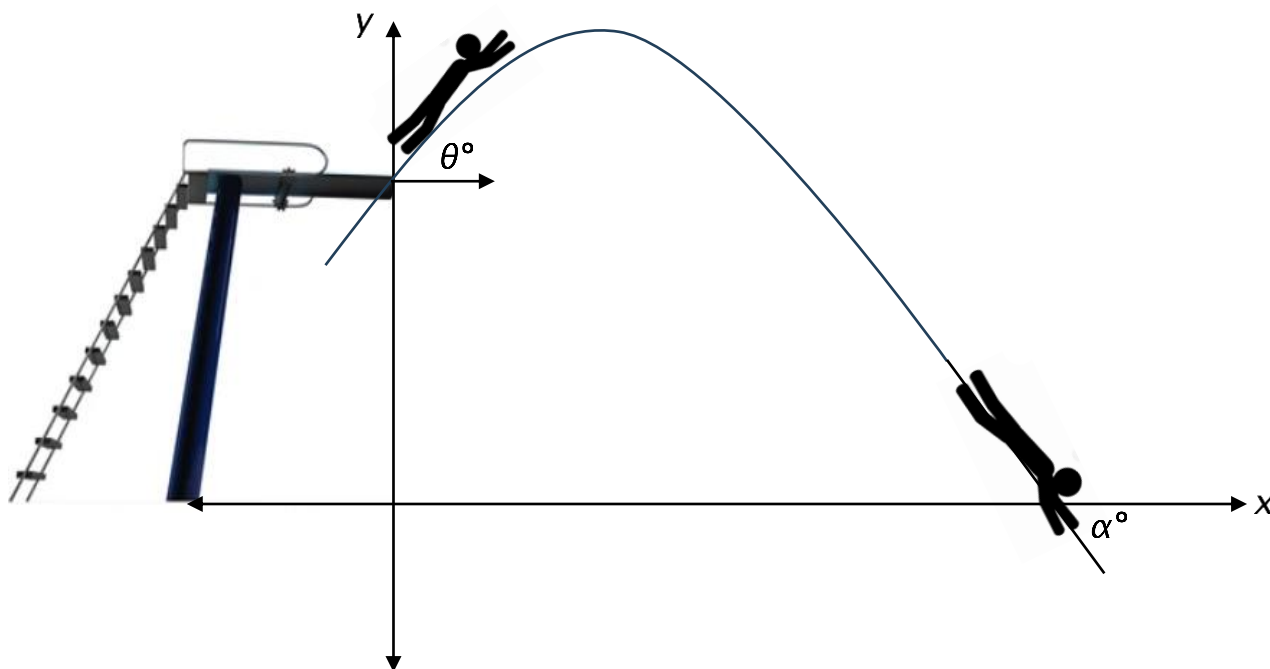
- $h(x)$ has exactly one real root.
- $h(4) = 25$ and $h(0) = -30$.
- $h'(4) = 0$ and $h''(4) = 0$.

Sketch a possible graph of $h(x)$ and label two points on the graph. (3)

Question 10

14 Marks

- (a) A diver jumps upward from a board as shown below at an angle of θ° with the horizontal. At the instant of entering the water, she makes an angle of α° with the horizontal. The path of the diver can be modelled by $y = -\frac{14}{3}x^2 + \frac{28}{3}x + 14$.

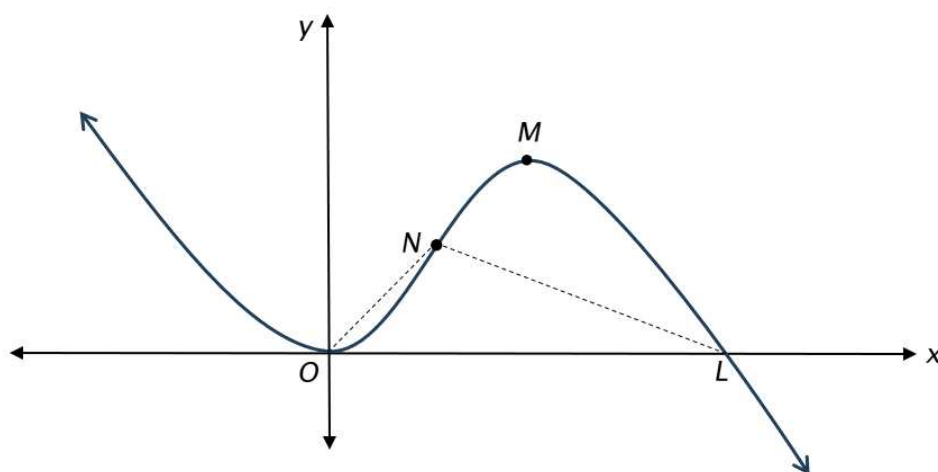


Calculate the size of:

(1) θ (3)

(2) α (4)

- (b) In the diagram below, the graph of $f(x) = 6x^2 - x^3$ is drawn. N is the point of inflection and L the x -intercept.



Calculate the area of $\triangle ONL$.

(7)

- (a) The probability that it will rain on Saturday is $x\%$. If it rains, there is a 40% chance that the hockey team will play their match while the probability that they will play if it doesn't rain is 85%.

(1) Draw a tree diagram to illustrate the situation above. (3)

(2) If the probability that the hockey team will play is 0,505 ; calculate the value of x . (4)



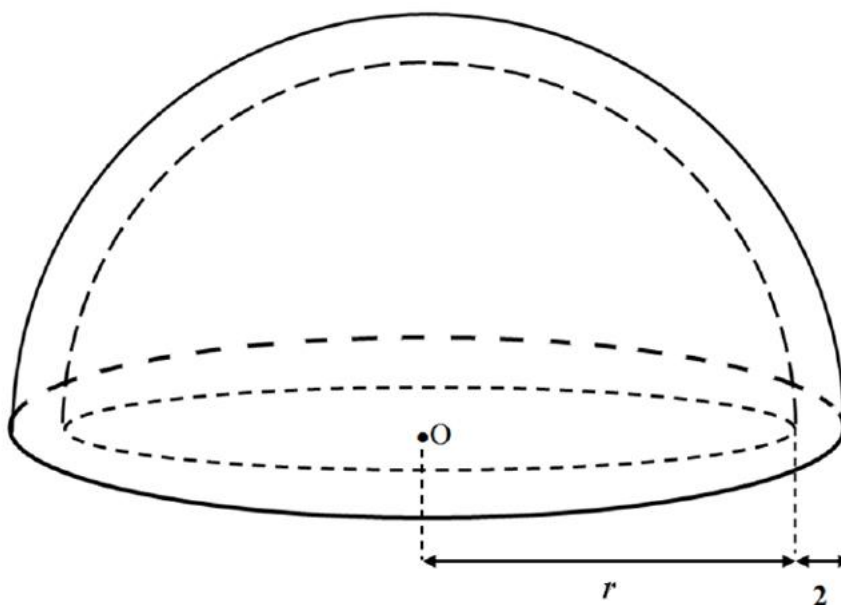
[https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F645562927811484997%](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.pinterest.com%2Fpin%2F645562927811484997%2F)

- (b) Given: $P(A \text{ or } B)' = 0,2$, $P(A \text{ and } B)' = 0,7$ and $P(A)' = 0,4$. Are the events A and B independent? Justify your answer. (6)

Question 12

8 Marks

In the diagram below, two hemispheres of different size have the same centre. The radius of the larger hemisphere is 2 more than the radius of the smaller hemisphere. The region between the two hemispheres are made out of rubber and the inner hemisphere is hollow.



Volume of sphere

$$= \frac{4}{3} \pi r^3$$

(a) Show that the volume of the rubber is $4\pi r^2 + 8\pi r + \frac{16\pi}{3}$. (4)

(b) The rate of change of volume of the rubber with respect to r , is $\frac{88\pi}{3} \text{ cm}^3 / \text{cm}$.
Determine r . (4)

- g is the outcome of a regular 6-sided green die
- r is the outcome of a regular 6-sided red die
- $f(x)$ is a tangent to a graph with $f(g) = r$ and $f'(2) = 6$

If both dice are thrown simultaneously, what is the probability that the equation of the tangent at $x = 2$ will have a y-intercept less than -7 ? (6)



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SUB-TOTAL SECTION B: 73

TOTAL: 150

ADDITIONAL WORKING SPACE