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| Centre Number | Candidate Number | Candidate Name |
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NAMIBIA SENIOR SECONDARY CERTIFICATE

MATHEMATICS HIGHER LEVEL

8323/2

PAPER 2

3 hours

Marks 120

2019

Additional Materials: Geometrical instruments
Non programmable calculator

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
- Write in dark blue or black pen.
- You may use a soft pencil for any diagrams or graphs.
- Do not use correction fluid.
- Do not write in the margin *For Examiner's Use*.
- Answer **all** questions.
- If working is needed for any question it must be shown below, or where working is indicated.
- The number of marks is given in brackets [] at the end of each question or part question.
- Non-programmable calculators may be used.
- If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to **three** significant figures. Give answers for angle sizes to **one** decimal place but angles in radians to **three** significant figures.
- For π , either use your calculator value, or use 3.142.

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This document consists of **16** printed pages.



Republic of Namibia

MINISTRY OF EDUCATION, ARTS AND CULTURE

1 A function f is such that

$$f(x) = 6x^3 - x^2 - 11x + 6.$$

- (a) Given that $f(x) = (ax^2 + bx + c)(x - 2) + R$, find the values of the constants a , b , c and R .

Answer (a) $a =$

$b =$

$c =$

$R =$ [4]

- (b) Show that $(x - 1)$ is a factor of $f(x)$.

Answer (b)

[2]

- (c) Hence factorise $f(x)$ completely.

Answer (c) [3]

2 Find

$$\int \frac{2x + 3}{x^2} dx.$$

Answer [3]

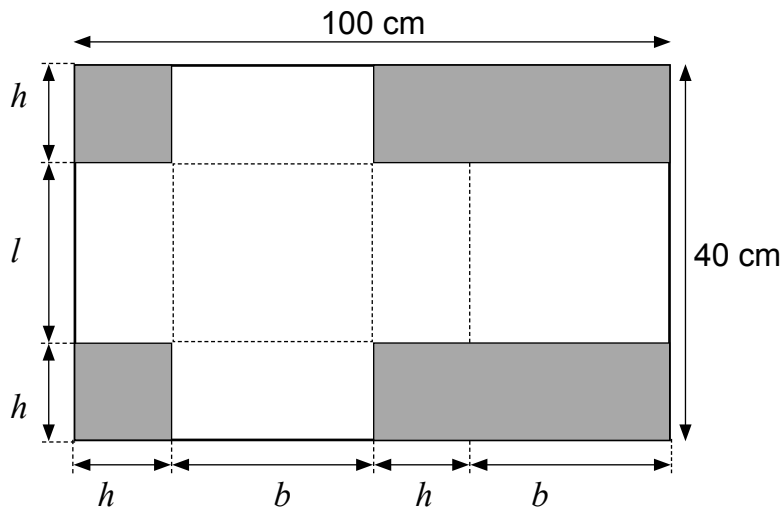
3 (a) Differentiate e^{2x^2-3} with respect to x .

Answer (a) [2]

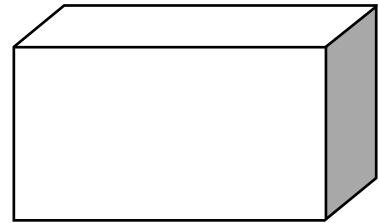
(b) Hence find $\int xe^{2x^2-3} dx$.

Answer (b) [3]

- 4 A box is made from a rectangular piece of cardboard, 100 cm by 40 cm, by cutting out the shaded areas and folding it along the dotted lines as shown in the diagrams.



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SCALE



- (a) Express the length, l , in terms of the height, h .

Answer (a) $l = \dots\dots\dots$ [1]

- (b) Hence prove that the volume of the box is given by $V = h(50 - h)(40 - 2h)$.

Answer (b)

[2]

- (c) Given that h may vary, find the value of h for which the volume of the box is a maximum.

Answer (c) $h = \dots\dots\dots$ cm [5]

- 5 Relative to an origin O , the points A , B and C have position vectors $\begin{pmatrix} 2 \\ -1 \\ -3 \end{pmatrix}$, $\begin{pmatrix} 0 \\ -2 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} c \\ 0 \\ 3 \end{pmatrix}$ respectively.

(a) Calculate angle AOB , correct to the nearest degree.

Answer (a) angle $AOB = \dots\dots\dots^\circ$ [4]

(b) Find the value of c for which angle BAC is equal to 90° .

Answer (b) $c = \dots\dots\dots$ [5]

- 6 (a) Solve the inequality $-\log_3 x - \log_3(2x + 1) \geq -1$.

Answer (a) [4]

- (b) Solve the equation,

(i) $3a^2 - 125a - 100 = 0$, correct to 2 decimal places.

Answer (b) (i) $a =$ [3]

(ii) Hence solve the equation $3 \times 5^{2x} - 5^{x+3} - 100 = 0$.

Answer (b) (ii) $x =$ [3]

- 7 (a) Find the sum to infinity of the geometric progression whose first term is $-\frac{2}{5}$ and second term is $\frac{6}{25}$.

Answer (a) [3]

- (b) An arithmetic sequence is $-5, -2, 1, \dots$.
The n^{th} term is the first term that exceeds 650.
Find the value of n .

Answer (b) $n =$ [3]

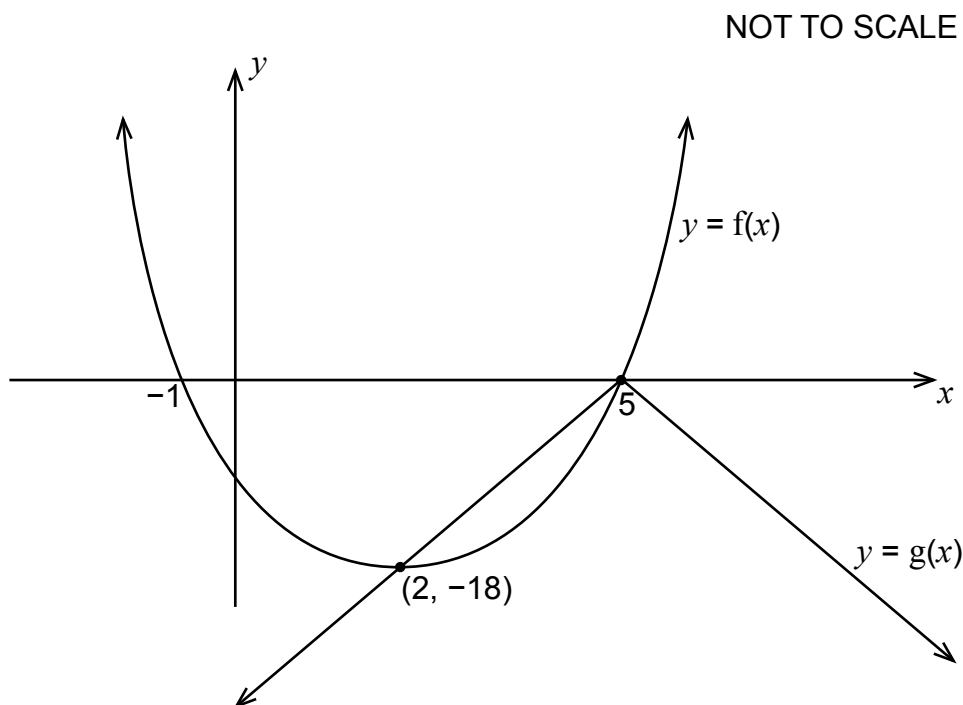
- (c) Given that $\sum_{k=1}^n 5 \times 2^{k-1} = 167772155$, find the value of n .
Show all your working.

Answer (c) $n =$ [5]

8 Functions f and g are both defined for $x \in \mathbb{R}$.

The diagram shows the graph of the quadratic function $y = f(x)$, which intersects the x -axis at $(-1, 0)$ and $(5, 0)$. The minimum point of the curve $y = f(x)$ is $(2, -18)$.

The function g is defined by $g(x) = a|x + b|$ and the graph of $y = g(x)$ passes through the points $(5, 0)$ and $(2, -18)$.



(a) Write down the range of

(i) f ,

Answer (a) (i)..... [1]

(ii) g .

Answer (a) (ii)..... [1]

(b) Find the set of values of x for which $g(x) \geq f(x)$.

Answer (b)..... [1]

(c) Find the values of a and b .

Answer (c) $a =$

$b =$ [2]

(d) Determine whether

(i) f^{-1} exists,

Answer (d) (i) f^{-1} [1]

(ii) g^{-1} exists.

Answer (d) (ii) g^{-1} [1]

(e) Find the equation of function f .

Answer (e) [4]

9 The function f is given by $f(x) = x^3 - 3x^2 + 5x - 3$.

- (a) Write down an expression for $f'(x)$ and hence show that the graph of $y = f(x)$ has no stationary points.

Answer (a)

[5]

- (b) Find the coordinates of the point of inflection of the graph of $y = f(x)$.

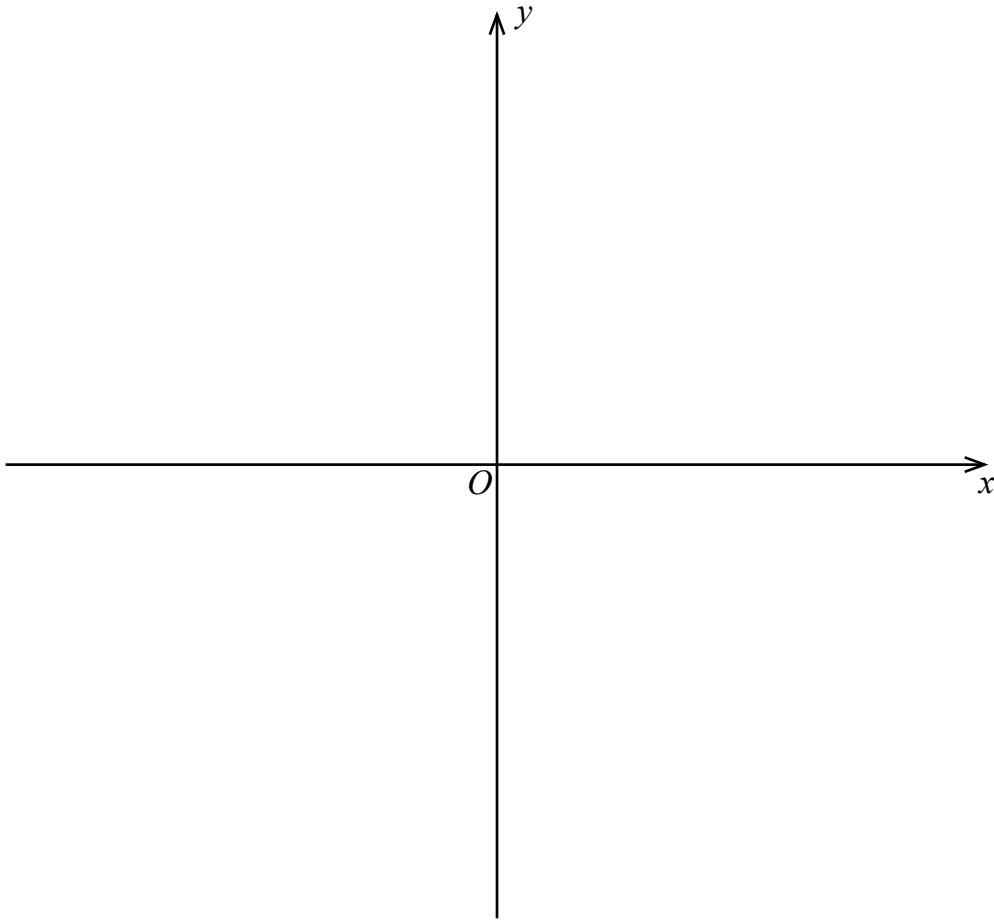
Answer (b)..... [3]

- (c) Write down the coordinates of the points at which the graph of $y = f(x)$ intersects the axes.

Answer (c)..... [2]

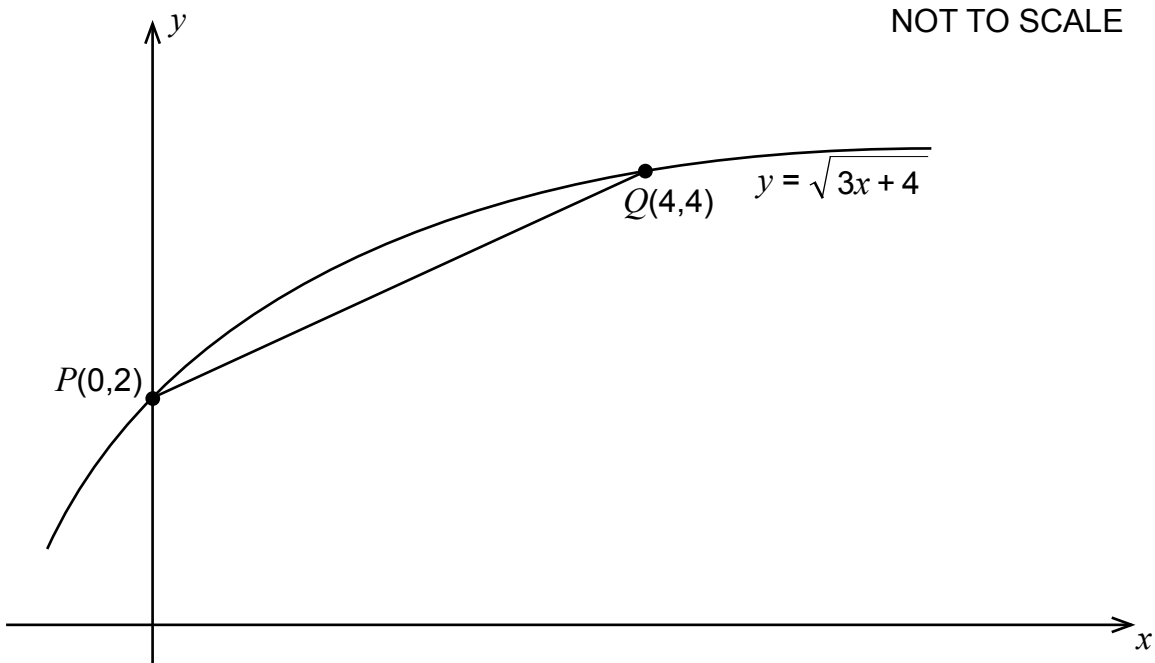
(d) Sketch and label the graph of $y = f(x)$.

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[2]

- 10** The diagram shows chord PQ and part of the curve $y = \sqrt{3x+4}$, intersecting the y -axis at the point $P(0,2)$. The point $Q(4,4)$ lies on the curve.



- (a)** Find the gradient of the tangent to the curve at Q .

Answer **(a)** [3]

- (b)** The region enclosed by the curve, the x -axis, the lines $x = 0$ and $x = 4$ is rotated through 360° about x -axis.

Find, in terms of π , the volume of the solid formed.

Answer **(b)** [4]

- (c) Calculate the area of the region enclosed by the line PQ and the curve from P to Q .

Answer (c) [6]

- 11 (a) Functions f and g are defined for $0^\circ \leq x \leq 180^\circ$ by

$$f(x) = -2 \sin x \text{ and}$$

$$g(x) = \tan 2x.$$

On the same diagram, sketch and label the graphs of

$$y = f(x) \text{ and } y = g(x) \text{ for } 0^\circ \leq x \leq 180^\circ.$$

Answer (a)



[4]

- (b) Hence state the number of solutions of the equation $f(x) = g(x)$ in the interval $0^\circ \leq x \leq 180^\circ$.

Answer (b)..... [1]

12 Functions f and g are defined by

$$f: x \mapsto \frac{3-x}{2+x}, \text{ for } x \neq -2 \text{ and}$$

$$g: x \mapsto \ln(x+3), \text{ for } x > -3.$$

- (a) Evaluate $fg(1)$, giving your answer correct to 4 significant figures.

Answer (a)..... [2]

- (b) Explain why $gf(-4)$ cannot be evaluated.

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- (c) Find an expression for

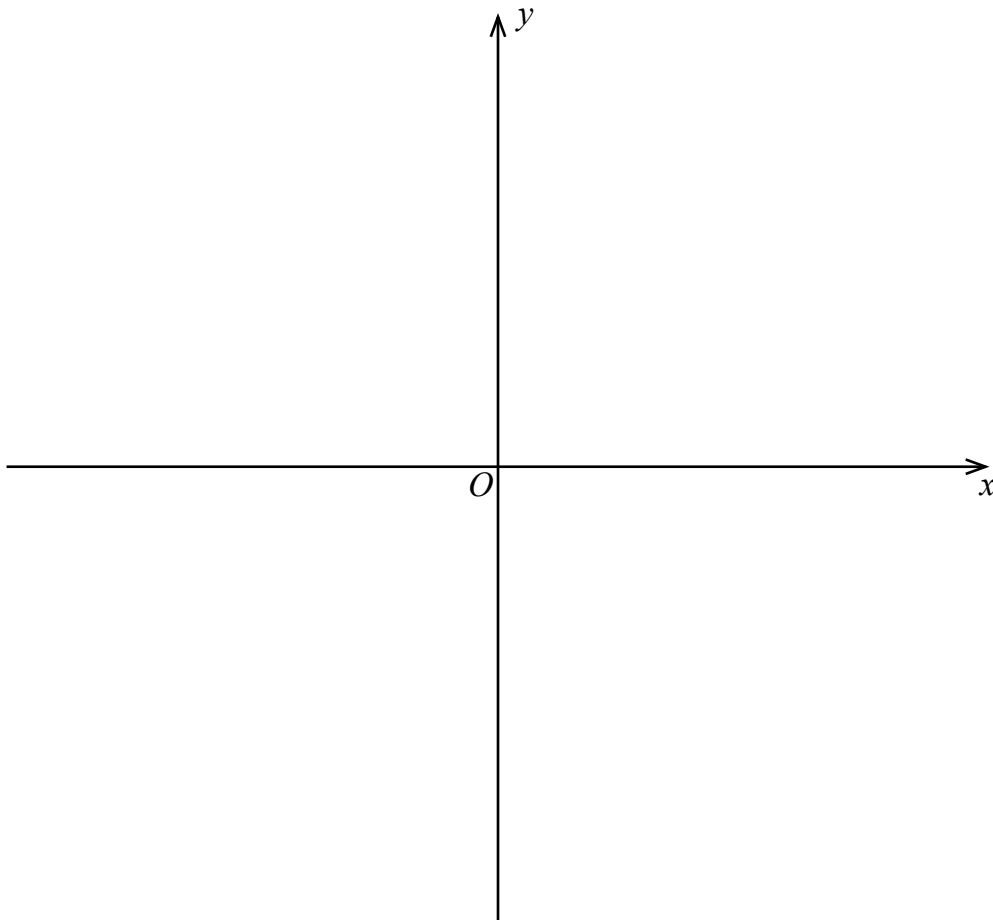
(i) f^{-1} ,

Answer (c) (i) $f^{-1} =$ [3]

(ii) g^{-1} .

Answer (c) (ii) $g^{-1} = \dots\dots\dots$ [3]

(d) Sketch the graphs of $y = g(x)$ and $y = g^{-1}(x)$ on the same system of axes.
Label each graph clearly.



[4]

13 (a) Prove the identity

(i) $\tan \theta \sin \theta + \cos \theta \equiv \frac{1}{\cos \theta}$.

Answer (a)

[3]

(ii) Hence solve the equation $\tan \theta \sin \theta + \cos \theta = 3 \operatorname{cosec} \theta$
for $0 \leq \theta \leq 2\pi$.

Answer (a) (i)..... [3]

(b) Solve the equation $\cot^2 x - \operatorname{cosec} x = 1$ for $0^\circ \leq x \leq 90^\circ$.

Answer (b)..... [4]