OFFICE OF TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

Tasmanian Certificate of Education
External Assessment 2019

PLACE YOUR CANDIDATE LABEL HERE

MATHEMATICS METHODS - Foundation

(MTM315117)

Pages:	28
Questions:	24
Attachment:	Information Sheet

PART 1

Calculators are NOT allowed to be used

Time: 80 minutes

Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criterion can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 80 minutes in total answering the questions in this booklet.
5. The 2019 External Examination Information Sheet for Mathematics Methods - Foundation can be used throughout the examination. No other written material is allowed into the examination.
6. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course document:

Criterion 4 Manipulate algebraic expressions and solve equations.

Criterion 5 Understand linear, quadratic and cubic functions.

Criterion 6 Understand logarithmic, exponential and trigonometric functions.

Criterion 7 Use differential calculus in the study of functions.

Criterion 8 Understand experimental and theoretical probabilities and of statistics.

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Additional Instructions for Candidates

This part **(Part 1)** of the examination is worth 80 marks in total. Each section is worth 16 marks.

You **MUST NOT** use your calculator(s) during reading time nor during the first 80 minutes of the examination. This is the time allocated for completing Part 1 of the examination paper. You may start Part 2 during this time but you cannot use your calculator.

Part 1 will be collected after 80 minutes (the time allocated to complete this part).

The exam supervisors will instruct you when you can use your calculator(s).

You will have a further 100 minutes to complete Part 2 and you can use your calculator(s) during this time.

For questions worth 1 mark, whilst no working is required, markers will look at the presentation of the answer(s) and at the arguments(s) leading to the answer(s).

For questions worth 2 or more marks **you are required** to show relevant working. Marks will be allocated:

- according to the degree to which workings convey a logical line of reasoning, and
- for suitable justifications and explanations of methods and processes when requested.

A spare set of diagrams has been provided in the back of the answer booklet for you to use if required. If you use the spare diagrams, you **MUST** indicate you have done so in your answer to that question.

SECTION A

Answer **ALL** questions in this section.

This section assesses **Criterion 4**.

Section A Marks = 16

For Marker Use Only

Question 1

Expand the following expression:

$3x(4x-5)$ (1 mark)

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Question 2

Solve the following for x:

(a) $3(x-4)=5-x$ (1 mark)

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(b) $\frac{2(x+1)}{3}=\frac{4x}{4}-2$ (2 marks)

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Section A continues

For Marker Use Only

Question 3

Factorise the following:

(a) $x^2 + 2x - 15$ (1 mark)

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(b) $6a^2b - 8ab + 10ab^2$ (1 mark)

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(c) $4x^2 - 5x - 6$ (2 marks)

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(d) $x^2 + 3x - 2$ (2 marks)

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Question 4

Using Pascal's triangle or the binomial theorem to assist, expand $(2x+1)^4$. (3 marks)

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Section A continues

For Marker Use Only

Question 5

Solve the following equation by factorising it first.

$x^3 - x^2 - 8x + 12 = 0$ (3 marks)

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Criterion 4 Total

SECTION B

Answer **ALL** questions in this section.

This section assesses **Criterion 5**

Section B Marks = 16

For Marker Use Only

Question 6

(a) Determine the gradient of $3y = 5 - 0.5x$. (1 mark)

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(b) Sketch the graph of the function $y = mx + 4$ where the gradient equals -2.
Label the x and y intercepts. (2 marks)

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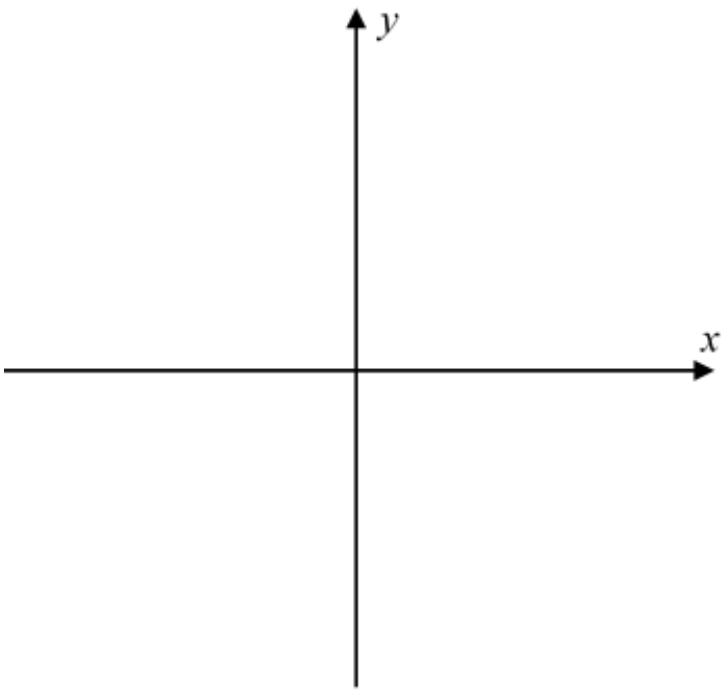

Section B continues

For Marker Use Only

Question 7

For the function: $y = 2x^2 + 12x + 18$

(a) Determine the x and y intercepts. (2 marks)

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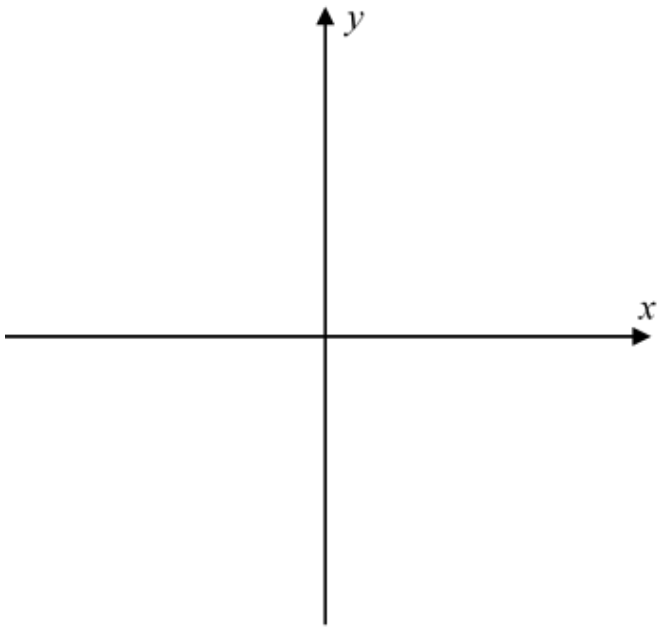
(b) Sketch the graph on the axes below, labelling the x and y intercepts.

(1.5 marks)



Question 8

State the transformations of $f(x) = 2(x-5)^2 - 1$ from $f(x) = x^2$.

(1.5 marks)

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Section B continues

For Marker Use Only

Question 9

For the function: $y = -\frac{1}{2}(x-3)^3 + 2$

Determine the point of inflection and the y intercept. (The x intercept is not required).

Sketch the graph on the axes below, labelling the point of inflection and the y intercept.

(3 marks)

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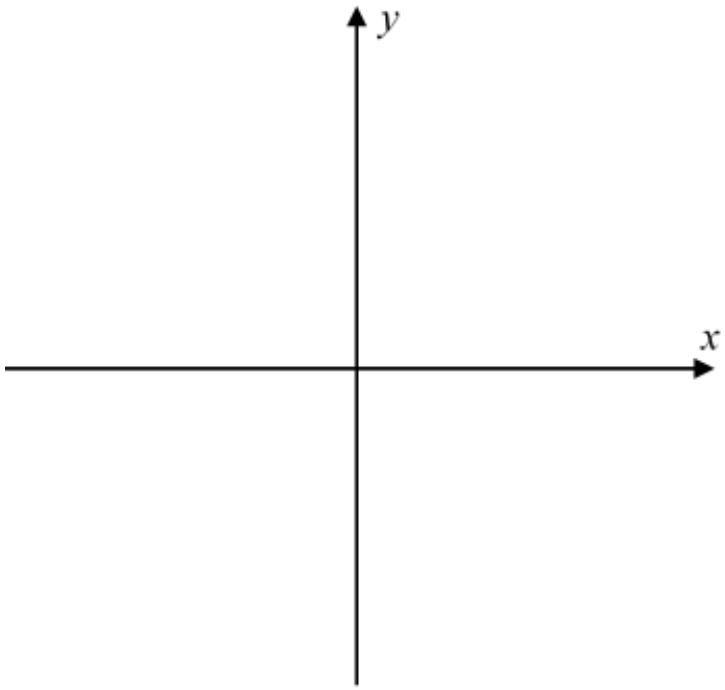

Section B continues

Section B (continued)

For Marker Use Only

Question 10

For the function: $f:(-\infty,4)\to R$, where $f(x)=2x^3-18x$

(a) Determine the x and y intercepts of the function. (2 marks)

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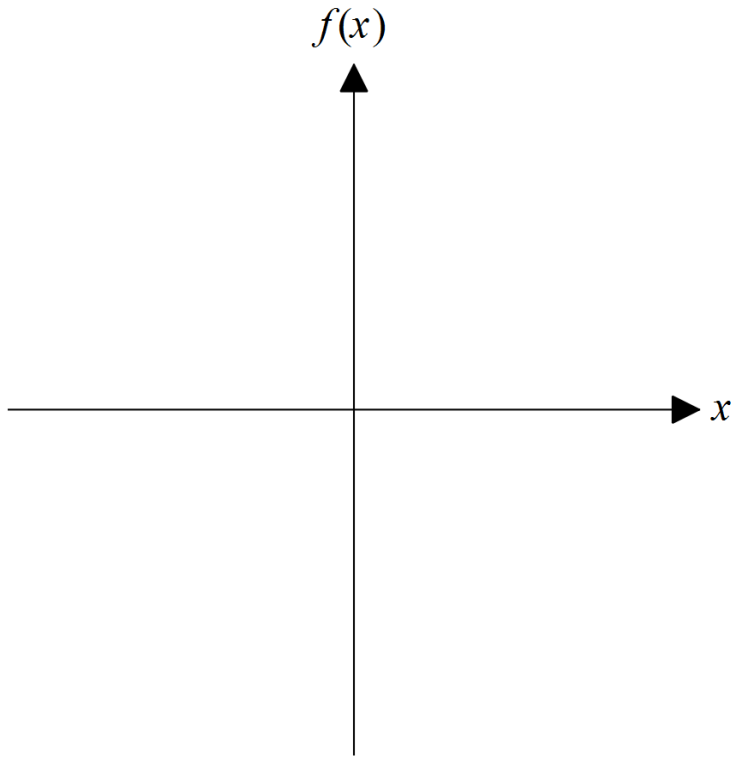
(b) Sketch the graph on the axes below, labelling the x and y intercepts and any end point(s). *(Turning points are not required)* (3 marks)



Criterion 5 Total

SECTION C

Answer **ALL** questions in this section.

This section assesses **Criterion 6**.

Section C Marks = 16

For Marker Use Only

Question 11

Simplify the following expressions:

(a) $\dfrac{4a^2 \times 27ab^2}{3b \times 8a^5}$ (1 mark)

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(b) $x^2y \div (xy^3)^2$ (1 mark)

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(c) $\log_5(\sqrt{8}) \div \log_5(8)$ (2 marks)

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Section C continues

For Marker Use Only

Question 12

Solve the following equations for x.

(a) $\left(\frac{1}{2}\right)^{3x-1} = 1$ (1 mark)

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(b) $\log_4 16 = \log_3 (9)^x$ (1 mark)

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(c) $\log_3 (x) - 2 = \log_3 (x-2)$ (2 marks)

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Section C continues

For Marker Use Only

Question 13

Sketch the graph of the function $y = -2\log_4 x$ on the axes below. Label any intercepts, the asymptote and add at least one other point. (3 marks)

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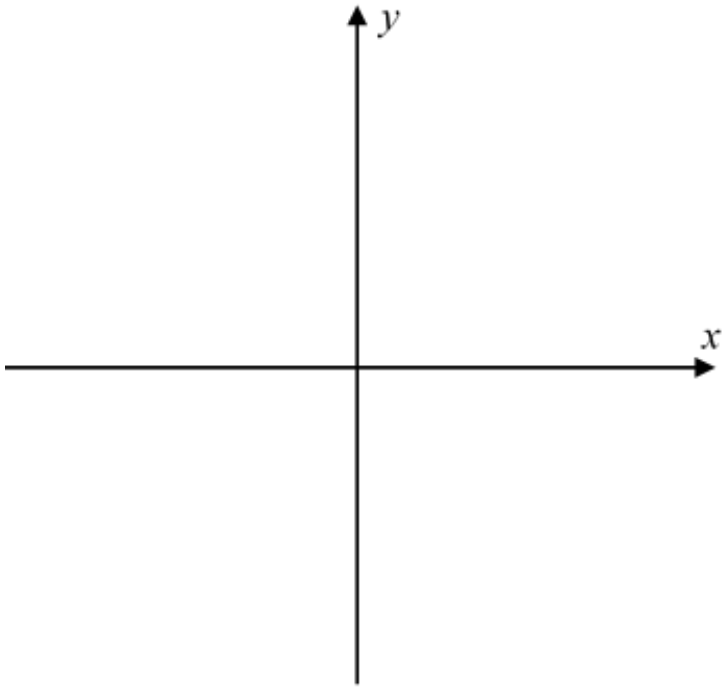

Question 14

If $\tan\theta = 2.15$, find

(a) $\tan(180+\theta)^\circ$ (0.5 marks)

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(b) $\tan(-\theta)^\circ$ (0.5 marks)

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Section C continues

Section C (continued)

Question 15

For Marker Use Only

For the function: $y = \frac{3}{2}\sin(0.5x)$ for $x \in [-2\pi, 2\pi]$

(a) State the amplitude. (1 mark)

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(b) Determine the period. (1 mark)

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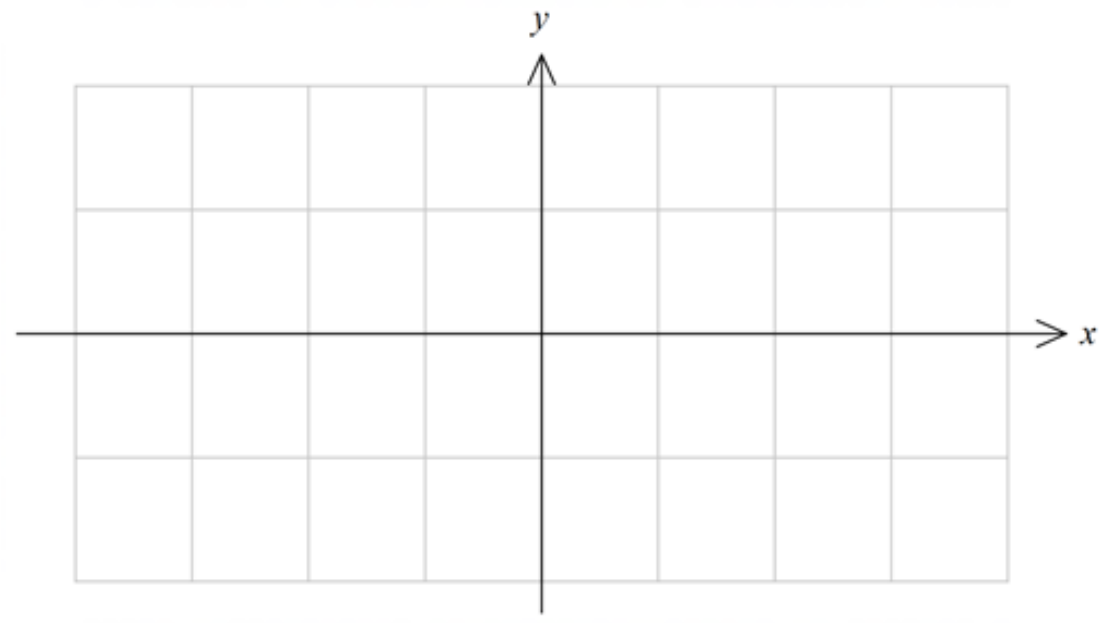
(c) Sketch this function, clearly indicating all intercepts and the amplitude.

Scale the x axis in **radians**. (2 marks)



Criterion 6 Total

SECTION D

Answer **ALL** questions in this section.

This section assesses **Criterion 7**.

Section D Marks = 16

For Marker Use Only

Question 16

Determine the derivative of each of the following functions.

(a) $f(x) = 3x^3 + x^2 - 5x + 7$ (1 mark)

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(b) $y = x^{-3} + 5$ (1 mark)

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(c) $f(x) = \frac{2}{x^2}$ (1 mark)

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(d) $y = \frac{1}{\sqrt{x}} + \sqrt[5]{x^3}$ Express the answer with **positive indices**. (3 marks)

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Section D continues

For Marker Use Only

Question 17

Find the derivative of $y = \dfrac{8x^4 - 4x^2}{2x}$ (2 marks)

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Question 18

A projectile is fired with a trajectory equation, $V = 80 + 6x - x^2$ where V is the vertical height and x is the horizontal displacement, both in metres.

(a) Use **calculus techniques** to determine the horizontal distance when the projectile has reached the maximum vertical height. (2 marks)

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(b) What is the maximum height of the projectile? (1 mark)

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Section D (continued)

For Marker Use Only

Question 19

A 20 litre tank is leaking and the reduced volume of the tank is given by the equation;

$V = 20 - \frac{1}{5}t - \frac{1}{50}t^2$ where V is the volume in litres and t is time in days.

Determine the **rate** at which the tank **is leaking on day 5**. Include units in your answer.

(2 marks)

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Question 20

Find the equation of a tangent to $f(x) = x^2 + 10x + 16$ that is parallel to the x axis.

(3 marks)

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Criterion 7 Total

SECTION E

Answer **ALL** questions in this section.

This section assesses **Criterion 8**.

Section E marks = 16

For Marker Use Only

Question 21

Evaluate $4!$ (1 mark)

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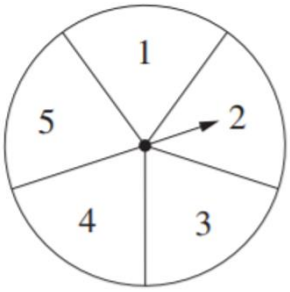
Question 22

A spinner is marked with the numbers 1 to 5. When it is spun each of the numbers is equally likely to occur.



The spinner is spun 3 times.

(a) What is the probability that an even number occurs on the first spin? (1 mark)

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(b) What is the probability that the number 3 occurs on all three spins? (1 mark)

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(c) What is the probability that an even number occurs on at least one of the three spins? (2 marks)

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Section E continues

For Marker Use Only

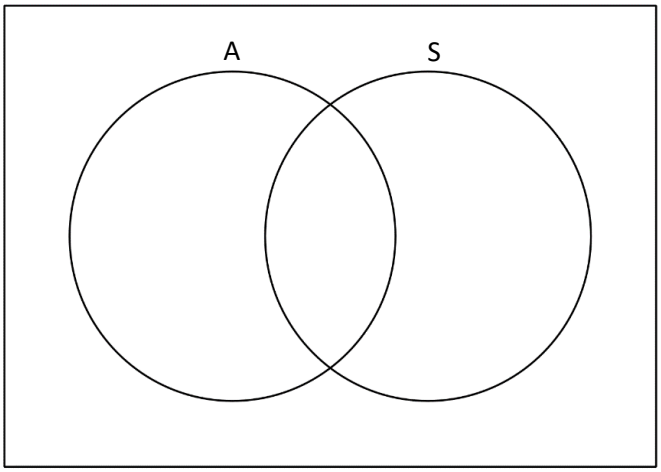
Question 23

A survey of computer game genres (types) was conducted at a school, to find the most popular type. 43 students were surveyed.

The results of the survey were:

- 12 liked both action and sports games.
- 13 liked neither action or sports games.
- Twice as many liked action games only compared to sports games only.

(a) Complete the Venn diagram below, showing this information. (2 marks)



(b) Determine the probability of randomly selecting:

(i) A student who liked neither genre of games. (1 mark)

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(ii) A student who likes action games (A) only. (1 mark)

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(iii) A student who likes sport games (S), given that they also like action games (A). (2 marks)

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Section E continues

Section E (continued)

Question 24

For Marker Use Only

Two students, Lauren and Amber often play chess. Lauren estimates the probability of beating Amber is 0.6 and the probability of a draw is 0.3.

(a) If they play 2 games, show all possible outcomes on a tree diagram below. Include **all** the probabilities. (3 marks)

(b) Determine the probability that Amber wins at least 1 game. (2 marks)

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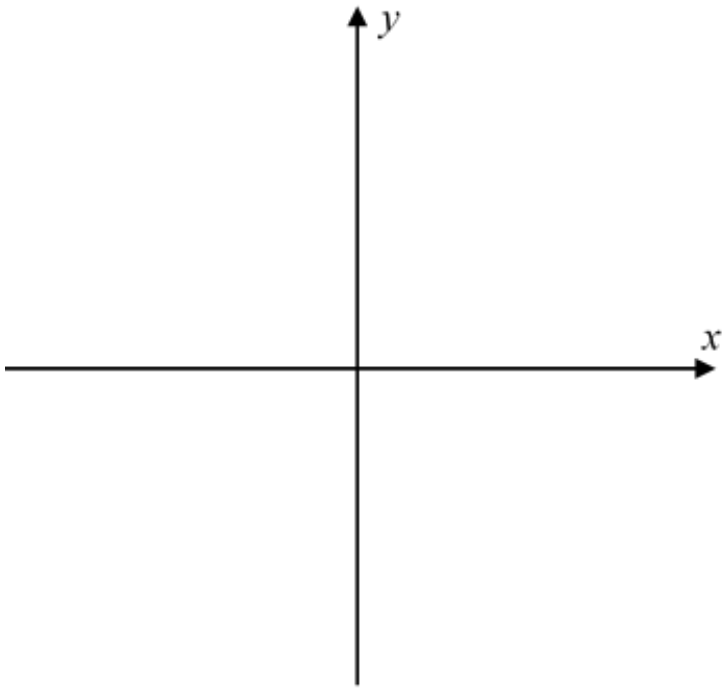
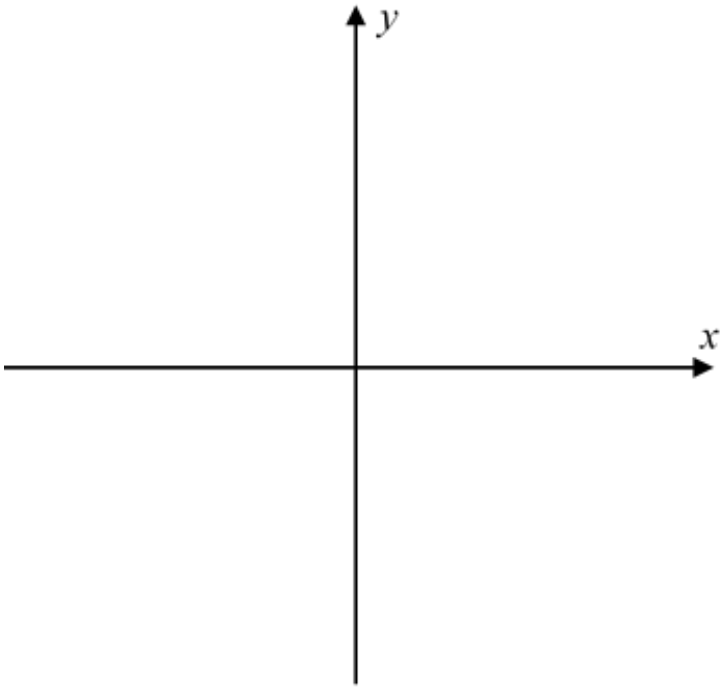
Criterion 8 Total

SPARE DIAGRAMS

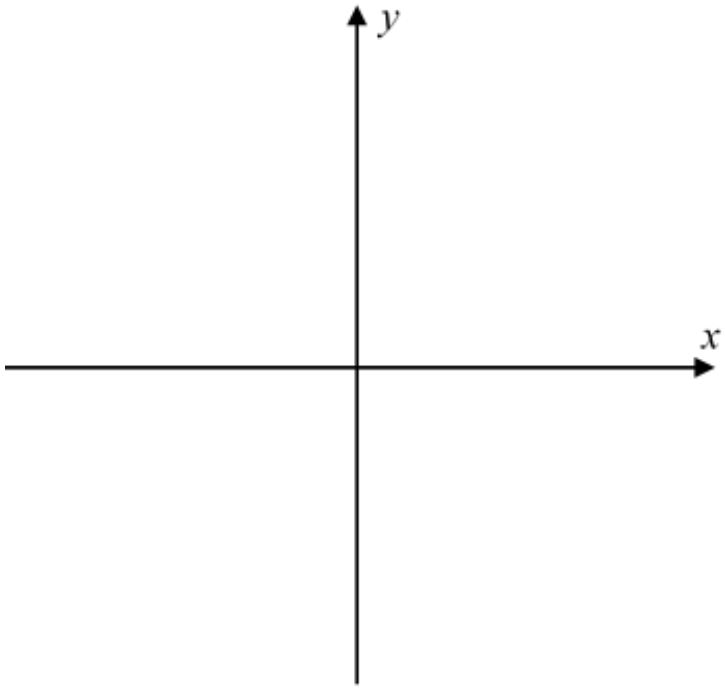
Question 6 (b)



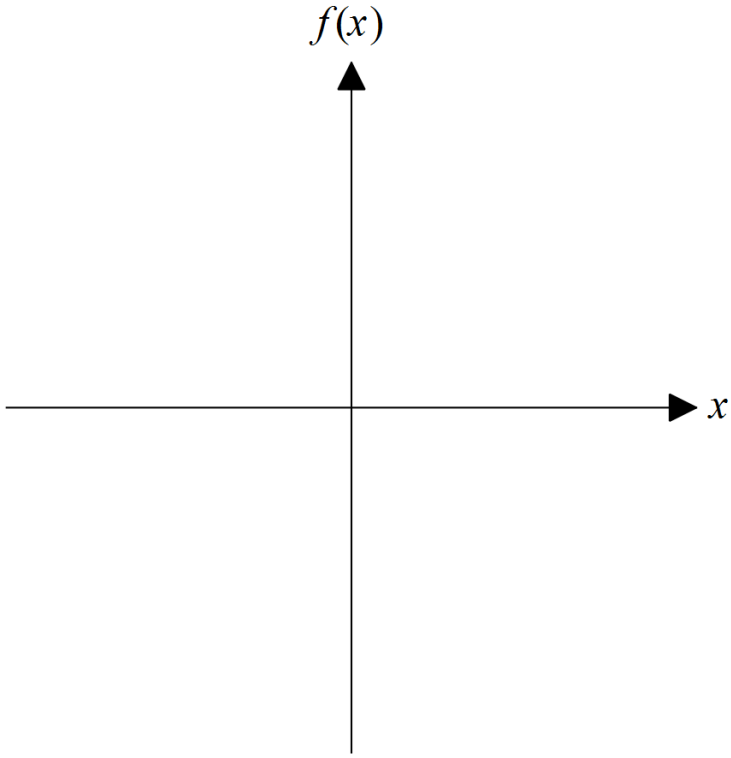
Question 7 (b)



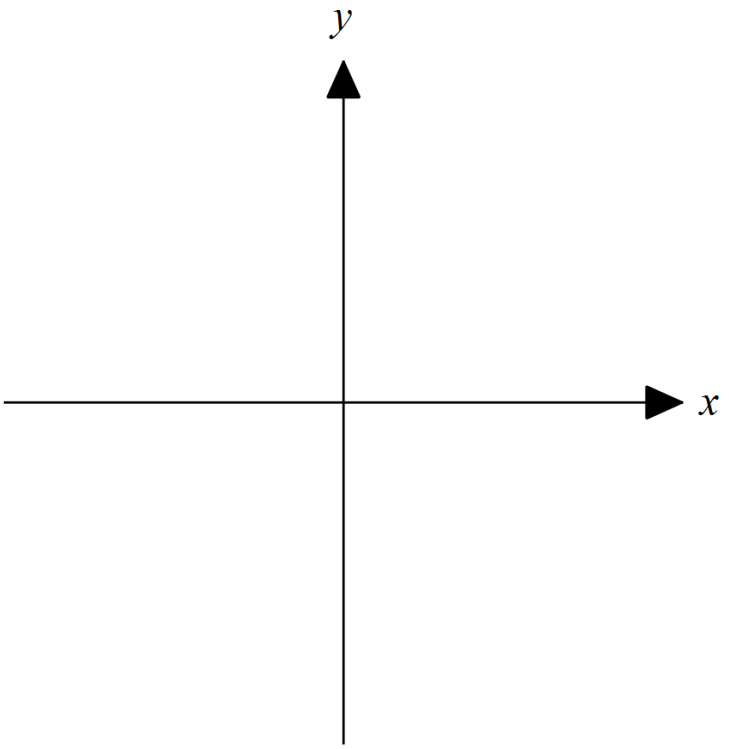
Question 9



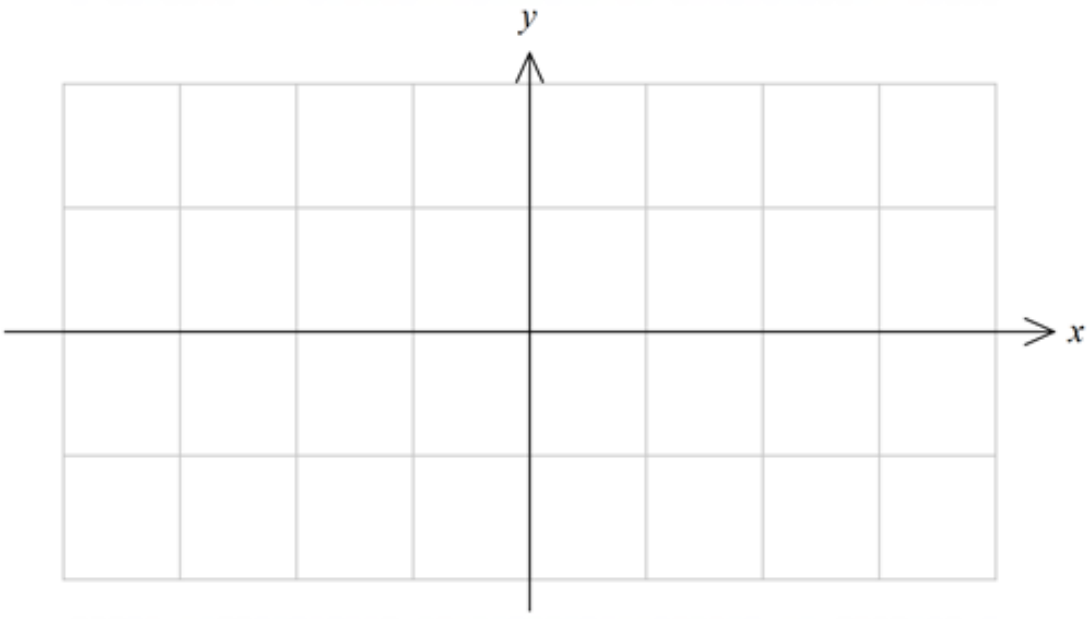
Question 10 (b)



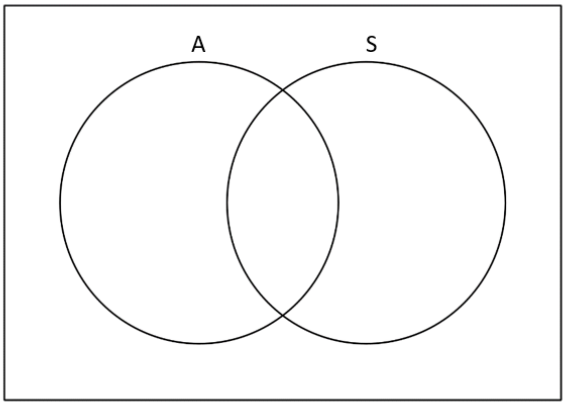
Question 13



Question 15 (c)



Question 23 (a)



Question 24 (a)

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Tasmanian Certificate of Education
External Assessment 2019

PLACE YOUR CANDIDATE LABEL HERE

MATHEMATICS METHODS - Foundation

(MTM315117)

Pages:	28
Questions:	34
Attachment:	Information Sheet

PART 2

Calculators are allowed to be used

Time: 100 minutes

Candidate Instructions

1. You **MUST** make sure that your responses to the questions in this examination paper will show your achievement in the criteria being assessed.
2. Answer **ALL** questions. Answers must be written in the spaces provided on the examination paper.
3. You should make sure you answer all parts within each question so that the criteria can be assessed.
4. This examination is 3 hours in length. It is recommended that you spend approximately 100 minutes in total answering the questions in this booklet.
5. The 2019 External Examination Information Sheet for Mathematics Methods - Foundation can be used throughout the examination. No other written material is allowed into the examination.
6. A TASC approved calculator can be used throughout this part of the examination.
7. All written responses must be in English.

On the basis of your performance in this examination, the examiners will provide results on each of the following criteria taken from the course document:

Criterion 4 Manipulate algebraic expressions and solve equations.

Criterion 5 Understand linear, quadratic and cubic functions.

Criterion 6 Understand logarithmic, exponential and trigonometric functions.

Criterion 7 Use differential calculus in the study of functions.

Criterion 8 Understand experimental and theoretical probabilities and of statistics.

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Additional Instructions for Candidates

This part **(Part 2)** of the examination is worth 100 marks in total. Each section is worth 20 marks.

You are expected to provide a calculator(s) as approved by the Office of the Tasmanian Assessment, Standards and Certification.

You **MUST NOT** use your calculator(s) during reading time nor during the first 80 minutes of the examination. This is the time allocated for completing Part 1 of the examination paper. **You may start Part 2 during this time but you cannot use your calculator.**

Part 1 will be collected after 80 minutes (the time allocated to complete this part).

The exam supervisors will instruct you when you can use your calculator(s).

You will have a further 100 minutes to complete Part 2 and you can use your calculator(s) during this time.

For questions worth 1 mark, whilst no working is required, markers will look at the presentation of the answer(s) and at the arguments(s) leading to the answer(s).

For questions worth 2 or more marks **you are required** to show relevant working. Marks will be allocated:

- according to the degree to which workings convey a logical line of reasoning, and
- for suitable justifications and explanations of methods and processes when requested.

A spare diagram has been provided in the back of the answer booklet for you to use if required. If you use the spare diagrams, you **MUST** indicate you have done so in your answer to that question.

SECTION A

Answer **ALL** questions in this section.

This section assesses **Criterion 4**.

Section A Marks = 20

For Marker Use Only

Question 25

By applying the remainder theorem, find the remainder when

$P(x) = 2x^3 - 4x^2 - 3x + 2$ is divided by $(x - 2)$. (1 mark)

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Question 26

The velocity (V) of a seismic P wave is given by the equation: $V = \sqrt{\frac{K + \frac{4}{3}u}{p}}$

(a) Determine the velocity (V) given that $K = 50$, $u = 24$ and $p = 2.7$ (1 mark)

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(b) Rearrange the equation to make p the subject. (2 marks)

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Section A continues

For Marker Use Only

Question 27

(a) Use the discriminant to predict the **number** and **type** (rational or irrational) of solution(s) for the equation:

$5x^2 = 8x - 4$ (2 marks)

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(b) For which values of k does $x^2 + kx + 16 = 0$ have no real solutions. (2 marks)

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Question 28

Determine if any points of intersection exist with the following pair of simultaneous equations. State the coordinates of any intersection point(s). Show some **algebraic working.**

$y = x^2 + 11x + 28$ and $y = 10x + 40$ (3 marks)

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For Marker Use Only

Question 29

Solve the following equation by **completing the square**. Give the answer in exact values.

$3x^2 - 12x - 7 = 0$ (2 marks)

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Question 30

Solve $(x-8)^2 - 2(x-8) = 15$ showing some **algebraic working**. (2 marks)

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Question 31

Use the **quadratic formula** to solve the following equation $7x^2 + 12x - 10 = 0$**.**

Give the answer to three decimal places. (2 marks)

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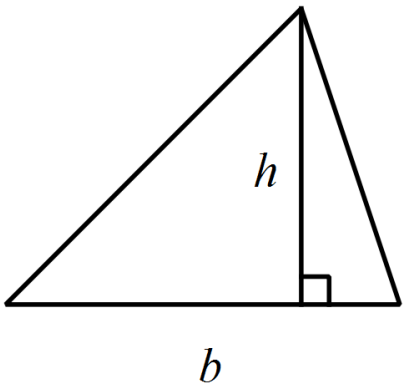
Section A continues

Section A (continued)

Question 32

The area of a triangle is 24 cm^2. The base (b) is 2 cm less than its height (h).

Determine the dimensions of both the base and the height. Show some **algebraic working.**



(3 marks)

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For Marker Use Only

Criterion 4 Total

SECTION B

Answer **ALL** questions in this section.

This section assesses **Criterion 5**.

Section B Marks = 20

For Marker Use Only

Question 33

(a) What is the x intercept of the line $2x+3y+7=0$. (1 mark)

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(b) Find the equation of a straight line that passes through the following pair of points:
(2,-2) and (0,1). (2 marks)

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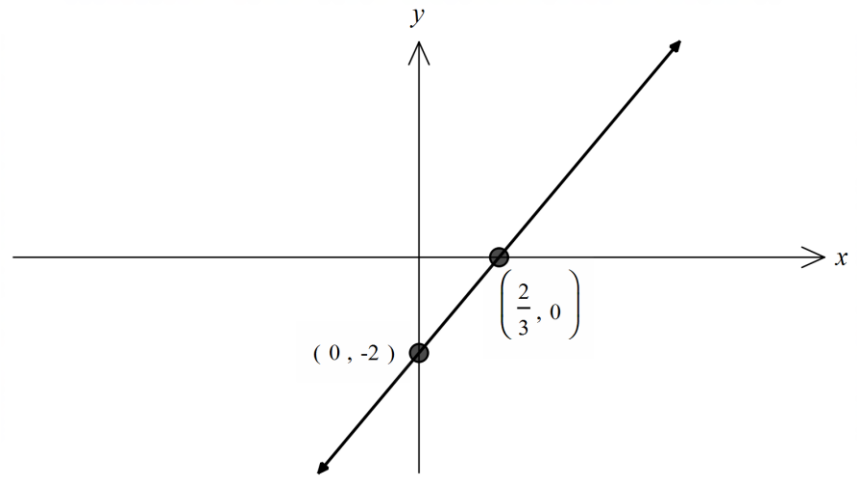
Section B continues

For Marker Use Only

Question 34

The graph of a function is shown below**.**



Determine the equation of this function in the form $y = mx + c$. (1 mark)

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Question 35

The point (3,-2) lies on the function $y = -3x + 7$. Determine the equation of a line that is perpendicular to the function at the point (3,-2).

Express your answer in the form $ax + by + c = 0$.

(2 marks)

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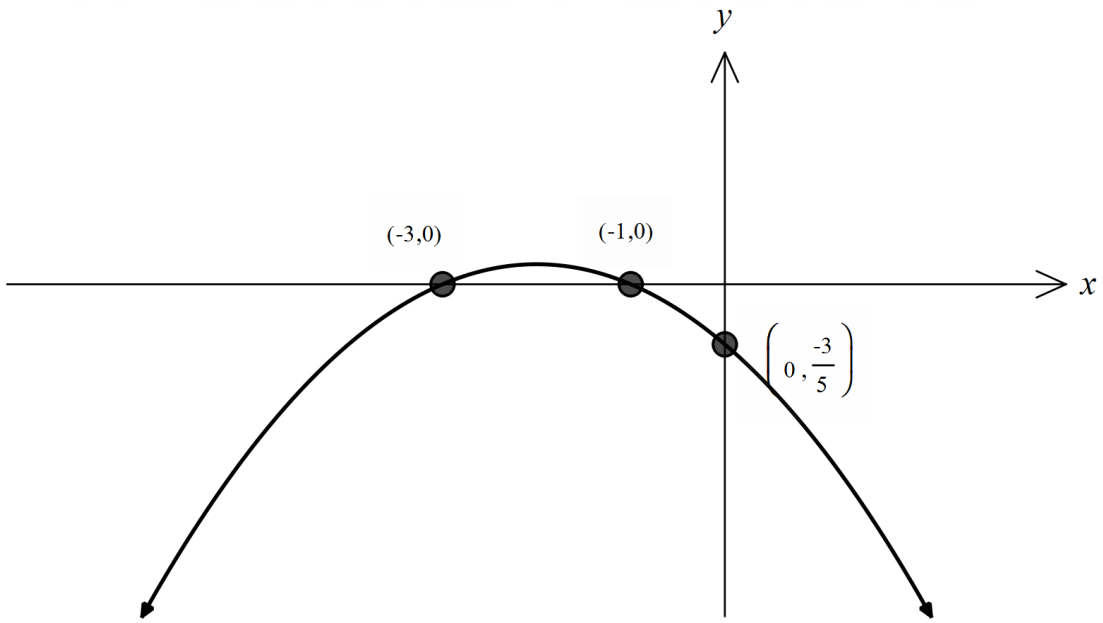
Section B continues

Question 36

For Marker Use Only

A quadratic function is graphed below.



(a) Determine the equation of this function in the form $y = ax^2 + bx + c$ (3 marks)

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(b) Determine the turning point of the above function **showing some working**. (2 marks)

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Section B continues

For Marker Use Only

Question 37

The temperature, T (^0C), in a factory is controlled by a climate system using the following equation, $T = \frac{2}{3}x^2 - 2x + 6$ where x is time in hours. How long does it take the temperature to reach 18 ^0C? (2 marks)

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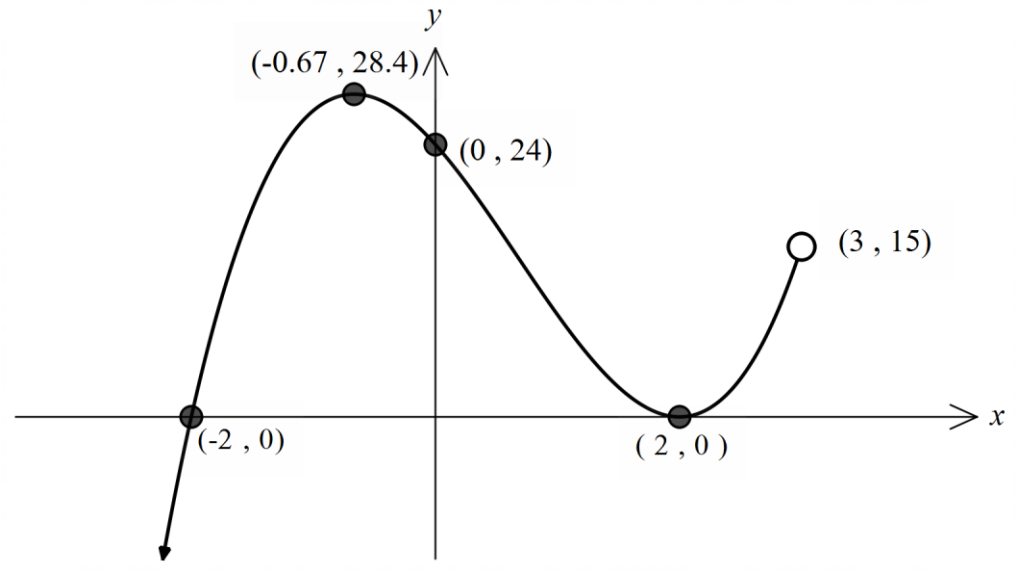
Question 38

The graph of a cubic function is shown below.



(a) Determine the equation of this function. (2 marks)

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(b) State the range of the function. ..... (1 mark)

(c) State the domain of the function. ..... (1 mark)

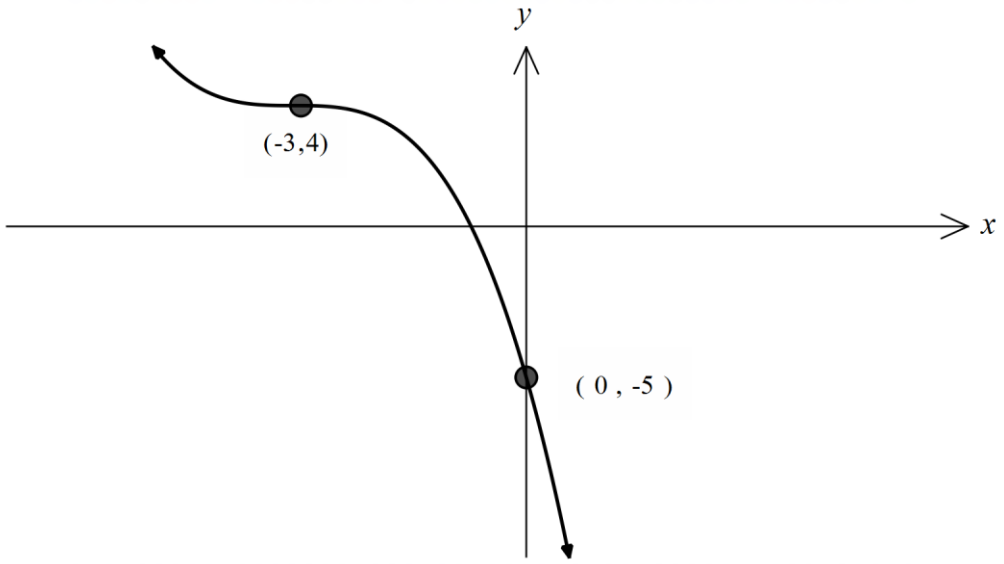
Section B continues

Section B (continued)

Question 39

For Marker Use Only

The graph of a cubic function is shown below.



(a) Determine the equation of this function in the form $y = a(x-h)^3 + k$. (2 marks)

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(b) Using the point of inflection (-3, 4), state the translations of the function above from $y = x^3$. (1 mark)

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Criterion 5 Total

SECTION C

Answer **ALL** questions in this section.

This section assesses **Criterion 6**.

Section C Marks = 20

For Marker Use Only

Question 40

Convert 144 degrees to radians. Give your answer in exact form. (1 mark)

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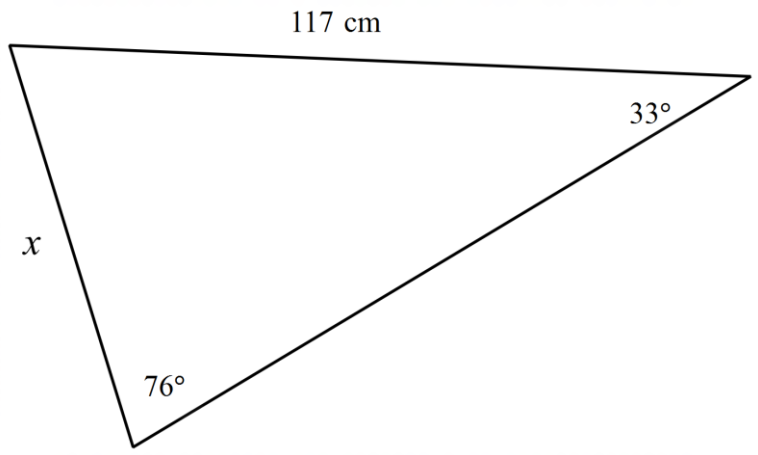
Question 41

Determine the value of x in the diagram below. (2 marks)



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Section C continues

For Marker Use Only

Question 42

If $\cos\theta = 0.96$, $0 \le \theta \le \frac{\pi}{2}$, then find the value of the following:

(a) $\cos(2\pi - \theta)$ (0.5 mark)

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(b) $\cos(\pi - \theta)$ (0.5 mark)

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(c) $\sin(\theta)$ (2 marks)

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(d) $\tan(\pi - \theta)$ (2 marks)

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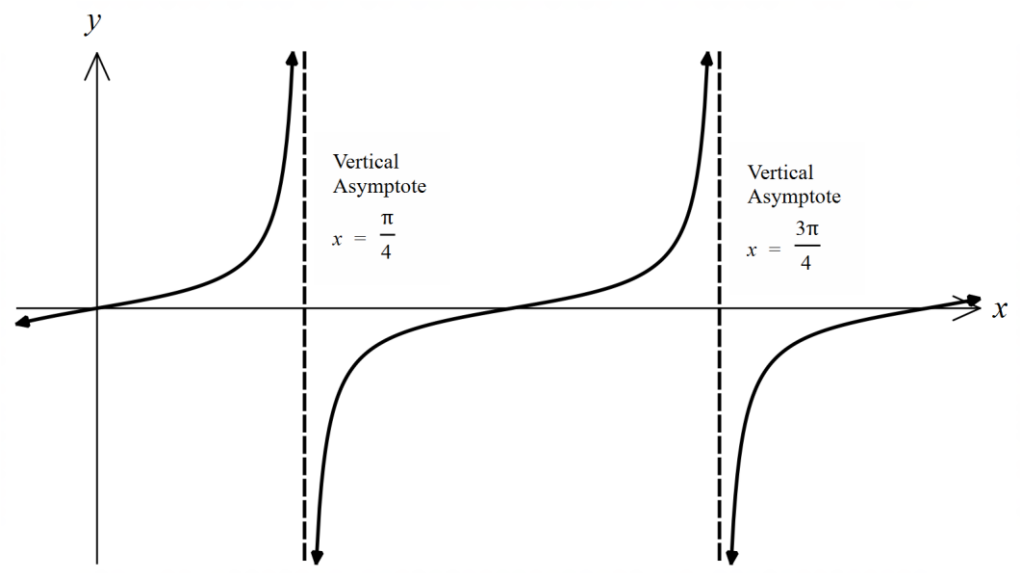
For Marker Use Only

Question 43

For the function below:



(a) State the period. (1 mark)

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(b) Determine a possible equation of this function. (2 marks)

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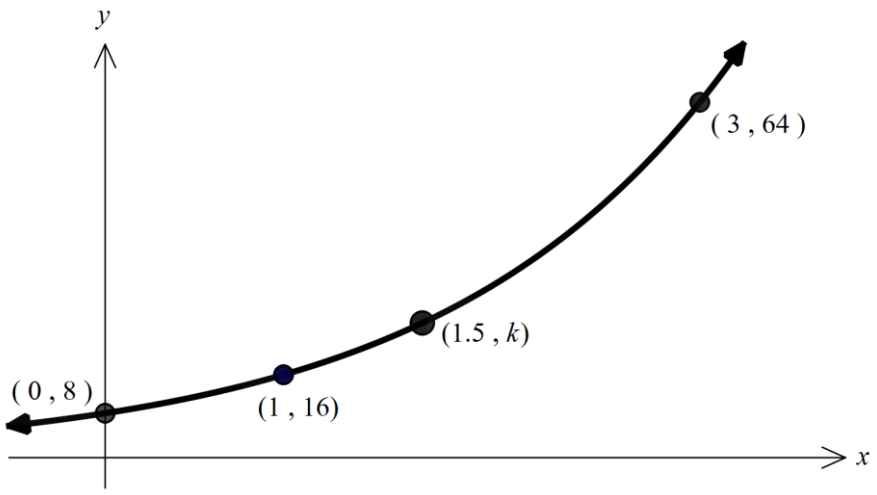
Section C continues

For Marker Use Only

Question 44

Consider the graph below of the exponential equation $y = a \times b^x$ where a and b are constants.



(a) Determine the equation of the above exponential function. (2 marks)

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(b) Determine the value of k on the graph, at the point $(1.5, k)$. (1 mark)

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(c) State the range of the function.....
(1 mark)

(d) State the domain of the function. .....
(1 mark)

Section C continues

For Marker Use Only

Question 45

Express the equation $\log_3(81) = x - 1$ in **index form** and then solve for x. (2 marks)

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Question 46

Earthquakes generate seismic waves. The measured wave amplitude (A) of a seismic wave can be used to determine a Richter scale value for the earthquake. The normal amplitude (A_0) was found to be a value of 1.3 units. $(A_0 = 1.3)$

The equation to calculate the Richter scale value (R) is as follows: $R = \log_{10}\left(\frac{A}{A_0}\right)$.

(a) Calculate the Richter scale value of an earthquake that has a wave amplitude (A) of 510 units. (1 mark)

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(b) Calculate the wave amplitude (A) of an earthquake that has a Richter scale value of 7. (1 mark)

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Criterion 6 Total

SECTION D

Answer **ALL** questions in this section.

This section assesses **Criterion 7**.

Section C Marks = 20

For Marker Use Only

Question 47

The table below shows distances travelled by a cyclist and their times for 1000 *m* intervals.

Time (*s*)	0	165	325	488	647	794
Distance (*m*)	0	1000	2000	3000	4000	5000

(a) Find the average rate of change of distance between the times of 325 *s* to 647 *s*? Include units in your answer. (2 marks)

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(b) In which 1000 *m* interval was the cyclist travelling the fastest? (1 mark)

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Question 48

(a) Use calculus techniques to determine the **gradient** of the function $f(x)=2.5x^2-3x+1$ at the point $(-2,17)$. (2 marks)

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Section D continues

Question 49

For the function $f(x) = -x^3 - 6x^2 + 7$ use **calculus techniques** to find any stationary points and determine their nature. (3 marks)

For Marker Use Only

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Question 50

Use calculus techniques to determine the equation of the **normal** to the function $y = 3x^2 - 7x + 7$ at the point $(2,5)$. (3 marks)

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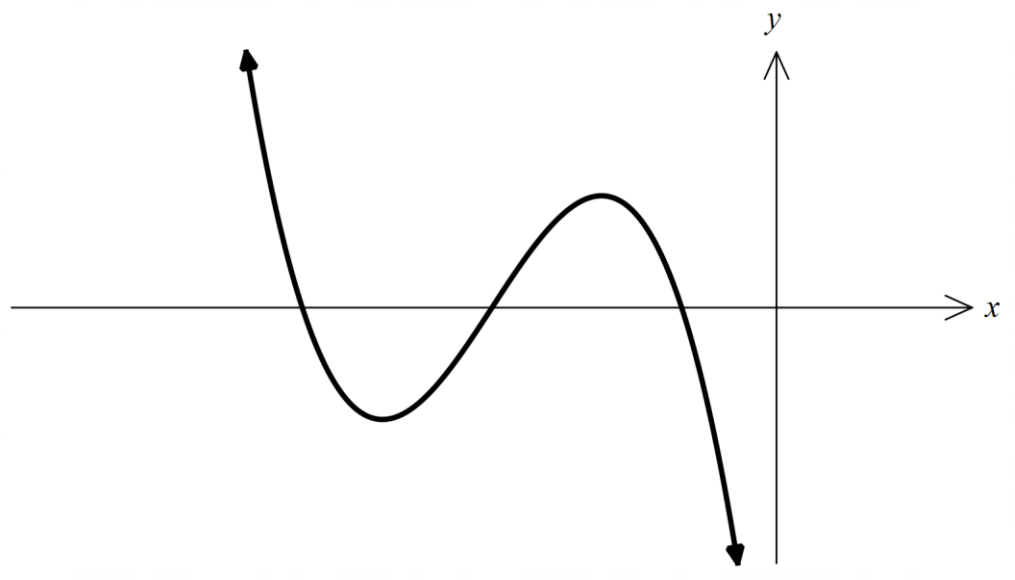
Section D continues

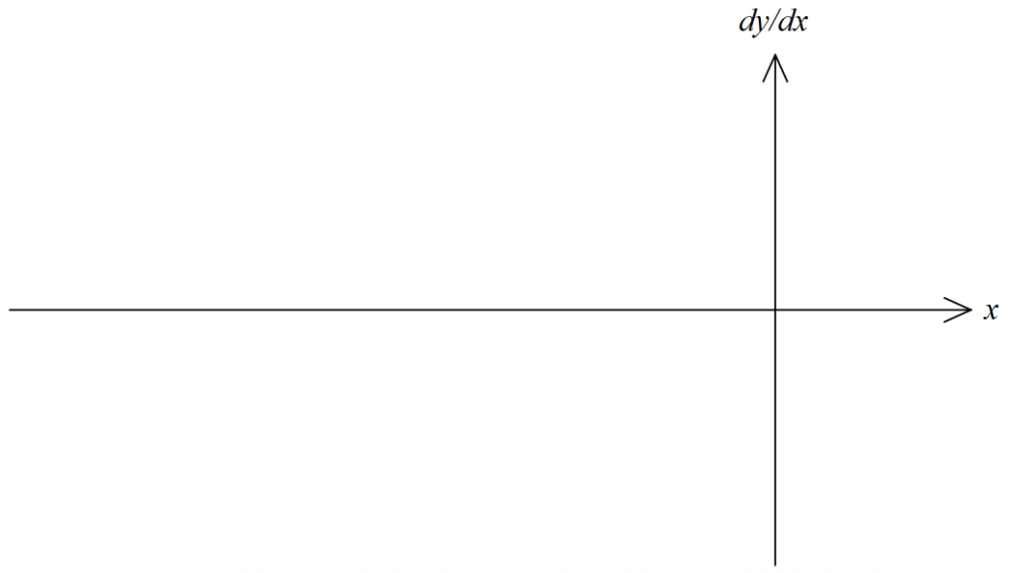
For Marker Use Only

Question 51

The graph of a function is shown below. (2 marks)



Sketch the graph of the derivative $\frac{dy}{dx}$, clearly indicating any possible x intercepts.



Section D continues

For Marker Use Only

Question 52

The profit (P) of a cabinet making company is determined by the number of items (x) that are made each week. The equation below models the company's profit.

$P = -\frac{1}{3}x^3 + 5x^2 - 16x + 2000$, where $0 \le x \le 11$

P = profit $(\$ \times 100)$ and $x =$ number of items made per week.

(a) Use **calculus techniques** to determine the number of items (x) that will give the **maximum profit.** (2 marks)

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(b) What is the maximum profit? (1 mark)

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(c) What is the rate of profit when 5 items are made per week? (1 mark)

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Section D continues

Section D (continued)

Question 53

For Marker Use Only

Using **first principles,** show that the derivative of $f(x) = 2x^3$ is $6x^2$**.** (3 marks)

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Criterion 7 Total

SECTION E

Answer **ALL** questions in this section.

This section assesses **Criterion 8**.

Section E Marks = 20

For Marker Use Only

Question 54

The word **FANTASTIC** contains 9 letters.

A letter will be chosen at random.

(a) **One** letter will be chosen at random. Determine the probability that the letter **C** is chosen. (1 mark)

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(b) Two letters are chosen at random. If the first letter is **not** replaced, determine the probability that **both** letters are **T**? (1 mark)

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Question 55

A student estimates the probability of passing their exams are;

Pr (English) = 0.95; Pr (Maths) = 0.75 and Pr (Science) = 0.85.

What is the probability that they will pass English and Maths, but **not** Science? (2 marks)

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Section E continues

Question 56

For Marker Use Only

The block of units has 4 levels. Each level has several units as detailed below.

Level four – 3 units

Level three – 4 units

Level two – 4 units

Level one – 5 units

The block of units has a committee to oversee maintenance.

The committee has 5 **members**, **each from a different unit.**

Committee members are chosen at **random**.

(a) How many different committees are possible? (1 mark)

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(b) Determine the **probability** of 2 committee members being chosen from level one and 3 committee members chosen from level four. (2 marks)

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(c) Determine the **probability** of at least one unit being chosen from every level. (3 marks)

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Section E continues

Section E (continued)

For Marker Use Only

Question 57

A box of 20 light globes was found to have 3 defective (not working) globes.

If 4 light globes were selected at random, without replacement, find the **probability** that **no more** than one is defective. (4 marks)

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Question 58

A geologist collects the following rocks around Queenstown, Tasmania. They classify the rocks into 3 main groups. Each group has several different rocks as shown below.

Group 1 - Sedimentary rocks: 4 different sedimentary rocks

Group 2 – Igneous rocks: 3 different igneous rocks

Group 3 – Metamorphic rocks: 5 different metamorphic rocks

(a) All the rocks were put in a box together. If 4 rocks are selected at random, determine the number of possible combinations. (1 mark)

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(b) All the rocks were put back in the box together. If 4 rocks are selected at random, determine the **probability** of selecting 2 igneous rocks and 2 sedimentary rocks. (2 marks)

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(c) All the rocks were put back in the box together. If 4 rocks are selected at random, determine the **probability** of selecting at least 3 metamorphic rocks. (3 marks)

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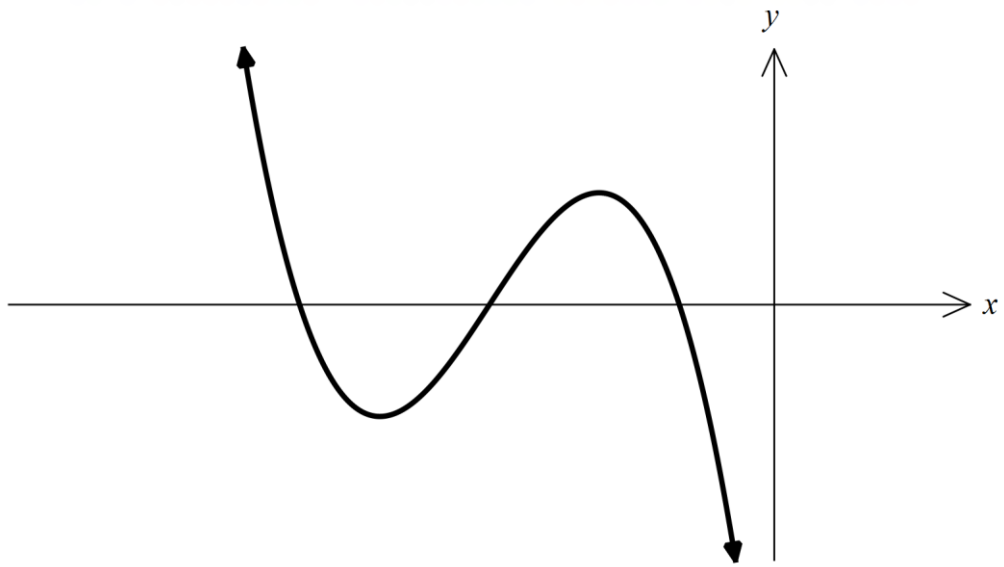
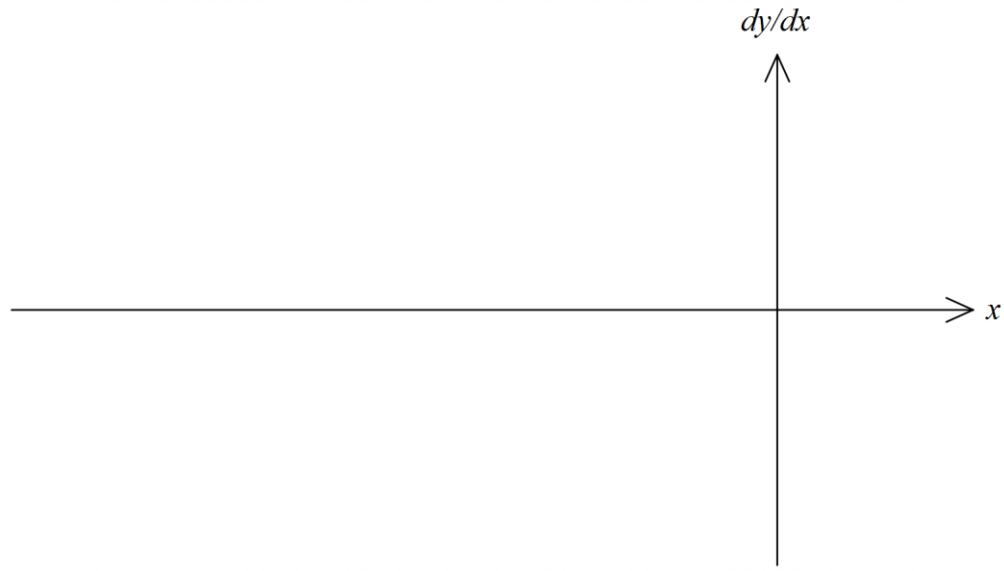
Criterion 8 Total

SPARE DIAGRAM

Question 51



Sketch the graph of the derivative $\frac{dy}{dx}$, clearly indicating any possible x intercepts.



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