TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

External Assessment 2025

Attach your candidate label here

MATHEMATICS METHODS

MTM415117

Section A

Pages: 20
Questions: 24
Information Sheets: 1

Preparation time for this exam: 15 minutes

Suggested working time: 80 minutes

Instructions:

Calculators are not allowed to be used in this section.

Section A will be collected after 80 minutes.

- There are **five (5) parts** to this section.
- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
  - A spare diagram has been provided at the end of Part 1. Indicate in the box provided if you have used the spare diagram.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 80 minutes**.
- During the first 80 minutes of the exam you may move onto Section B, but you **cannot** use your calculator until told by your supervisor(s).
- The Mathematics Methods Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criteria.

Marker use	
C4	/ 16
C5	/ 16
C6	/ 16
C7	/ 16
C8	/ 16

Additional Exam Instructions

For questions worth **one (1)** mark, you are not required to show workings. Markers will look at the presentation of the answer(s) and at the argument(s) leading to the final answer(s). For questions worth **two (2)** or more marks **you are required** to show relevant workings.

Marks will be allocated:

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

Criteria

You **must** make sure your answers address:

- Criterion 4 understand polynomial, hyperbolic, exponential and logarithmic functions
- Criterion 5 understand circular functions
- Criterion 6 use differential calculus in the study of functions
- Criterion 7 use integral calculus in the study of functions
- Criterion 8 understand binomial and normal probability distributions and statistical inference.

Guide to Exam Structure

	Parts	Questions available	Questions to answer	Suggested working time	Marks available
Section A	Part 1	5	5	16 minutes	16 marks
	Part 2	5	5	16 minutes	16 marks
	Part 3	4	4	16 minutes	16 marks
	Part 4	5	5	16 minutes	16 marks
	Part 5	5	5	16 minutes	16 marks
Totals		**24**	**24**	**80 minutes**	**80 marks**
Section B	Part 1	4	4	20 minutes	20 marks
	Part 2	4	4	20 minutes	20 marks
	Part 3	5	5	20 minutes	20 marks
	Part 4	5	5	20 minutes	20 marks
	Part 5	5	5	20 minutes	20 marks
Totals		**23**	**23**	**100 minutes**	**100 marks**
Totals		**47**	**47**	**180 minutes (3 hours)**	**180 marks**

Part 1

Marker use

- Answer **all** questions in this part.
- This part assesses **Criterion 4**.

Question 1

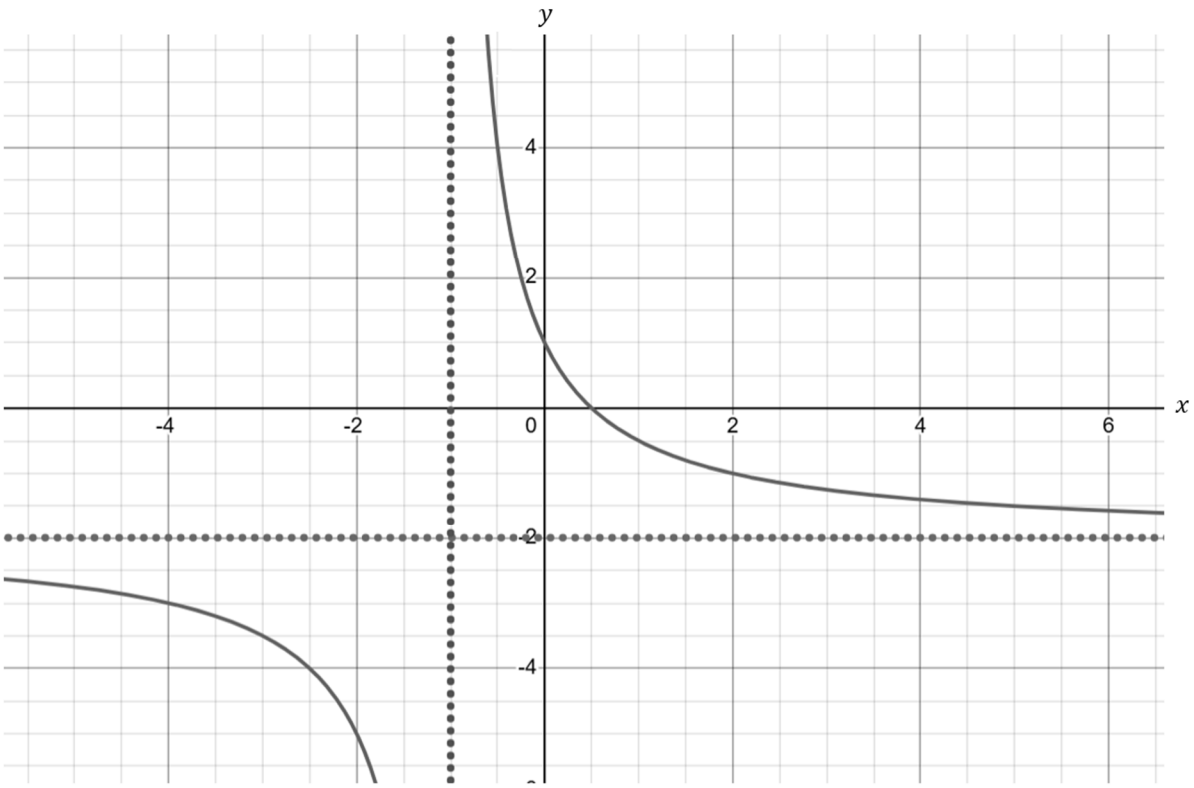

Figure 1

a) State the domain and range for the graph of the following function:

Domain: .....

Range: .....

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b) Determine the equation of the graph shown above.

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Question 2

Marker use

Solve $\log_3(3x - 2) = 2$.

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Question 3

Given that $f(x) = -2e^{x-4} + 1$ find the inverse $f^{-1}(x)$.

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Question 4

Determine the coefficient of x^2 in the expansion of $(5 - 2x)^4$.

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Question 5

Marker use

Sketch the graph of

$$f(x) = \frac{4}{(x-2)^2} + 1, x \neq 2$$

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on Figure 2 below.

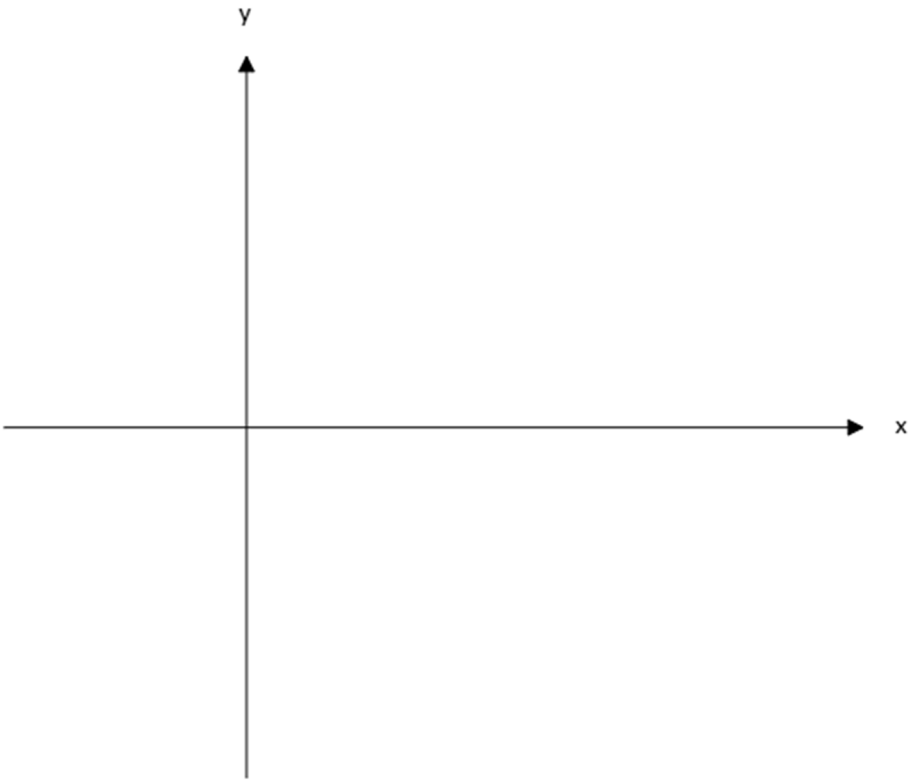

Figure 2

Spare diagram used (x) ☐

Total P1

/16

Spare Diagram

Marker use

Question 5

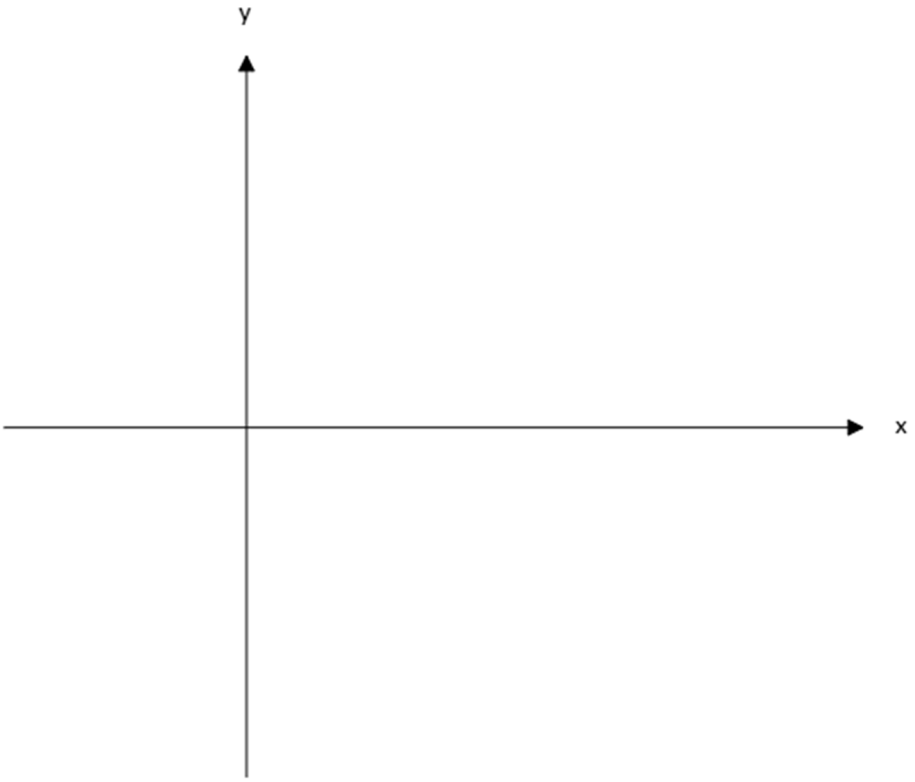

Figure 2

Part 2

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 5**.

Question 6

Find the exact value of $\cos\frac{7\pi}{6} + \tan\frac{\pi}{4}$.

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Question 7

If $\sin x = \frac{1}{5}$ and $\frac{\pi}{2} < x < \pi$ find exact values for $\cos x$ and $\tan x$.

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Question 8

Marker use

Find all solutions of the equation $\cos(2x - \frac{\pi}{4}) = -\frac{\sqrt{2}}{2}$ in the domain $0 \leq x \leq 2\pi$.

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Question 9

Sketch the graph of $y = -4\tan\left(x - \frac{\pi}{2}\right)$ for $-\frac{\pi}{2} \leq x < 2\pi$.

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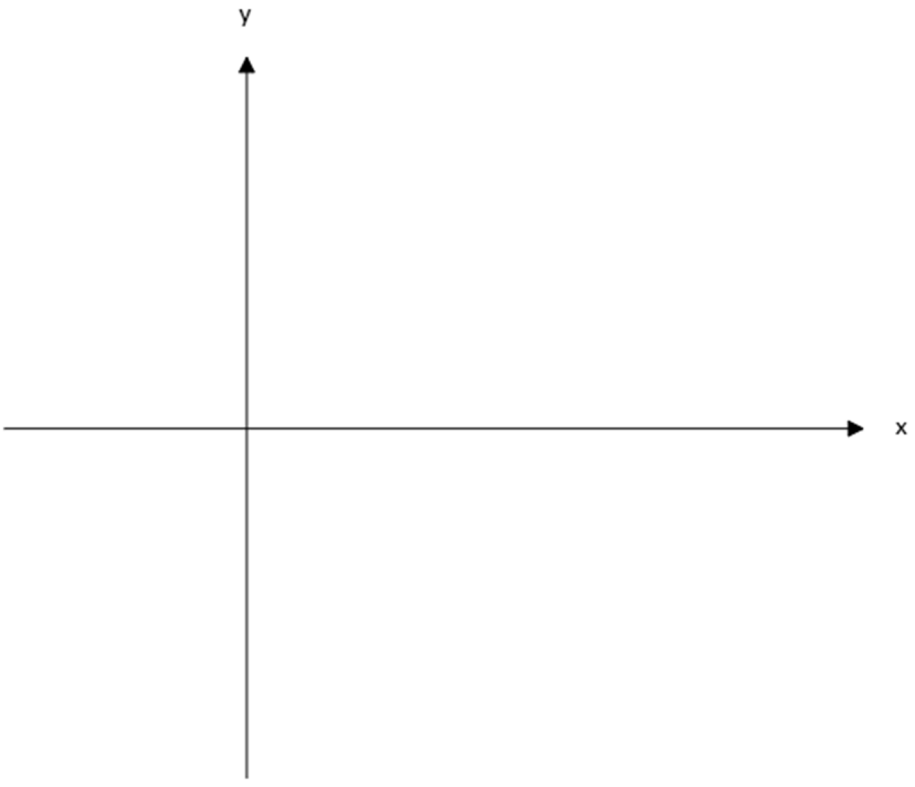

Figure 3

Spare diagram used (x) ☐

Question 10

Marker use

Determine the value of $\cos^2 135° + \sin 150° + \sin^2 135°$.

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Spare Diagram

Question 9

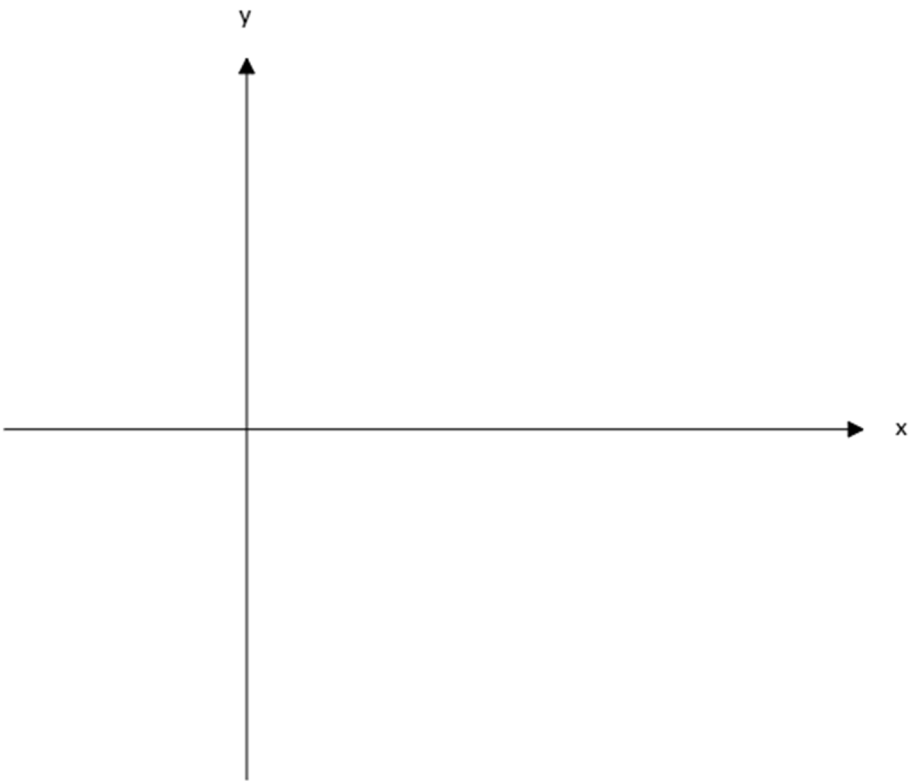

Figure 3

Total P2

/16

Part 3

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 6**.

Question 11

Differentiate the following:

a) $f(x) = -5x^2 - \cos 2x - lnx + 4 - \frac{x}{3}$. /2

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b) $g(x) = \frac{\tan x}{x^2}$. /2

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c) $h(x) = e^{1+2x}\, ln(1 + 4x)$. /2

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Question 12

Marker use

Differentiate $y = 3x^2 - 4x + 6$ from first principles.

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Question 13

Find the exact value of $g'(2)$ when $g(x) = \sqrt{x^2 + 5}$.

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Question 14

Marker use

/3

Find the equation of the normal to the curve

$$y = \frac{x^3}{3} - x^2 - 3x + 10$$

at the point $(3, 1)$.

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Total P3

/16

Part 4

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 7**.

Question 15

Determine the indefinite integral of $5 - \cos 3x$.

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Question 16

Find the exact value of $\int_2^4 8e^{2x}dx$

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Question 17

Solve $\int_0^k (2x - 7)dx = -6$ for the constant k.

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Question 18

Marker use

Find the exact area between the curve, $y = e^x + 5$, the x-axis and the lines $x = 0$ and $x = 2$.

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Question 19

The function $f(x)$ has a stationary point at $(2, -28)$ and a y-intercept at 0.

The derivative of the function $f(x)$ is $f'(x) = 3x^2 + ax + b$ where a, b are real.

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Determine the function $f(x)$.

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Total P4

/16

Part 5

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 8**.

Question 20

A binomial distribution has a mean of 5 and a standard deviation of 2. Determine the number of trials and the probability of success.

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Question 21

The discrete random variable, X, has a probability distribution as given in the table below:

X	-1	0	1
$P(X = x)$	0.08	0.84	0.08

Table 1

Determine the expected value, variance and standard deviation of the distribution.

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Question 22

Marker use

Find the approximate 95% Confidence Interval of P for a random sample (n = 24), and a sample proportion, $\hat{p}$ of 0.6.

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Question 23

Gemima is a talented basketball player who is successful on 80% of her 'free throws' shooting attempts. A 'free throw' is a shot from a marked line on the basketball court. She is confident that on 98% of the times that she has 2 'free throws' she will make at least 1 out of 2 'free throws'.

a) Explain why a binomial distribution is appropriate to use in this scenario.

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b) Show that her calculations are not correct.

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Question 24

Marker use

A random variable X is normally distributed with a mean of 100 and a standard deviation of 10. Using approximate values for areas of the normal distribution, find values for:

a) $P(110 \leq \mathrm{X} \leq 120)$.

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b) $P(90 \leq \mathrm{X} \leq 120)$.

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c) a such that $P(\mathrm{X} \leq a) = 0.975$.

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Total P5

/16

End of Section A

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This exam paper and any materials associated with this exam

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TASMANIAN ASSESSMENT, STANDARDS & CERTIFICATION

External Assessment 2025

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MATHEMATICS METHODS

MTM415117

Section B

Pages: 28
Questions: 23
Information Sheets: 1

Suggested working time: 100 minutes

Instructions:

Calculators are allowed to be used in this section.

- There are **five (5) parts** to this section.
- Answer **all** questions and **all** items within each question.
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Marker use	
C4	/ 20
C5	/ 20
C6	/ 20
C7	/ 20
C8	/ 20

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	Part 4	5	5	16 minutes	16 marks
	Part 5	5	5	16 minutes	16 marks
Totals		**24**	**24**	**80 minutes**	**80 marks**
Section B	Part 1	4	4	20 minutes	20 marks
	Part 2	4	4	20 minutes	20 marks
	Part 3	5	5	20 minutes	20 marks
	Part 4	5	5	20 minutes	20 marks
	Part 5	5	5	20 minutes	20 marks
Totals		**23**	**23**	**100 minutes**	**100 marks**
Totals		**47**	**47**	**180 minutes (3 hours)**	**180 marks**

Part 1

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 4**.

Question 25

Given $f(x) = 2x + 5$ and $g(x) = \frac{3}{x^2} + 1$

a) Determine the function $g\{f(x)\}$.

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b) Solve $g\{f(x)\} = 10$ for x. Give solution(s) correct to **two (2)** decimal places.

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Question 26

The graph of the function $f: [2, 5] \to \mathbb{R}, f(x) = ln\, x$ is reflected in the y-axis, translated 2 units to the left and then translated 3 units up to create a new function $g(x)$.

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Determine the new function $g(x)$.

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Question 27

Marker use

Radium is a radioactive element which decays according to the formula $M = Ae^{-kt}$ where M is the mass of radium after t days and A and k are constants.

10 g of radium was present at the start of an observation.

After 5 days there was 7.4 g of radium remaining.

a) Determine the values of A and k.

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b) What will be the mass of radium after 25 days?

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c) After how many days will there be 2 g remaining?

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Question 28

Marker use

A person contracting a particular disease requires treatment with a certain drug.

The concentration C of that drug in the bloodstream t hours after taking a dose of the drug is given by $C = 0.02t + at^3$, where a is a constant.

Five (5) hours after taking the first dose, the concentration is equal to 0.075.

a) Find the value of a.

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b) For how many hours is the drug still in the bloodstream?

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c) Write down the relevant domain of C.

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Question 28 continues

Question 28 continued

Marker use

The drug is known to be ineffective when $C < 0.05$.

d) For how many hours is the first dose effective, correct to **one (1)** decimal place?

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Total P1

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Part 2

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 5**.

Question 29

The graph below is of the form $y = a\cos\big(n(x-b)\big) + c$.

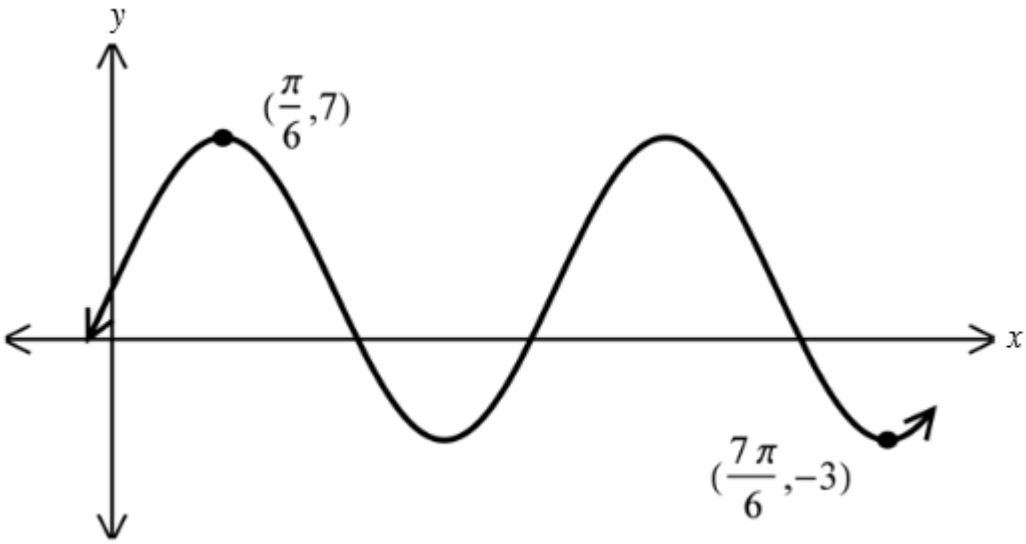

Figure 4

Determine possible values for a, b, c and n.

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Question 30

Marker use

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The graph of $f(x) = \cos x$ undergoes the following transformations (in the order given):

- dilation by a factor of 2 in the y-direction
- dilation by a factor of 4 in the x-direction
- reflection in the x-axis
- translation of $\frac{\pi}{4}$ units to the right and 3 units down.

Write down the equation of the transformed function $g(x)$.

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Question 31

Determine the exact solutions of

$3\sin\left(2x + \frac{\pi}{2}\right) = \sqrt{3}\cos\left(2x + \frac{\pi}{2}\right)$ over the interval $[0, \pi]$.

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Question 32

Marker use

The Derwent River in Tasmania experiences semidiurnal tides (two (2) high and two (2) low tides each day). At a particular monitoring station in Hobart, the water depth varies between 2.4 metres at low tide and 4.8 metres at high tide.

On a particular day, high tide occurs at 3 am and 3 pm, while low tide occurs at 9 am and 9 pm.

a) Create a sine function $d(t)$ that models the water depth (in metres) at the monitoring station, where t represents the number of hours since midnight. /3

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b) What is the water depth at 6 am on this day? /1

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c) A small boat requires at least 3.5 metres of water depth to safely navigate this section of the river. During what hours between 10 am and 8 pm is it safe for the boat to pass through? /3

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Question 32 continues

Question 32 continued

Marker use

d) It was suggested that more accurate tide times needed to be used to ensure that the boat was safe. The new tide times were: high tides at 3 am and 3:12 pm, while low tides occur at 9:06 am and 9:18 pm.

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Determine the new sine function that models the water depth $d(t)$.

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e) During what hours between 10 am and 8 pm on this particular day, is it now safe for the boat to pass through with more accurate tide times?

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Total P2

/20

Part 3

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 6**.

Question 33

A 12 cm by 8 cm rectangular sheet of cardboard is to be made into a box by cutting equal sized squares from each corner and folding up the four edges. Let x be the height of the box as shown in Figure 5.

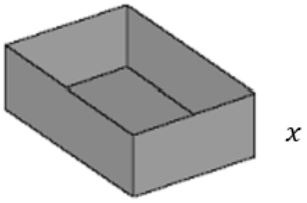

Figure 5

a) Show that the volume, $V(x)$ can be represented by $V(x) = 4x^3 - 40x^2 + 96x$. /1

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b) Using the volume formula for a cut of 7 cm, a student suggests this would result in a greater volume of 84 cm^3. Explain why this is incorrect. /1

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Question 33 continues

Marker use

c) Using calculus techniques determine the dimensions of the box (to **two (2)** decimal places) with the largest volume.

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d) Determine the maximum volume of the box (to the nearest cm^3).

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Question 34

Marker use

If $f(x) = ln(1-x)$, find the gradient at the point where $x = \frac{1}{2}$.

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Question 35

a) Find the derivative of $y = x^3e^{4x}$.

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b) Hence, find the co-ordinates of and classify the nature of the stationary points on the graph $y = x^3e^{4x}$.

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Question 36

Marker use

Find the value of k if the function:

$f(x) = (2x-1)^2(kx+1)$ has a gradient of zero when $x = -\frac{5}{2}$.

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Question 37

The sketch below is of the function $y = f(x)$.

Sketch the graph of the derivative function $y = f'(x)$ on the same set of axes.

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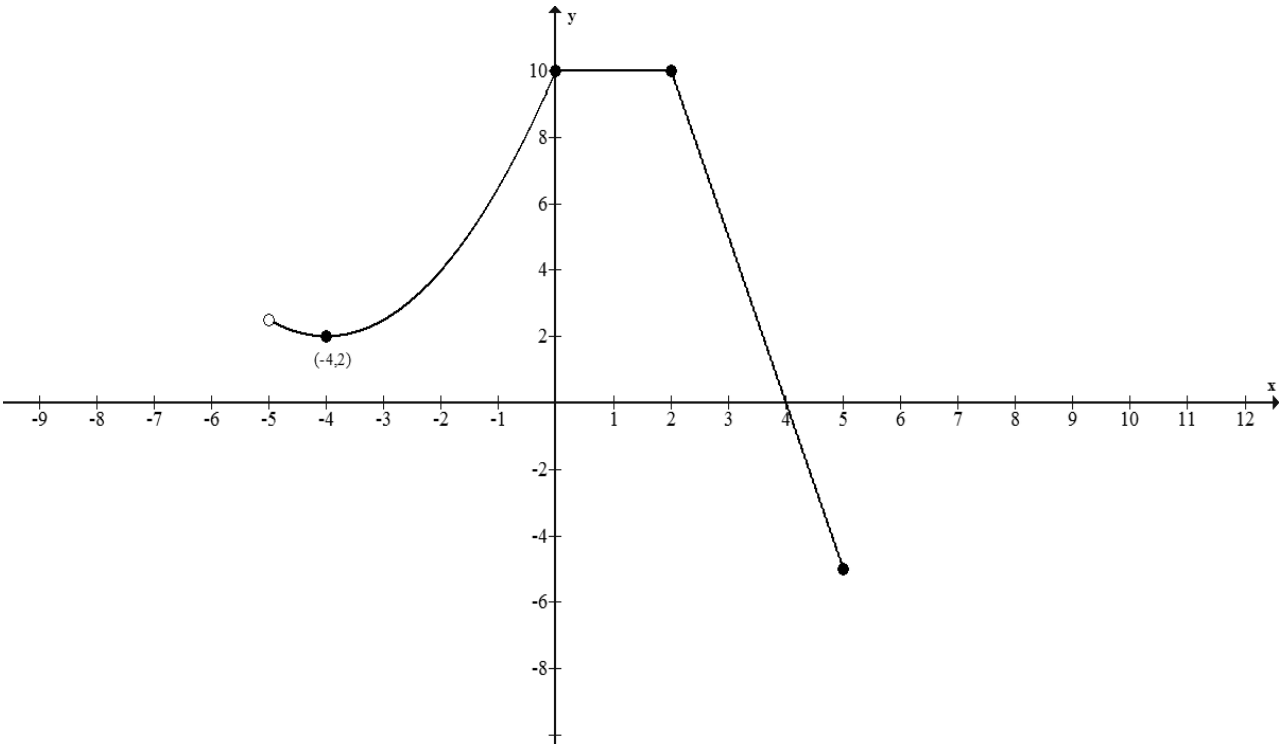

Figure 6

Spare diagram used (x) ☐

Total P3

/20

Spare Diagram

Marker use

Question 37

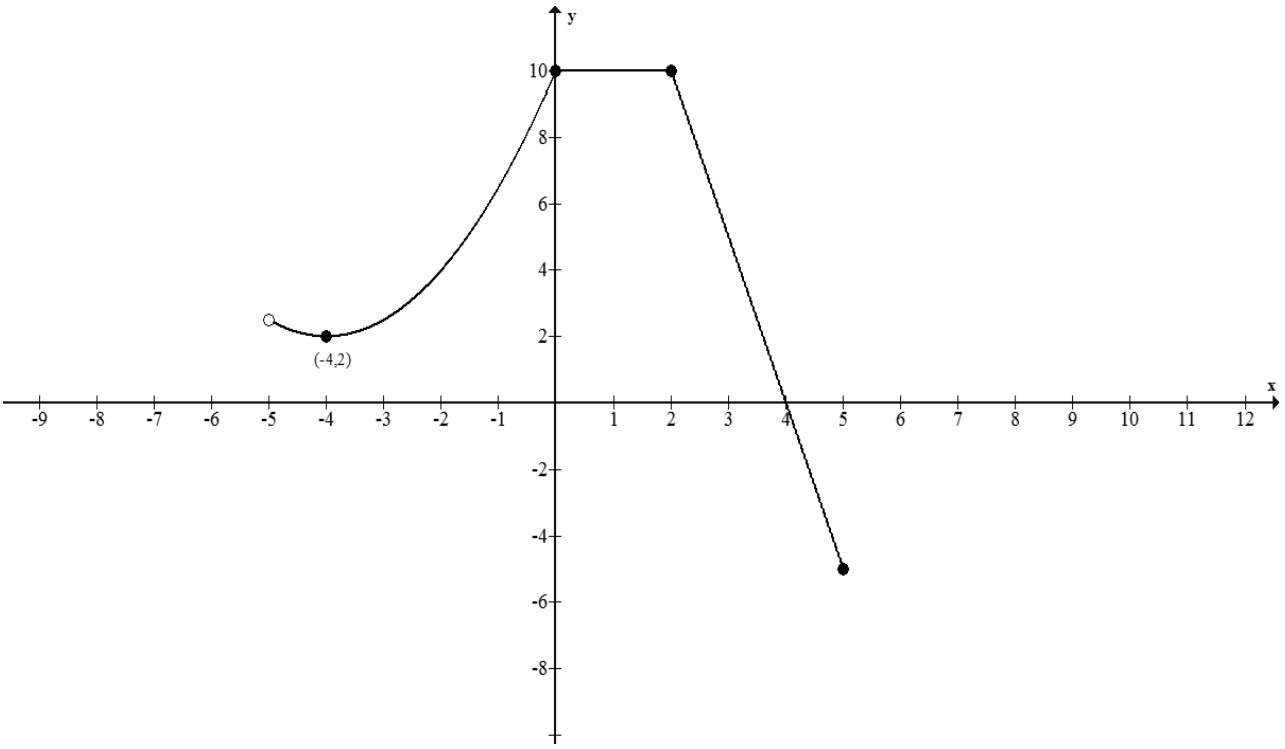

Figure 6

Part 4

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 7**.

Question 38

Determine $\int \left(\sin\left(\frac{x}{2}\right) - \frac{5}{x^2} + 2e^{3x}\right) dx$. /3

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Question 39

Given that the derivative of xe^{kx} is $(kx+1)e^{kx}$, determine $\int xe^{kx}\ dx$. /3

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Question 40

If $\int_3^5 \left(5 - 3f(x)\right) dx = 15$ determine the exact value of $\int_3^5 f(x)\ dx$. /2

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Question 41

Marker use

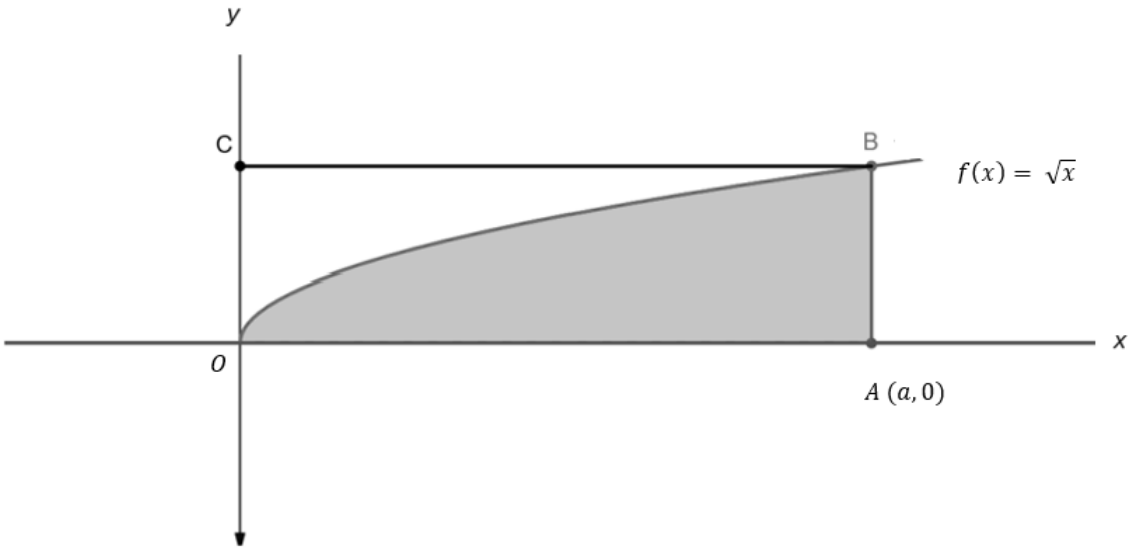

Figure 7

a) If point A has co-ordinates $(a, 0)$ state the co-ordinates of B and C in terms of a.

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b) Show that the area of the shaded region is $\frac{2}{3}$ the area of the rectangle OABC.

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Question 42

Marker use

In the domain $[-4, 4]$, the curves $f(x) = e^x - 1$ and $g(x) = 2\sin x$ intersect where $x = a,\ x = 0$ and $x = b$ as shown.

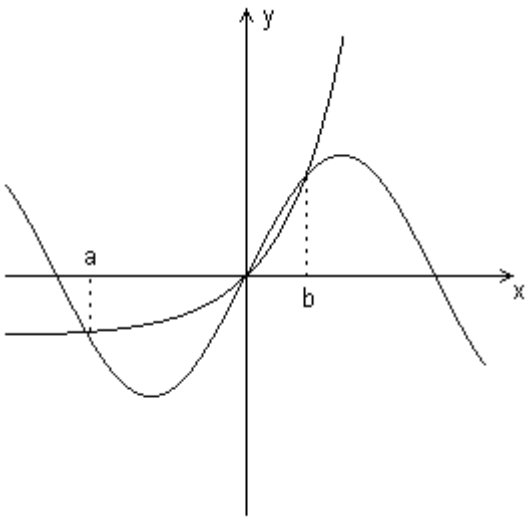

Figure 8

a) Label $f(x)$ and $g(x)$ on the graph above. /1

b) Write an expression using integrals for the area bound between the curves on the interval $[a, b]$. /2

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c) Determine the values of a and b correct to **three (3)** decimal places, and hence evaluate the area enclosed between the curves on the interval $[a, b]$ correct to **three (3)** decimal places. /4

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Total P4 /20

Part 5

Marker use

- Answer **all** questions in this section.
- This section assesses **Criterion 8**.

Question 43

The weights of free-range eggs from a particular farm in Tasmania are normally distributed with a mean of 67.5 g and a standard deviation of 2.8 g.

a) Determine the percentage of eggs that will have weights between 63.5 g and 68.5 g. /1

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b) If a typical day has a total production of 9600 eggs, how many eggs are likely to have a weight greater than 61 g? /2

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Question 44

Marker use

The number of swimmers, x, in a particular lane at a local swimming pool at 7 am has a probability distribution given by:

x	0	1	2	3	4
$P(X = x)$	$\frac{1}{k}$	$\frac{3}{k}$	$\frac{5}{k}$	$\frac{7}{k}$	$\frac{9}{k}$

Table 2

a) Show that the value of k is 25.

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b) Determine the expected number of swimmers in the lane each day.

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c) Determine the variance in the number of swimmers in the lane each day.

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Question 45

Marker use

/4

400 people are randomly sampled regarding a new proposal. 220 of the people sampled were in favour of the proposal and a confidence interval of $(0.5003, 0.5997)$ was given.

Find the level of confidence that would generate this interval.

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Question 46

Marker use

/5

The heights of students in a school are normally distributed.

20% of these students have heights less than 150 cm and 11% have heights greater than 180 cm.

Determine the mean and standard deviation of the heights of the students in this school.

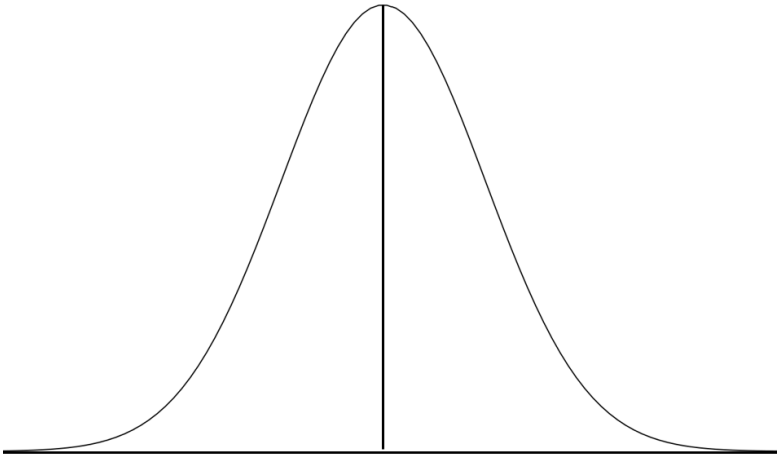

Figure 9

Spare diagram used (x) ☐

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Question 47

Marker use

In an endurance event, the probability that a competitor will complete the course is 0.75. Teams consist of four (4) competitors. A team scores points if at least half its members complete the course.

a) Find the probability that a randomly chosen team scores points.

/2

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b) Find the probability that a randomly chosen team scores points, given that at least **one (1)** of its members fails to complete the course.

/2

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Total P5

/20

Spare Diagram

Question 46

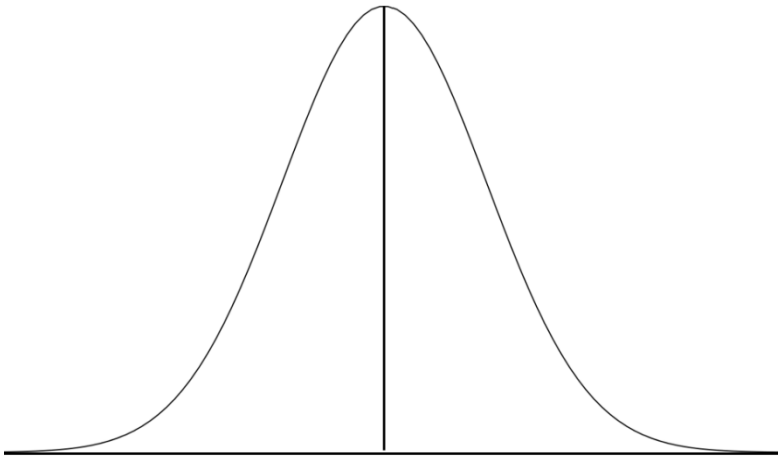

Figure 9

End of Section B

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