

**Show all working clearly**, in sufficient detail to allow your answers to be checked  
readily and for marks to be allocated for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. It is recommended that students do not use a pencil, except in diagrams

No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised material if you have any unauthorised material with you, hand it to the supervisor **before** reading any further.  
**Important note to candidates**

Special items: nil

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

**To be provided by the candidate**

Formula sheet

This Question/Answer booklet

**To be provided by the supervisor**

Materials required/recommended for this section

Total Marks: forty-six marks

Working time for paper: forty minutes

Reading time before commencing work: one minute

**Time allowed for this section**

Teacher's Name:

Student Name:

**Section One: Calculator-free**

[Curriculum references: Logarithms 4.1.1-4.1.14]

Test 4

Semester 2, 2021

YEAR 12, UNIT 4

MATHEMATICS METHODS

SENIOR HIGH SCHOOL

MELVILLE



**Question 1. [2, 2 = 4 marks]**

Express each of the following as a single logarithm.

a)  $2\log 3 + \log 2 - \log 6$

b)  $(\log x)^3 \div (\log x)^2 + \log x^2$

**Question 2. [2, 2 = 4 marks]**

Evaluate each of the following, showing full working.

a)  $1.5 \log_8 4$

b)  $\frac{\log 135 - \log 5}{\log 3^2}$

**Question 3. [1, 3 = 4 marks]**

If  $\log x = y$ , where  $x$  is positive, express each of the following in terms of  $y$ .

a)  $\log x^2$

b)  $\log xm^3 - 3 \log m$

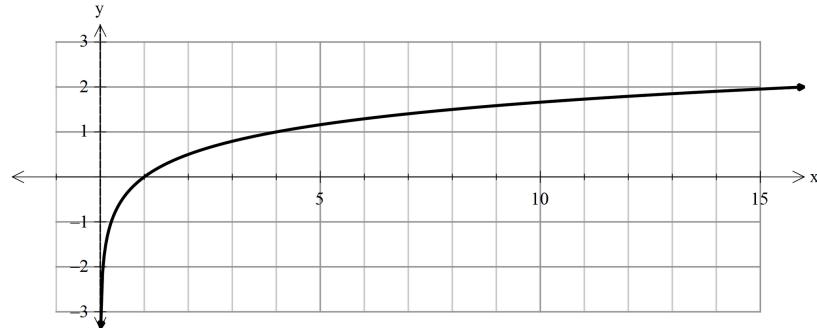
$$4^{2x} - 4^x - 6 = 0$$

Give an exact value for  $x$  in terms of  $\log_{10}$  (simplify your logs)

Question 4. [3, 3 = 6 marks]

**Question. 5. [1, 1, 1, 2 = 5 marks]**

The function  $y = \log_a x$  is graphed below. Use the graph to answer the questions that follow.



- a) Find the value of  $a$ .
- b) Use the graph to approximate to 1 d.p. the solution to  $\log_a x = 1.6$
- c) Approximate the solution for  $x$  if  $x = a^{1.2}$
- d) Use the graph to find an approximation to  $\log_3 7$

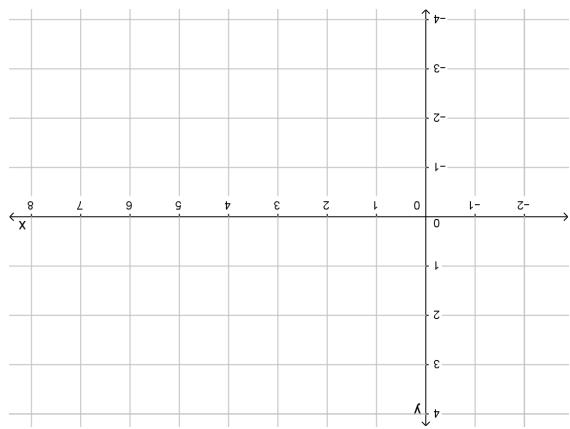
$$\frac{x+2}{(x+1)(x-2)} = \frac{A}{x+1} + \frac{B}{x-2} \text{ where } A \text{ and } B \text{ are constants.}$$

- a) Determine the values of  $A$  and  $B$ .

- b) Hence, find  $\int \frac{x+2}{(x+1)(x-2)} dx$

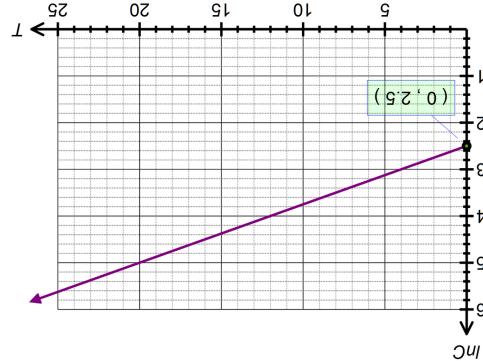
- (b) Use your answer to (a) to determine the exponential function which models the energy consumption based on the maximum temperature recorded.

(a) Determine the equation of  $\ln C$  in terms of  $T$ .



Sketch the graph of  $y = \log_2 x$ . Clearly label the key features.

Question. 6 [3 marks]



Graphing the data provides us with the following graph, where  $C$  is maximum consumption in megawatts and  $T$  is the maximum temperature in degrees Celsius.

Synergy, the provider of electricity in Perth, monitors the maximum consumption of electricity over summer measured against the maximum temperatures.

Question 11. [3, 2 = 5 marks]

**Question. 7. [3, 3, 3 = 9 marks]**

Differentiate each of the following with respect to  $x$ , showing full working.

**(DO NOT SIMPLIFY YOUR ANSWER)**

a) If  $y=x^2 \ln(\sin x)$  find  $\frac{dy}{dx}$

b)  $g(x)=\ln[(x^2+1)(x-1)^4]$

c)  $y=\log_2(x^3-2x)$

answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat an answer to any question, ensure that you cancel the answer you do not wish to have marked. It is recommended that you **do not use pencil**, except in diagrams.

**Question 10. [2, 2, 2, 3 = 9 Marks]**

The annual profit,  $P$  **hundred thousand dollars**, of a retail store, is modelled by,  $P=2t \ln(t)$  for  $0 < t < 10$ , where  $t$  is time in years after establishing the store.

- a) Find the instantaneous rate of change of profit with respect to time when  $t = 1$ .

- b) Find **when** the rate of change of profit, with respect to time, is:
- i) \$0 per year.

- ii) \$400 000 per year.

- c) Find the largest loss experienced by the store, and when it occurred.

Show all your working clearly.

Your working should be in sufficient detail to allow your supervisor to read it further.

No other items may be taken into the examination room. If you have any unauthorised material with you, hand it to the supervisor examination room. If you have any unauthorised notes or other items of a non-personal nature in the

### Important note to candidates

up to three calculators approved for use in the WACE examinations.

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid, eraser, ruler, highlighters

To be provided by the candidate

Formula Sheet (extracted from Section One)

This Question/Answer booklet

To be provided by the supervisor

Material required/recommended for this section

Total Marks: eighteen marks

Working time for paper: fifteen minutes

Reading time before commencing work: one minute

Time allowed for this section

Teacher's Name: \_\_\_\_\_

Student Name: \_\_\_\_\_

Section Two: Calculator-assumed

$$\text{a) } \int \frac{x^2 - 4}{x} dx$$

Integrate each of the following, showing full working.

Question 8. [2, 3 = 5 marks]

[Curriculum references: Logarithms 4.1.1-4.1.4]

Weighting 7%

YEAR 12, UNIT 4: Test 4 2021

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**End of Calculator Free Section ☺**

**Question 9. [2, 4 = 6 marks]**

Given  $y = \frac{\ln x}{x}$

**Additional working space.**

a) Find  $\frac{dy}{dx}$

b) Hence, or otherwise, use  $\frac{dy}{dx}$  to show that  $\int_1^2 \frac{\ln x}{x^2} dx = \frac{1 - \ln 2}{2}$