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### Important note to candidates

To be provided by the candidate  
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,  
correction tape/fluid, erasers, ruler, highlighters  
Special items: nil

To be provided by the supervisor  
This Question/Answer booklet  
Formula Sheet

### Material required/recommended for this section

Time allowed for this section  
Reading time before commencing work: five minutes  
Working time for paper: fifty minutes

Teacher's Name:

Student Name:

Section One:  
Calculator-free

## METHODS UNIT 3 and 4 MATHEMATICS

Question/Answer booklet

Examination 2021

Semester Two

Insert School Logo

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Question number(s): .....

Additional working space

**Structure of this paper**

	Number of questions available	Number of questions to be attempted	Working time (minutes)	Marks available	Percentage of exam
<b>Section One Calculator-free</b>	<b>10</b>	<b>10</b>	<b>50</b>	<b>50</b>	<b>35</b>
Section Two Calculator-assumed	12	12	100	100	65
			150	100	

**Instructions to candidates**

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2021*. Sitting this examination implies that you agree to abide by these rules.
2. Answer the questions according to the following instructions.

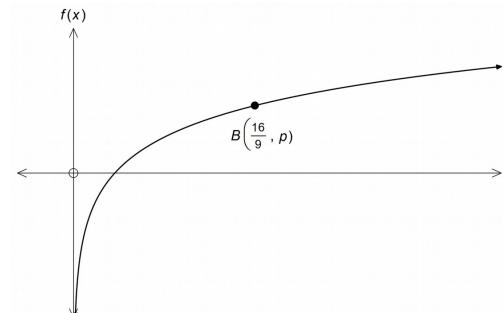
**Show all your working clearly.** Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two 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.

3. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
5. The Formula Sheet is **not** handed in with your Question/Answer Booklet.

**Question 10 (7 marks)**

The graph of  $f(x) = \log_{\frac{4}{3}} x$  is shown below.  $B\left(\frac{16}{9}, p\right)$  is a point on  $f(x)$ .



- (a) For which value(s) of  $x$  is  $\log_{\frac{4}{3}} x \leq 0$  ? (2 marks)

- (b) Determine the value of  $p$ . (2 marks)

- (c) (i) Sketch the graph of the derivative of  $f(x)$  on the same axes. (1 mark)  
(ii) State the equation of the derivative graph. (2 marks)

**End of Questions**

See next page

(2 marks)

(b) Evaluate  $\int_{\frac{\pi}{2}}^{\pi} \ln(x^2) \tan x \, dx$ .

(3 marks)

- (a) The function  $f(x) = \ln(x^2) \tan(x)$  is defined over a certain domain.  
 Find the equation of the tangent at  $x = 2\pi$ .

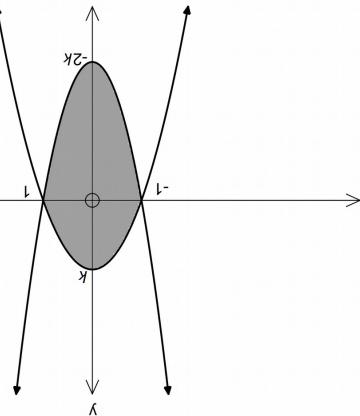
### Question 1 (5 marks)

Working time: 50 minutes

- Number of the question(s) that you are continuing to answer at the top of the page.
- Continue answering an answer: if you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.
- Planning: if you use the spare pages for planning, indicate this clearly at the top of the page.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.  
 This section has ten (10) questions. Attempt all questions. Write your answers in the spaces provided.

### Section One: Calculator-free 35% (50 marks)



The shaded region shown is enclosed by the functions  $f(x) = 2k(x^2 - 1)$  and  $g(x) = k(1 - x^2)$ , where  $k > 0$ , as shown below.

Given that the area of the shaded region is 8, find the value of  $k$ .

The shaded region shown is enclosed by the functions

$$f(x) = 2k(x^2 - 1) \text{ and } g(x) = k(1 - x^2)$$

### Question 9 (3 marks)

**Question 2 (8 marks)**

The probability distribution of a random variable  $Y$  is such that

$$P(Y = y) = \frac{y}{k} \text{ for } y = 1, 2, 3, 4, 5.$$

- (a) Find the value of  $k$ .

(1 mark)

- (b) Determine the probability that  $Y$  is at least 3.

(1 mark)

- (c) Find the expected value of  $Y$ .

(1 mark)

- (d) The random variable  $Y$  is transformed into another random variable,  $X$ , such that  $0.1Y = X - 2$ .

- (i) Find the expected value and the standard deviation of the random variable  $X$ .

(3 marks)

**Question 7 (4 marks)**

$$m(x) = \frac{e^{x^2-1}}{x^2-1}.$$

On a suitable domain, a function is defined by  
Find the exact co-ordinates of the stationary points of the function.

(4 marks)

- (c) State the median of the distribution.

(1 mark)

- (b) Determine the probability that she will have to wait less than 5 minutes for the next train,  
given she has to wait more than 3 minutes.

(2 marks)

$$P\left(X \leq \frac{11}{5}\right).$$

- (ii) Determine the probability:

(2 marks)

(2 marks)

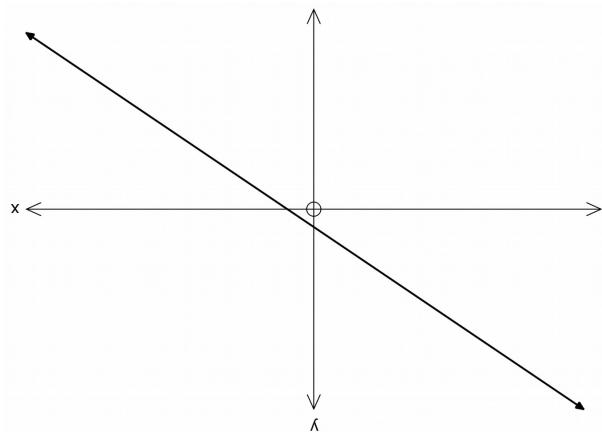
- (c) On the same set of axes, draw the graph of the function  $g(x)$ .

(1 mark)

- (b) State the nature of the turning point of  $g_1(x)$ , the gradient function of  $g(x)$ .

(2 marks)

- (a) For which values of  $x$  is the function  $g(x)$  concave down?

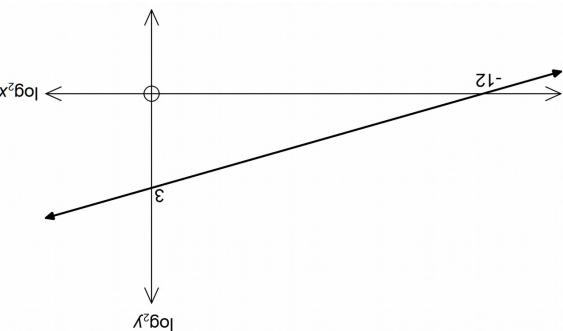


The graph of  $g''(x)$  is shown below.  $g''(x)$  passes through the points  $(0, 1)$  and  $(1, -1)$ .

Question 3 (5 marks)

Question 6 (3 marks)

Two variables,  $x$  and  $y$ , are connected by the equation  $y = kx^p$ .  
The graph of  $\log_2 y$  against  $\log_2 x$  is a straight line as shown below.



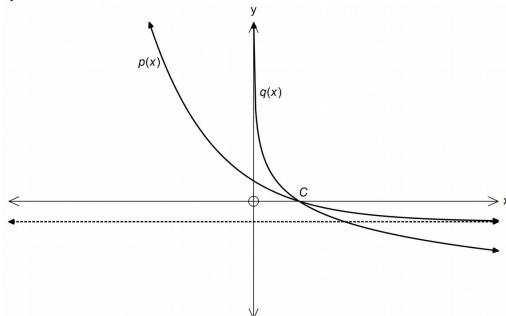
Find the values of  $k$  and  $n$ .

(3 marks)

**Question 4 (7 marks)**

- (a) Consider the graphs of  $p(x) = 2a^x + b$  and  $q(x) = \log_c x$  shown below.

The asymptote of  $p(x)$  and the graph of  $q(x)$  pass through the point  $(2, -1)$ .  
The graphs intersect at C.



Find the values of  $a$ ,  $b$  and  $c$ .

(3 marks)

- (b) Find the value of  $\log_5 250 - \frac{1}{3} \log_5 8$ .

(2 marks)

- (c) Solve for  $x$ ,  $\log_4 x + \log_4(x - 6) = \log_5 25$

(2 marks)

**Question 5 (4 marks)**

Let  $X$  be a normally distributed random variable with a mean of 72 and a standard deviation of 8. Let  $Z$  be the standard normal random variable.

Use the result that  $P(Z < 1) = 0.84$ , correct to two decimal places, to find:

- (a) the probability that  $X$  is greater than 80.

(1 mark)

- (b) the probability that  $64 < X < 72$ .

(1 mark)

- (c) the probability that  $X < 64$  given that  $X < 72$ .

(2 marks)