

Main Examination period 2019

**MTH4100/MTH4200: Calculus I**

**Duration: 2 hours**

Student number

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Desk number

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**Apart from this page, you are not permitted to read the contents of this question paper until instructed to do so by an invigilator.**

**Write your solutions in the spaces provided in this exam paper. If you need more paper, ask an invigilator for an additional booklet and attach it to this paper at the end of the exam.**

<b>You should attempt ALL questions. Marks available are shown next to the questions.</b>
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**Calculators are not permitted in this examination. The unauthorised use of a calculator constitutes an examination offence.**

Complete all rough work in the answer book and cross through any work that is not to be assessed.

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**Exam papers must not be removed from the examination room.**

**Examiners: O.F. Bandtlow and W. Just**

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This page is for marking purposes only.  
**Do not write on it.**

Question	Mark	Comments
1	/ 8	
2	/ 8	
3	/ 8	
4	/ 8	
5	/ 8	
6	/ 8	
7	/ 8	
8	/ 8	
9	/ 10	
10	/ 8	
11	/ 8	
12	/ 10	
<b>Total</b>		

**Question 1.** Find the natural domain and the range of the function

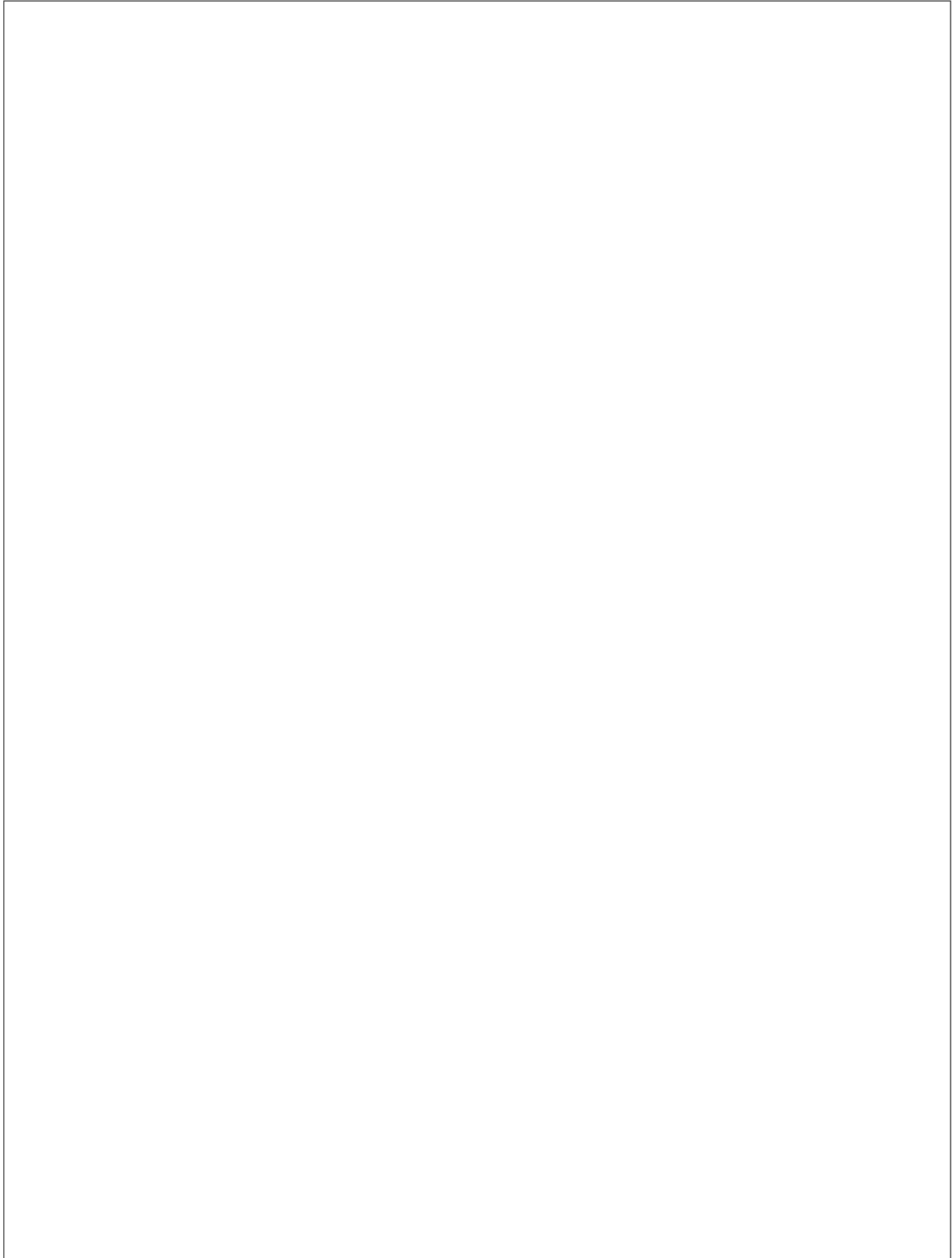
[8]

$$f(x) = \frac{1}{\sqrt{x^2 - 6x}}.$$

**Question 2.** Sketch the function

[8]

$$f(x) = 2 \sin(\pi|x|) - 2.$$



**Question 3.** Find the limit

[8]

$$\lim_{x \rightarrow 0} \frac{1 - x - \exp(-x)}{1 - \cos(x)}.$$

**Question 4.** At which points is the following function continuous?

[8]

$$f(x) = \begin{cases} \frac{\sin(x)}{x}, & x < 0; \\ \ln(1+x), & x \geq 0. \end{cases}$$

**Question 5.** Using the definition of the derivative of a function as a limit, find the derivative of the following function on its natural domain [8]

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

**Question 6.** Find the equations of all horizontal asymptotes of the function

[8]

$$f(x) = \frac{1 + 2 \cos(x) + 3x}{4 + 5|x|}.$$



**Question 7.** Determine the linearisation of the function

[8]

$$f(x) = \frac{1}{2 + \sin(\pi x^2)}$$

at  $x = -1$ .

**Question 8.** Determine the absolute maximum and the absolute minimum of the function  $f : [-3, 1] \rightarrow \mathbb{R}$  given by

[8]

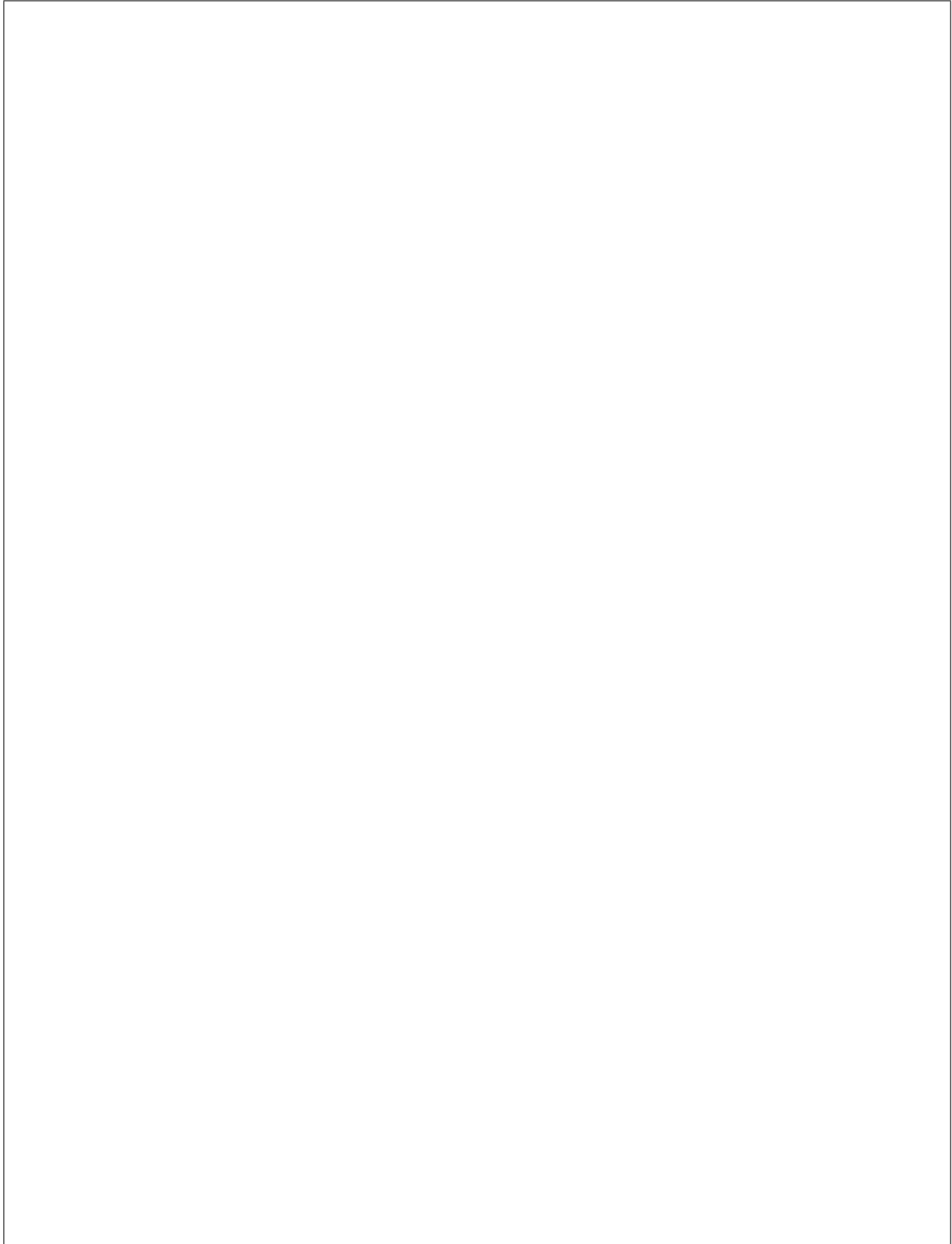
$$f(x) = x^{1/3}(x + 4).$$

**Question 9.** On which open intervals is the graph of

[10]

$$f(x) = 3x^5 + 5x^4 - 20x^3 + 10x - 7$$

concave up or concave down?



**Question 10.** Find the derivative of  $f : \mathbb{R} \rightarrow \mathbb{R}$  given by

[8]

$$f(x) = \int_0^{\exp(-x^2)} \ln(1+t) \cos(t^3) dt.$$

**Question 11.** Evaluate the indefinite integral

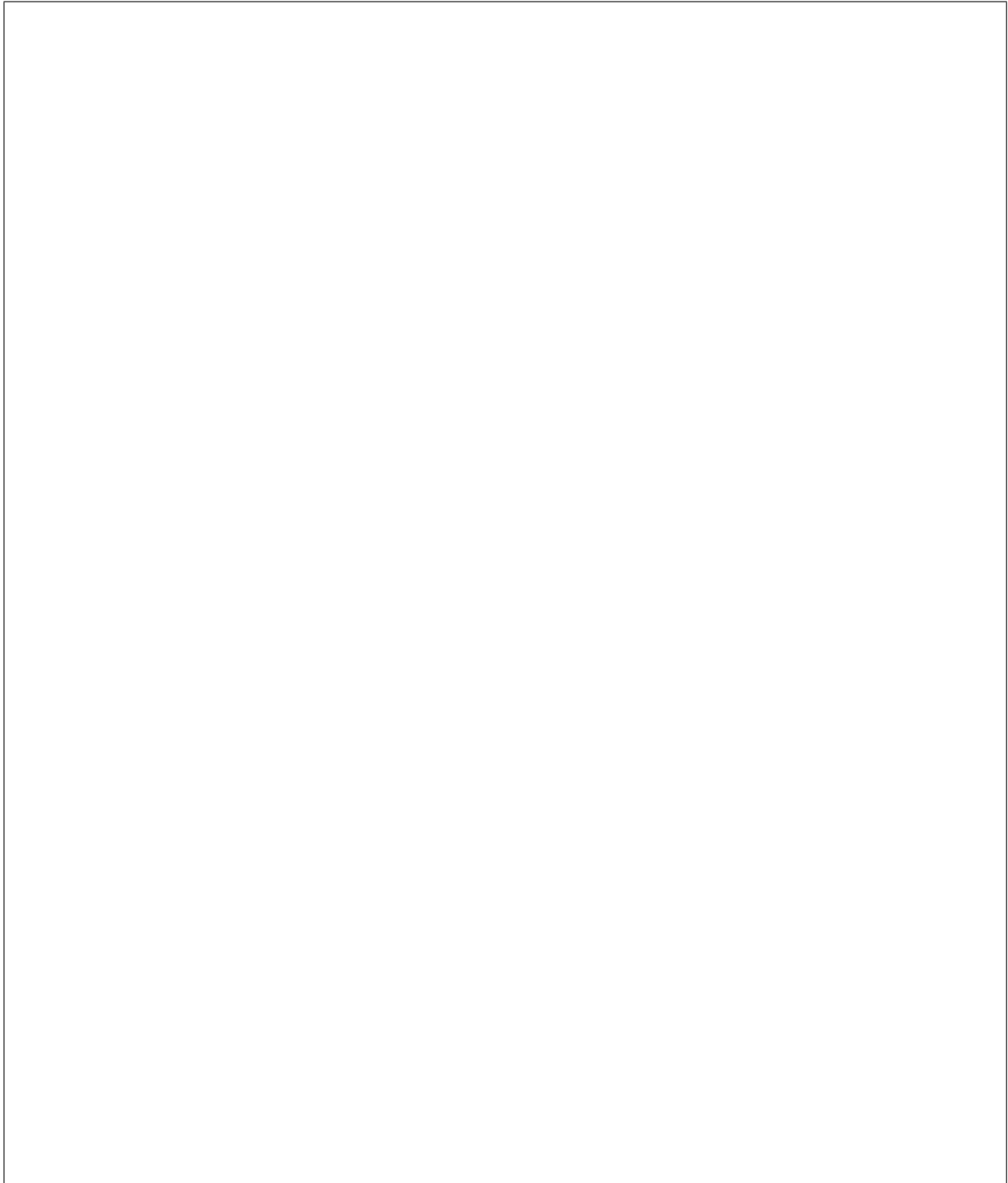
[8]

$$\int \frac{\cos^3(x)}{\sqrt{\sin(x)}} dx.$$

**Question 12.** Evaluate the improper integral

[10]

$$\int_0^{\infty} \frac{1}{(1+x)\sqrt{x}} dx.$$



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**End of Paper.**

**Use this space for rough work**

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