THE UNIVERSITY of EDINBURGH

SCHOOL OF ECONOMICS

SELF-STUDY MATHEMATICS
ECNM11070

Exam Start Time & Date:	09:30 (BST), 03 August 2020	**Submission Deadline:**	**12:30 (BST), 03 August 2020**	Exam Diet: **Summer School**

Please read full instructions before commencing writing

Exam paper information

- This exam contains 5 pages (including the cover sheet).
- Students should answer ALL questions.
- Answers that do not show procedure will not be considered.

Special instructions

- This is an open-book exam.
- You should start EACH question on a separate page. Questions must be clearly numbered in the left margin.
- You are expected to complete this exam within the 2-hour standard exam duration.
- You have one additional hour immediately following the exam to photograph, and upload your answers to Learn.
- You must number each answer page.
- Your exam number (e.g. B123456) must be clearly written at the top of each page.
- Your answers must be clearly written in ink on lined paper.
- Answers will be subject to checks through TurnItIn.
- All work must be completed individually, without collaboration, as a standard exam would be.

Special items

- Non-programmable calculators may be used.

Examiner(s) or Chairperson or Convenor of Board:
Tatiana Kornienko

This examination will be marked anonymously

Question 1

Find the roots of the following functions (the values of x for which $f(x) = 0$):

(a) $f(x) = (ax + 6)(x + 4) + (a + 3)x^2 + 2a - 21$ [5pt]

(b) $f(x) = (3a + x)^2 - (2x - a)^2$ [5pt]

Question 2

For each of the following functions, find $f'(x)$ and $f''(x)$.

(a) $f(x) = x^{2a}\left(3x^2 - 2x + 1\right)$ [5pt]

(b) $f(x) = \ln\left((ax + b)^n\right)$ [5pt]

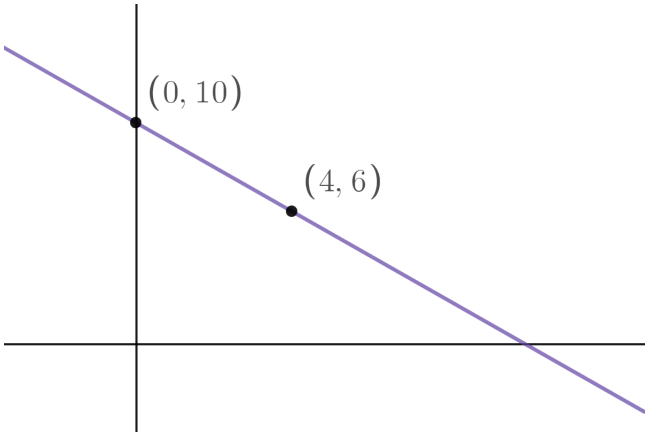
(c) $f(x) = \frac{e^x}{x^n}$ [5pt]

Question 3

The image below shows the graph of a linear function.

(a) Find the equation that expresses this function in slope-intercept form, and state the x-intercept, y-intercept, and slope of the function. [8pt]

(b) Consider another linear function, $y = 4x + c$. Find the point at which the two functions meet, in terms of c. [4pt]



Question 4

Find the critical points of the following functions. State whether each point is (locally) a maximum, minimum, or point of inflection.

(a) $f(x) = 4\sqrt{x} - x$ [7pt]

(b) $f(x) = x^3 - 12x$ [7pt]

Question 5

Find the following limits.

(a) $\lim_{x \to 2} \frac{x^2+3x-10}{x-2}$ [5pt]

(b) $\lim_{x \to \frac{1}{a}} a^2 e^{ax-1}\left(x^2-1\right)$ [5pt]

Question 6

An angler catches fish to sell at a local market. The more fish she brings, the lower she has to set her price in order to sell all of her fish. If she brings one fish, she can sell it for £22, but for each additional fish she brings to market, the price she can sell for goes down by £2. So if she brings two fish, she sells them for £20 each, if she brings three she sells them for £18 each, and so on.

(a) Assume it costs her nothing to catch fish. How many fish should she catch and bring to the market to maximise the money she makes? How much money will she make if she does this? [10pt]

(b) Now assume instead that for each fish she catches, she must spend £4 on bait. Given this, how many fish should she catch, and how much money can she make? [4pt]

Question 7

Evaluate the following integrals.

(a) $\int_1^2 8x^3 - 6x \, dx$ [5pt]

(b) $\int 2k(x+3)^{k-1} \, dx$ [5pt]

Question 8

Solve the following system of equations for x, y, and z, treating a as a constant. That means that, for example, your solution for x can contain a but not y or z. [15pt]

$$x + 2y = z + 4$$

$$a(y - z) = 4x + 2a$$

$$\frac{a}{x} = \frac{4}{3y - 5z}$$

[End of examination]