Undergraduate Admissions Assessment March 2020
TEST 1 - (Sections A, B1 and D). Three Hour Assessment.

The UG Admissions Assessment (UGAA) gives Admissions Tutors the opportunity to see a sample of the applicant's original work, produced under examination conditions, and seeks to assess applicants from a variety of backgrounds in a fair and equitable manner.

The assessment has three sections: comprehension exercises (**Section A**); essay questions (**Section B**); and mathematical problems (**Section C** _or_ **D**). The purpose is to assess the applicant's English language and mathematics abilities. *It is not an assessment of general knowledge.* The following criteria are of particular importance:

- Clarity and precision of language
- Sophisticated vocabulary
- Logical structure and argument
- Mathematical accuracy, techniques and conceptual understanding

Before beginning the assessment, please read the following guidance and instructions carefully.

Depending on the course to which you have applied, you have been entered for Test 1 or 2. Before beginning the assessment please check that you have received the correct paper. A list of courses and corresponding papers can be found overleaf.

The assessment lasts three hours and **all three sections must be completed**. The marks for each section are weighted according to the paper. More time should be spent completing the sections with more marks attached. However, please note that to pass the UGAA a minimum grade in *all three sections* is required, as well as a good grade overall.

Test 1: Section A **(25%)**, Section B1 **(25%)**, Section D **(50%)**
Test 2: Section A **(25%)**, Section B2 **(50%)**, Section C **(25%)**

Answer booklets

You must use the **BLUE** booklet for Sections A and B (English Sections) and the **YELLOW** booklet for Sections C or D (Maths Sections).

When answering the maths questions, you must show your working out, as well as your final answer.

Permitted/not permitted items

- Dictionaries may **NOT** be used
- Hand-held calculators may **NOT** be used.

Test Papers

TEST 1

BSc Actuarial Science (N321)
BSc Econometrics and Mathematical Economics (L140)
BSc Economic History with Economics (V3L1)
BSc Economics (L101)
BSc Economics and Economic History (VL31)
BSc Economics with Economic History (L1V3)
BSc Environmental Policy with Economics (F9L1)
BSc Finance (N300)
BSc Financial Mathematics and Statistics (GN13)
BSc Geography with Economics (L7L1)

BSc International Social and Public Policy and Economics (LLK1)
BSc Management (N200)
BSc Mathematics and Economics (GL11)
BSc Mathematics with Economics (G1L1)
BSc Mathematics, Statistics, and Business (G0N0)
BSc Philosophy and Economics (LV15)
BSc Philosophy, Politics and Economics (L0V0)
BSc Politics and Economics (LL12)

TEST 2

BSc Accounting and Finance (NN34)
BSc Anthropology and Law (ML16)
BSc Economic History (V300)
BSc Economic History and Geography (V3L7)
BSc Environment and Development (FK84)
BA Geography (L702)
BA History (V146)
BSc International Relations (L250)
BSc International Relations and Chinese (L2T1)
BSc International Relations and History (VL12)
BSc International Social and Public Policy (L400)

BSc International Social and Public Policy with Government (LL42)
BSc Language, Culture and Society (L3R9)
BSc Philosophy, Logic and Scientific Method (V503)
BSc Politics (L230)
BSc Politics and History (LV21)
BSc Politics and International Relations (L290)
BSc Politics and Philosophy (LV25)
BSc Psychological and Behavioural Science (C800)
BA Social Anthropology (L601)
BSc Social Anthropology (L603)
BSc Sociology (L301)

Please check you have received the correct paper. If you think you have received the wrong paper please notify the invigilator immediately.

The Undergraduate Admissions Assessment

TEST 1

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Section A

- **All** candidates should complete this section.

- This section has **one** question only.

- The marks achieved in this section account for **25%** of your final exam result.

Donald Trump arrived in the UK to meet NATO allies who are fearful that he could pose a serious threat to the survival of the alliance if he wins re-election next year.

Days before Wednesday's leaders' meeting just outside London to mark NATO's 70th anniversary, the US announced it was cutting its contribution to joint NATO projects. NATO officials say the cut (which reduces the US contribution to equivalence with Germany's) was mutually agreed, but it comes against a backdrop of Trump's longstanding ambivalence about the value of the alliance, and suggestions that US security guarantees to allied nations were dependent on their military spending.

John Bolton, Trump's national security adviser until September, heightened fears among allies about the president's intentions in a private speech to a hedge fund last month, in which Bolton (according to a NBC report) warned that Trump could "go full isolationist" if he wins re-election next November, withdrawing from NATO and other international alliances.

Trump has continually complained about the defence spending of European allies who committed less than the agreed 2% to defence, particularly Germany. And he has cast doubt on US commitment to its obligations under article 5 of NATO's founding document, the Washington Treaty, under which an attack on one ally is considered an attack on all allies.

Julian Borger, 'Trump Re-election Could Sound Death Knell for NATO, Allies Fear,' *The Guardian*, December 3, 2019

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Section B1

- Complete Section B1 **ONLY** if you are completing Maths Section D.

- The marks achieved in this section account for **25%** of your final exam result.

Instructions:
Write **ONE** essay from the following three choices:

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1. 'Democracies are more peace-loving than other forms of government.' Discuss.
   - Why are democracies more peace-loving than other forms of government?

2. 'Education is the best way to reduce inequality in society.' Discuss.
   - How important is education in combating inequality?

3. 'Preoccupied with economic growth, governments have ignored the problem of global warming.' Discuss.
   - Why have governments been so slow to address the problem of global warming?

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Section D

- The marks achieved in this section account for **50%** of your final exam result.

- Full algebraic working out must be clearly shown.

Instructions:
This section has **seven questions**, with a total of **100 marks**. Answer **all** questions in this section.

Question 1

$$f(x) = 1 + \frac{1}{9x^2 + 3x - 2} - \frac{3x}{9x^2 + 3x - 2}$$

a) Express $f(x)$ in the form $\frac{Ax+B}{Cx+D}$ where A,B,C,D are integers

(5 marks)

b) Solve the equation $f(x) = x$ giving your solutions **exactly**.

(3 marks)

c) Find $g(x)$ where $g(x)f(x) = x$

(2 marks)

d) Find $h(x)$ where the composite function $f(h(x)) = x$

(5 marks)
Total 15 marks

Question 2

Solve the following equations giving your answers **exactly**.

a) $2^{x+2} + 2^{-x} = 5$

(4 marks)

b) $2 \ln(x + 2) - 2 \ln(x - 1) - \ln 9 = 0$

(5 marks)

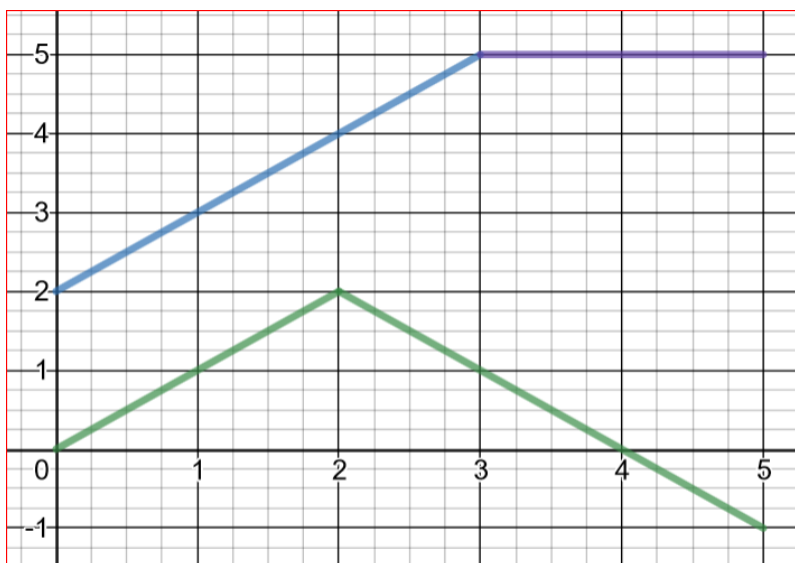c) $\frac{cosx+1}{sinx} = 2\ sinx\ for\ 0 \leq x \leq 2\pi$

(3 marks)

d) $2 \sin\left(\frac{x}{2} + \frac{\pi}{12}\right) \cos\left(\frac{x}{2} + \frac{\pi}{12}\right) = 1\ \ for\ \ 0 \leq x \leq 2\pi$

(3 marks)
Total 15 marks

Question 3

The graph shows two functions $f(x)$ and $g(x)$ both defined for $0 \leq x \leq 5$

a)   Write down $f(3)$

(1 mark)

b)   Find a such that $f(a) = 4$

(1 mark)

c)   Find $f(g(4))$

(2 marks)

d)   Write down $g'(3)$

(1 mark)

e) $h(x) = \frac{g(x)}{f(x)}$ Find $h'(1)$

(3 marks)

f)   Find $\int_{1}^{5} g(x)dx$

(2 marks)

Total 10 marks

Question 4

For this question, $\sin y = 4x^2$ has domain $0 \leq x \leq \frac{1}{2}$ and range $0 \leq y \leq \frac{\pi}{2}$

a)   Differentiate $\sin y = 4x^2$ *implicitly* to find $\frac{dy}{dx}$

(4 marks)

b)   Hence show that $\frac{dy}{dx} = \frac{8x}{\sqrt{1-16x^4}}$

(3 marks)

c) Find the equations of the tangents to the curve at the points where
i) $x = 0$　　ii) $x = \frac{1}{2}$　　iii) $x = \frac{1}{2\sqrt{2}}$

Give your answers **exactly**

(9 marks)

d) Sketch the curve $\sin y = 4x^2$ carefully for the given domain and range

(2 marks)

Total 18 marks

Question 5

a) Find $\frac{dy}{dx}$ for the following

i)　　$y = \frac{2x+1}{\sqrt{x}}$　　ii)　　$y = \frac{x^2+1}{2x-1}$　　iii)　　$y = \ln\left(\frac{x+1}{2x-3}\right)$

(6 marks)

b) Find the following indefinite integrals

i)　　$\int \frac{2x+1}{\sqrt{x}}\,dx$　　ii)　　$\int \frac{2x+1}{x+1}\,dx$　　iii)　　$\int \frac{2x}{\sqrt{x^2+3}}\,dx$

(6 marks)
Total 12 marks

Question 6

a) Write down the sum to infinity for the following geometric series

$$1 + x^2 + x^4 + x^6 + \cdots \qquad -1 \le x \le 1$$

Giving your answer in the form $\frac{A}{f(x)}$ where A is an integer.

(2 marks)

b) Hence or otherwise find the sum to infinity of the following series (you may assume convergence) giving your answers in the form $\frac{g(x)}{h(x)}$

i)　　$1 - ax + x^2 - ax^3 + x^4 - ax^5 + x^6 - ax^7 + \cdots$

ii)　　$2x + 4x^3 + 6x^5 + 8x^7 \dots$

(4 marks)
Total 6 marks

Question 7

a)   Use the formula for $\cos(2\theta)$ to write $\cos^2\left(\frac{x}{2}\right)$ in terms of $\cos x$

(2 marks)

A designer is modelling a new shape for a football.

b)   i)   Describe the two transformations that map the curve $y = \cos x$ onto the curve
$y = p\cos\left(\frac{x}{2}\right)$ where p is a constant such that $0 < p \leq 2$

        ii)   Sketch the curves $y = p\cos\left(\frac{x}{2}\right)$ and $y^2 = p^2\cos\left(\frac{x}{2}\right)$ on the same axes for $-\pi \leq x \leq \pi$
showing carefully the relationship between the two curves and any intercepts with the axes.

        iii)   The sections of the each of the curves that are above the $x\ axis$ are rotated by 2π radians
about the $x\ axis$. Find each of the two volumes generated and give your answer in terms of
π and p.

        (You may use the formula $V = \pi\int_a^b y^2 dx$ to find the volume when a section of a curve between
$x = a$ and $x = b$ is rotated by 2π radians about the x axis)

(13 marks)

c)   i)   On a new set of axes sketch both the curves
$x^2 + y^2 = p^2$ and $\left(\frac{px}{\pi}\right)^2 + y^2 = p^2$ for $-\pi \leq x \leq \pi$

        p is the same constant as in part a).

        Show carefully the relationship between the two curves and any intercepts with the axes.

        ii)   The section of the curve $\left(\frac{px}{\pi}\right)^2 + y^2 = p^2$ that is above the $x\ axis$ is rotated by 2π radians
about the $x\ axis$. Find the volume generated and give your answer in terms of π and p.

(7 marks)

d)   The manufacturer of the new football wants to choose the model whose equation gives the largest
volume. Using your answers to parts b(iii) and c(ii) explain which of the 3 volumes that you have
found is greatest.

(2 marks)

Total 24 marks

End of Test