# *95 years of the Leaving Cert*
# *Was Science more difficult in 1925?*

David Malone and Hazel Murray
Hamilton Institute / Dept Maths&Stats, Maynooth University.

Thursday 14th March 2019

**Eddy Carroll** @eddycarroll · 22 Oct 2013

Rather shocked by this insight into modern maths curriculum in the UK from Richard Bartle youhaventlived.com/qblog/2013/QBI…

1 1

**David Malone** @dwmal1 · 22 Oct 2013

@eddycarroll Matricies, complex numbers and calculus would be post junior/inter-cert here, so if you skipped senior cycle you wouldn't have?

1

**Eddy Carroll**
@eddycarroll

Following

Replying to @dwmal1

@dwmal1 It's been a while but pretty sure I did complex numbers for the intercert - and possibly matrices. Also, Newton's method!

10:32 pm - 22 Oct 2013

2

**Eddy Carroll**
@eddycarroll

Following

Replying to @dwmal1

@dwmal1 I checked with my old maths teacher; he confirmed my memory is terrible and it was all Leaving Cert material, not Intercert

10:55 am - 24 Oct 2013

# *Build an Archive*

- Our memories are imperfect.
- We overestimate our own abilities (Lake Wobegon effect).
- Material not consistently on line pre-2000s
- I must have kept old exam papers for a reason.

Made a serious start in Jan 2016 with maths, applied maths, physics, technical drawing and chemistry.

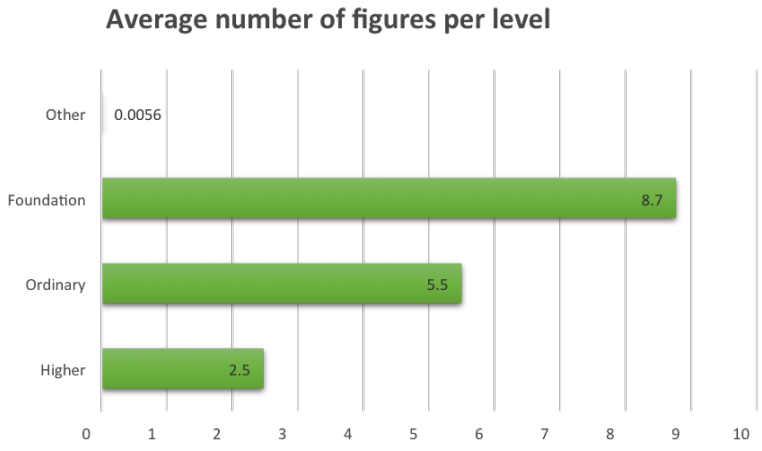
- The examination papers issued at the examinations held under the Department of Education (Secondary Branch)
- Scrúdpáipéir na hArdteistiméireachta

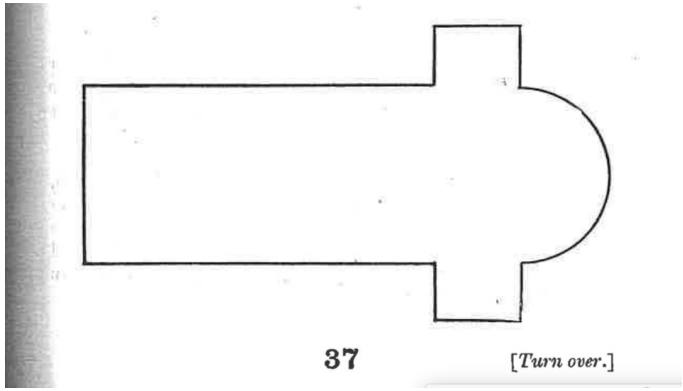
CERTIFICATE EXAMINATION PAPERS
1974
1975
1976
1977 & 1978
1979 & 1981
1983
1984
1985 1986
1987
1988
1989

# *Collecting papers*

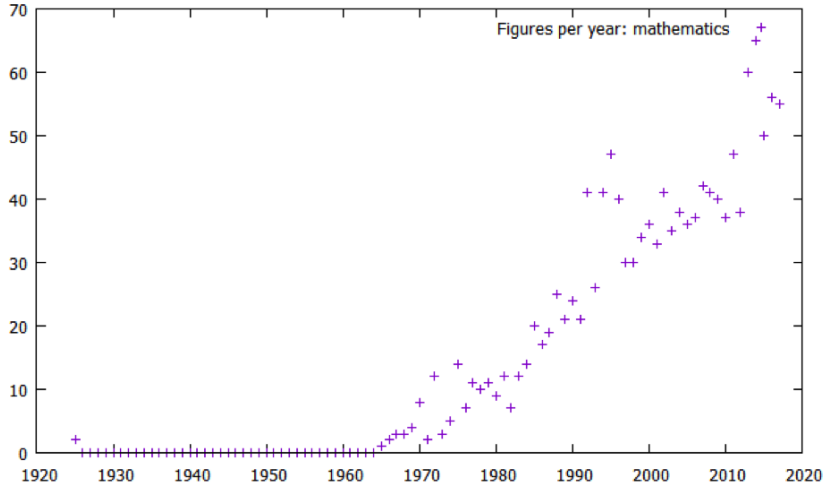
- Trinity College Dublin Library
- National Library of Ireland
- State Examinations Commission

# *Number of Figures*

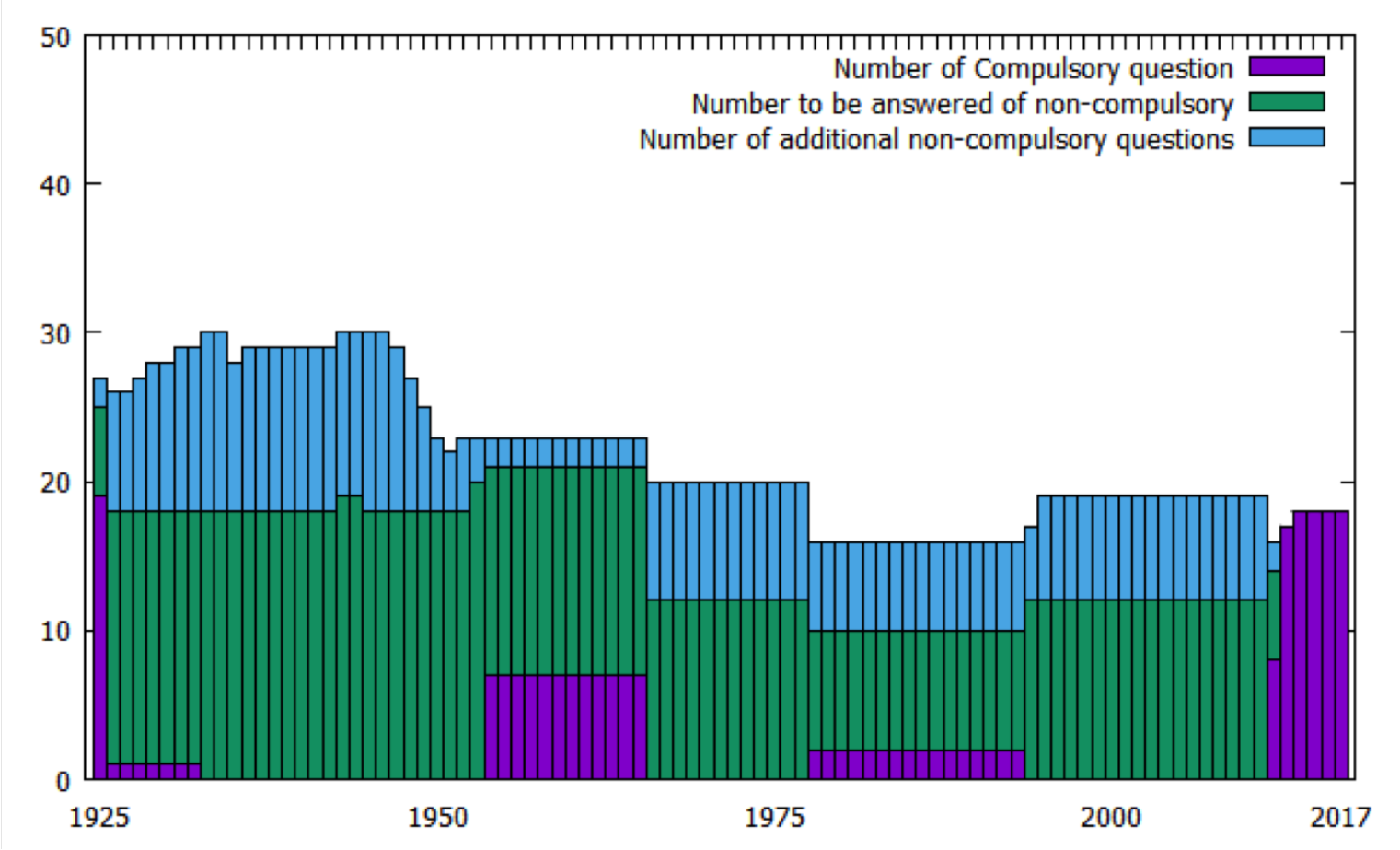


Picture: http://cs.nga.gov.au



# *Number of Compulsory vs. Non-Compulsory Questions*



# *Number of Pages per Year*

## Chemistry Paper 1925

AN ROINN OIDEACHAIS
(Department of Education).

ERAINSE AN MHEADHON-OIDEACHAIS
(Secondary Education Branch).

LEAVING CERTIFICATE EXAMINATION, 1925

HONOURS
CHEMISTRY.

*TUESDAY, 23rd JUNE.*—MORNING, 10 A.M. TO 12 NOON.

[All six questions may be attempted. Illustrate your answers by diagrams wherever possible.]

1. Describe the preparation of two oxides of carbon, and show how each may be converted into the other. What volume of carbon monoxide will be produced by the reduction of 100 litres of carbonic anhydride?

2. Describe and explain the action of hydrochloric acid upon litharge and upon red lead. State what occurs when chlorine is passed into (*a*) a solution of potassium iodide, (*b*) a solution of sulphur dioxide in water.

3. Describe experiments to determine the composition of water by weight and by volume.

4. How may the vapour density of a volatile substance be determined? Sketch the apparatus employed, and state the precautions necessary for obtaining accurate results.

5. Explain the statement: 'The properties of elements are a periodic function of their atomic weights.' Classify a number of elements in accordance with the 'Periodic Law.' Point out the services that the Periodic classification has rendered to chemistry.

6. Describe the preparation of acetaldehyde and acetic acid from ethyl alcohol. Give equations, and explain the changes that occur.

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## Chemistry Paper 2017 (Q4)

**Section B**

**See page 1 for instructions regarding the number of questions to be answered.**

**4.** Answer **eight** of the following (*a*), (*b*), (*c*), etc. (50)

(*a*) Why did Mendeleev place tellurium before iodine in his periodic table of the elements?

(*b*) Identify the main energy levels involved in the electron transition that gives rise to the first (red) line of the Balmer series in the emission spectrum of the hydrogen atom.

(*c*) Identify the atomic symbol **X** and the atomic number **Z** of the daughter nucleus in the following nuclear equation.

$$^{137}_{55}Cs \rightarrow {}^{137}_{Z}X + {}^{0}_{-1}e$$

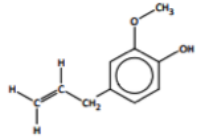
(*d*) Write the oxidation number for
(*i*) oxygen in $OF_2$,
(*ii*) xenon in $XeF_4$.

(*e*) State Avogadro's law.

(*f*) Calculate the mass of sodium chloride required to prepare 500 $cm^3$ of a 0.9% (w/v) saline solution for use as an intravenous fluid.

(*g*) Identify, in ammonia, the type of
(*i*) *intramolecular* bonding,
(*ii*) *intermolecular* forces, present.

(*h*) The structure of eugenol is shown.



(*i*) Write the molecular formula of eugenol.
(*ii*) Name a spectroscopic technique that could help confirm the identity of a sample of eugenol.

(*i*) Write a balanced equation for the displacement reaction between copper metal and $AgNO_3$ solution to produce copper(II) nitrate.

(*j*) How does boiling remove any temporary hardness, caused by the presence of calcium hydrogencarbonate, in a water sample?

(*k*) Answer part **A** *or* part **B**.

**A** Explain using balanced equations how sulfuric acid in rainwater is formed from sulfur dioxide in the atmosphere.

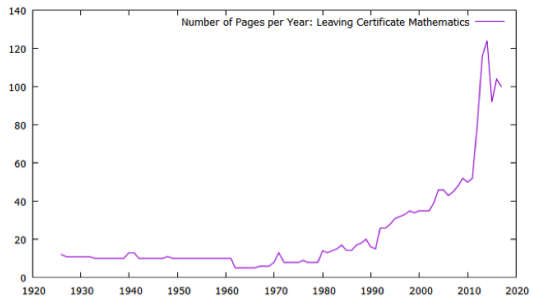
*or*

**B** How is aluminium anodised?

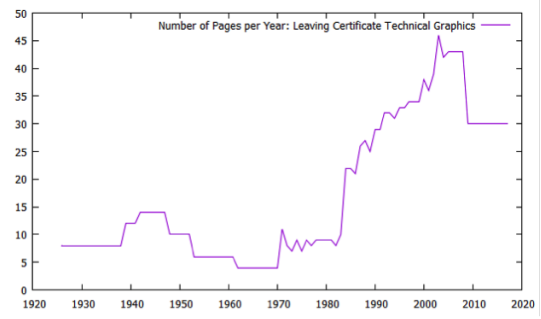
*Page 5 of 12*

# *Number of Pages per Year*

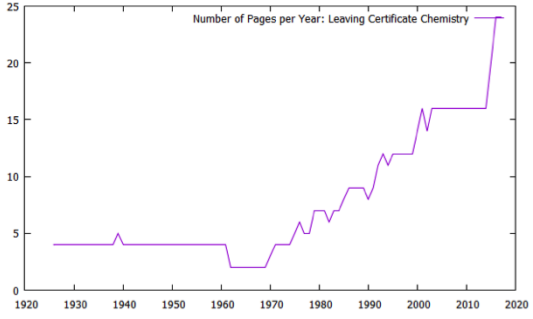
## Mathematics



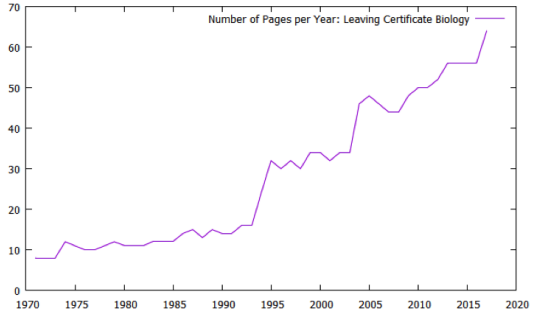

## Technical Graphics



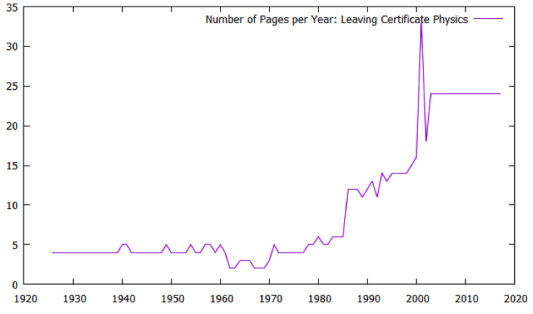

## Chemistry




## Biology




## Physics



AN ROINN OIDEACHAIS

(Department of Education)

INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

MATHEMATICS (Arithmetic).

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MATHEMATICS (Arithmetic).

AN ROINN OIDEACHAIS

(Department of Education)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—ARITHMETIC.

*WEDNESDAY, 7th JUNE.*—MORNING, 10 TO 12.

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INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

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AN ROINN OIDEACHAIS

(Department of Education)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—Algebra—Honours.

*TUESDAY, 13th JUNE.*—MORNING, 10 TO 12.30.

AN ROINN OIDEACHAIS

(Department of Education)

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MATHEMATICS (Arithmetic).

AN ROINN OIDEACHAIS

(Department of Education)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—ARITHMETIC.

*WEDNESDAY, 7th JUNE.*—MORNING, 10 TO 12.

AN ROINN OIDEACHAIS

(Department of Education)

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*TUESDAY, 13th JUNE.*—MORNING, 10 TO 12.30.

AN ROINN OIDEACHAIS

(Department of Education)

INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

ELEMENTARY MATHEMATICS (Algebra).

FOR GIRLS ONLY.

*TUESDAY, 13th JUNE.*—MORNING, 10 TO 12.

# *Intercert Elementary Mathematics (for Girls Only)*

- On peach coloured paper (c.f. ordinary alternative),
- A handful of questions like "A girl spends 8s. 2d. in buying $x$ bangles . . . "
- "Special lady maths exam for our little lady brains"?
- Ran from 1933–1968.
- 2007 Report: Sé Sí — Gender in Irish Education.
  *The clear implication from statistical reports of that era is that elementary mathematics was for girls, who, it was assumed, were unsuitable for higher-level mathematics.*

Department reports happen to be on shelves. . .

# *Why for Girls Only?*

- *in the Junior Course it is obligatory, except in the cases of girls, who may take Arithmetic in conjunction*
- *There is . . . a dearth of good mathematical teachers in the girls' schools, and the absence of girl candidates for the Honours Leaving Certificate in Mathematics gives reason to fear there will be a continuance of the present dearth.*
- *The dearth of candidates in the universities who take Mathematics as a special subject for the degree shows how serious the question of supply of mathematical teachers . . .*
- *especially in girls' schools is that the teachers give too much help and do not give pupils sufficient opportunity of overcoming their own difficulties*
- *many of the teachers are too tied to the text-book*
- *the department felt the position of Mathematics in Girls' Schools was not satisfactory. . . . introduce the subject "Elementary Mathematics for Girls", . . . while retaining the full-course . . . for girls as well as boys"*
- Wanted to abolish arithmetic-only option, but most schools objected.
- *feels that a knowledge of the subject is of considerable importance to girls as well as boys.*

# *What Hasn't Changed?*

## Applied Maths 1926

5. The equation of the path of a projectile referred to horizontal and vertical axes is $y = x - \frac{x^2}{64}$; find the angle at which it was projected and the initial velocity. Find also the direction of motion after $t$ seconds. (*Note.*—$g$ may be taken as 32).

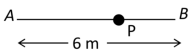
6. A number of unequal particles are distributed in a straight line: find a formula for the position of the centre of gravity.

Two masses $m_1$ and $m_2$ are attached to the ends of a light string passing over a smooth peg: show that the acceleration of the centre of gravity is $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2 g$.

7. A mass $m$ hangs from a light spiral spring. Show that, if $m$ is pulled down slightly and released, it will move with simple harmonic motion. Find the greatest velocity and the periodic time of $m$, showing clearly on what they depend.

## Applied Maths 2018

**6.** **(a)** Two points *A* and *B* are 6 m apart on a smooth horizontal surface. A particle P of mass 0·5 kg is attached to one end of a light elastic string, of natural length 2·5 m and elastic constant 8 N m$^{-1}$. The other end of the string is attached to *A*.




A second light elastic string, of natural length 1·5 m and elastic constant 12 N m$^{-1}$ has one end attached to P and the other end attached to *B*, as shown in the diagram.
Initially P rests in equilibrium at the point *O*, where *AOB* is a straight line.

**(i)** Find the length of *AO*.

The particle P is now displaced in the direction *AB*, through such a distance that neither string goes slack, and is then released.

**(ii)** Show that P moves with simple harmonic motion about *O*.

**(b)** A particle P is attached to one end of a light inextensible string of length $d$. The other end of the string is attached to a fixed point. The particle is hanging freely at rest, with the string vertical, when it is projected horizontally with speed $u$.
The particle moves in a complete vertical circle.

**(i)** Show that $u \geq \sqrt{5gd}$.

As P moves in the circle the least tension in the string is $T_1$ and the greatest tension is $kT_1$.

**(ii)** Given that $u = \sqrt{6gd}$, find the value of $k$.

# *What Has Changed?*

## Maths 1991 Paper 1

6. (i) Let $M = \begin{pmatrix} 1 & -2 \\ -2 & 4 \end{pmatrix}$.

Sketch the set of points represented by the quadratic equation $(x \;\; y)\, M \begin{pmatrix} x \\ y \end{pmatrix} = 1$

and find the equations of the axes of symmetry of the set where these axes contain the origin.

(ii) Let $t \in \mathbf{R}$.

Find $\lambda_1$ and $\lambda_2$ for which $M \begin{pmatrix} t \\ \frac{t}{2} \end{pmatrix} = \lambda_1 \begin{pmatrix} t \\ \frac{t}{2} \end{pmatrix}$

and $M \begin{pmatrix} t \\ -2t \end{pmatrix} = \lambda_2 \begin{pmatrix} t \\ -2t \end{pmatrix}$

and sketch the lines $L_1 : x = t, \; y = \frac{t}{2}$

$L_2 : x = t, \; y = -2t$.

(iii) Let $K$ be the unit circle $x^2 + y^2 = 1$.

Find $(x_1, y_1)$ the coordinates of the point common to $K$ and $L_1$ in the 1st quadrant.

Find $(x_2, y_2)$ the coordinates of the point common to $K$ and $L_2$ in the 2nd quadrant.

If $P = \begin{pmatrix} x_1 & x_2 \\ y_1 & y_2 \end{pmatrix}$, evaluate $P^{-1} M P$.

# *Is it harder?*

That's a hard question. Let's look at an example. (1926 Q3(a))

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That's a hard question. Let's look at an example. (1926 Q3(a))

> *What is meant by a convergent series?*
> *Show that* $u_1 - u_2 + u_3 - u_4 + \ldots$ *is convergent if* $u_1, u_2,$ *etc., are positive and decreasing without limit.*

# *Part 1*

*What is meant by a convergent series?*

You need to know what they want. Could be:

1. A series is convergent if the sequence of its partial sums tends to a limit.

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You need to know what they want. Could be:

1. A series is convergent if the sequence of its partial sums tends to a limit.
2. A series $\sum a_n$ is convergent if there is a number $I$ so that $\forall \epsilon > 0$ we can find $N > 0$ so that

$$\left| I - \sum_{k=1}^{n} a_k \right| < \epsilon$$

whenever $n \geq N$.

## *Part 2*

*Show that* $u_1 - u_2 + u_3 - u_4 + \ldots$ *is convergent if* $u_1, u_2,$ *etc., are positive and decreasing without limit.*

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If the partial sums are

$$\sum_{k=1}^{n} (-1)^{k+1} u_k,$$

then question is wrong: $u_k = 1 + 1/k$ gives a non-convergent series.

## *Part 2*

> *Show that* $u_1 - u_2 + u_3 - u_4 + \ldots$ *is convergent if* $u_1, u_2,$ *etc., are positive and decreasing without limit.*

If the partial sums are

$$\sum_{k=1}^{n} (-1)^{k+1} u_k,$$

then question is wrong: $u_k = 1 + 1/k$ gives a non-convergent series. Maybe they meant

$$\sum_{k=1}^{n} u_{2k-1} - u_{2k},$$

but then the question would have been

> *Show that* $(u_1 - u_2) + (u_3 - u_4) + \ldots$ *is convergent if* $u_1, u_2,$ *etc., are positive and decreasing without limit.*

And you need Bolzano-Weierstrass theorem!

# *Thanks*

Questions?

`http://archive.maths.nuim.ie/staff/dmalone/StateExamPapers/`