It was all much harder when I was young: Science and the Leaving Cert

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

Thursday 16th November

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.

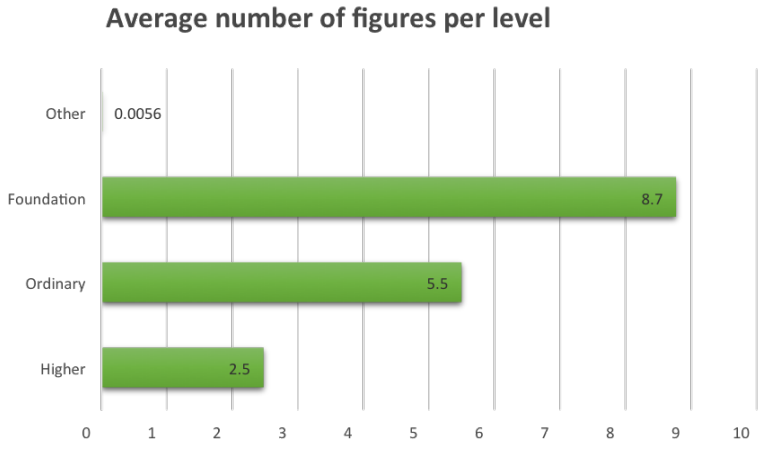
- The examination papers issued at the examinations held under the Department of Education (Secondary Branch)
- Scrúdpháipéirí na hArdteistiméireachta

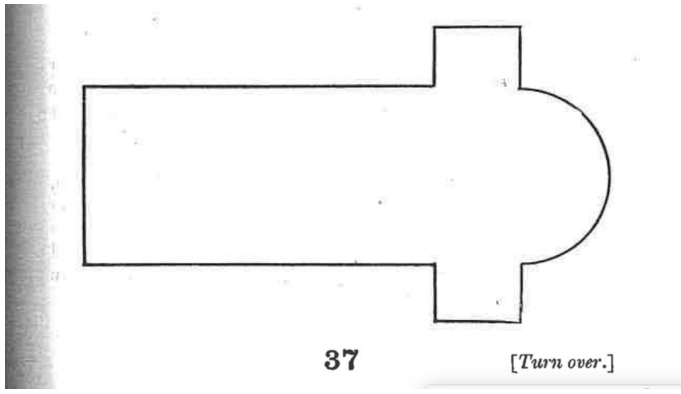

CERTIFICATE EXAMINATION PAPERS
SCRÚDPHÁIPÉIR NA HARDTEISTIMÉIREACHTA
1977 & 1978
1979 & 1981
1983
1984
1985 1986
1987
1988
1989
1974
1975
1976

Collecting papers

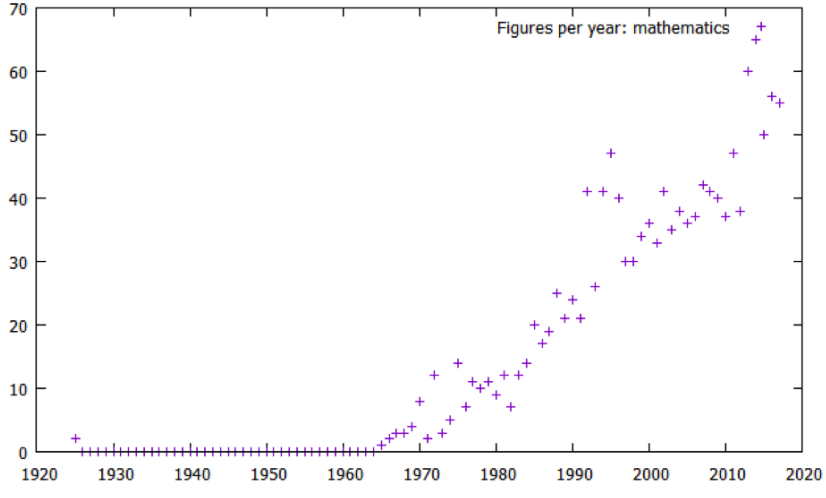
- Trinity College Dublin Library
- National Library of Ireland
- State Examinations Commission

Number of Figures

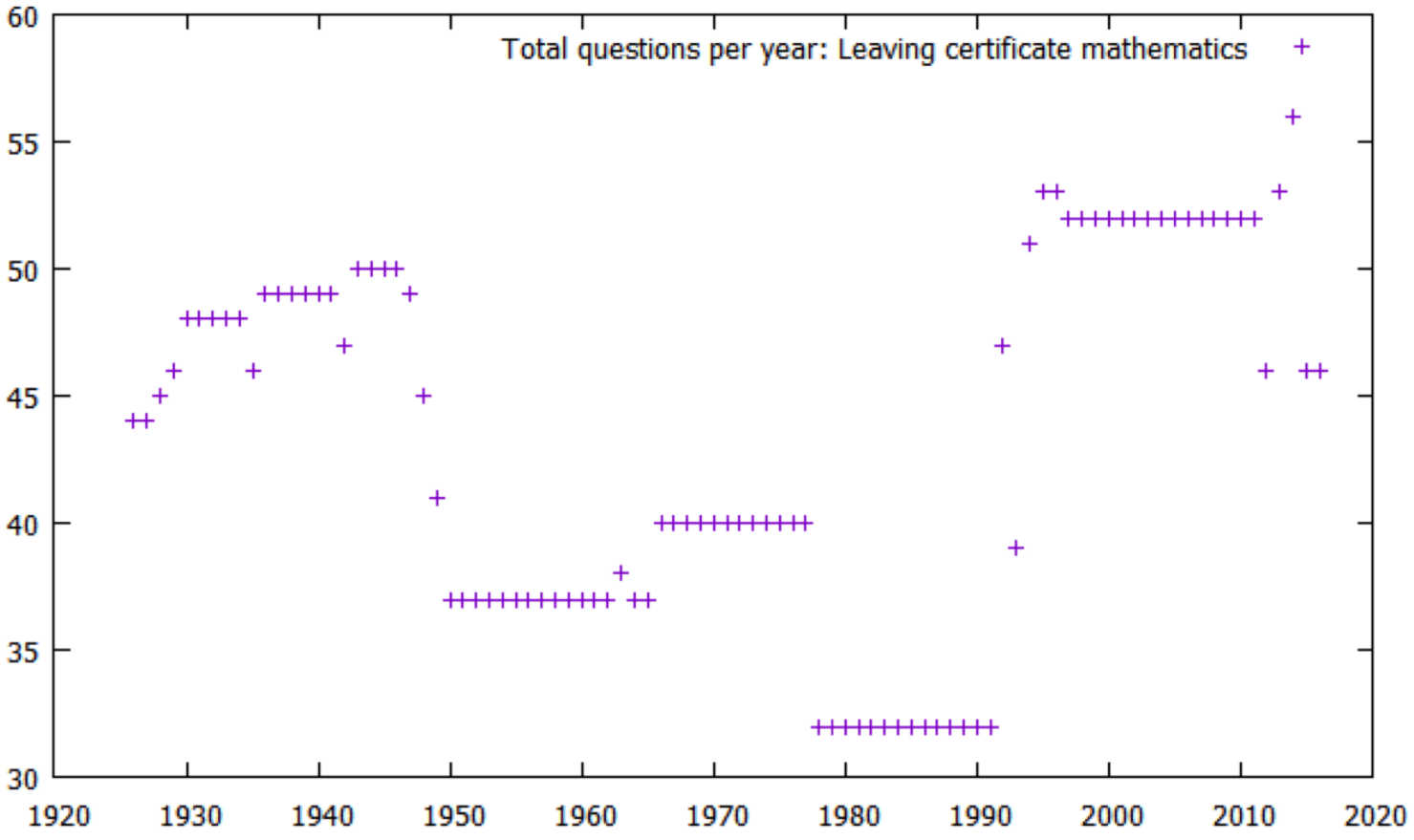




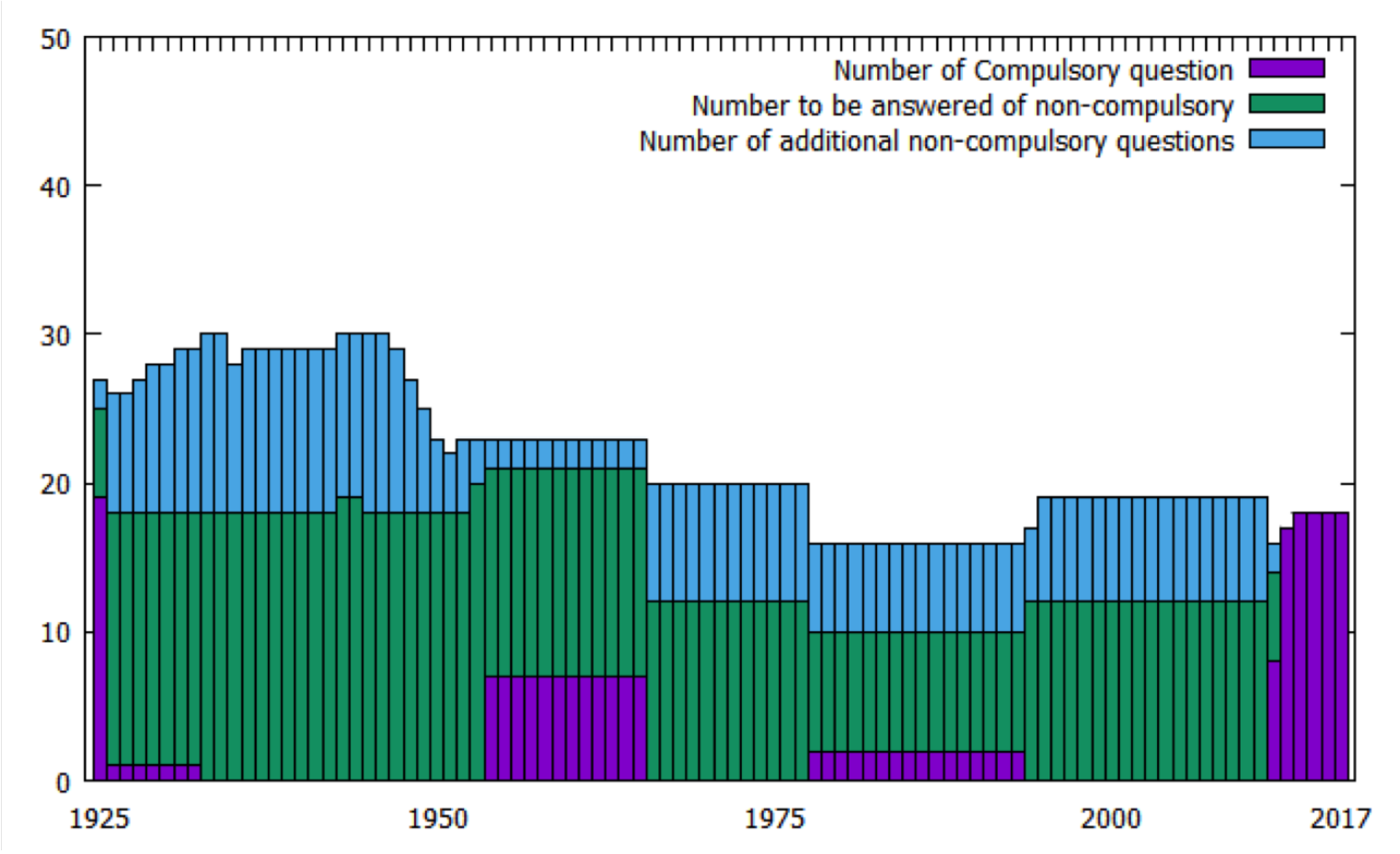
Picture: http://cs.nga.gov.au



Number of Questions per Year



Number of Compulsory vs. Non-Compulsory Questions



Number of Pages per Year

Chemistry Paper 1925

AN ROINN OIDEACHAIS
(Department of Education).

BRAINSE 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.

49

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.

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

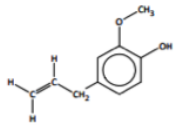
(*d*) Write the oxidation number for
- (*i*) oxygen in OF_2,
- (*ii*) xenon in XeF_4.

(*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.

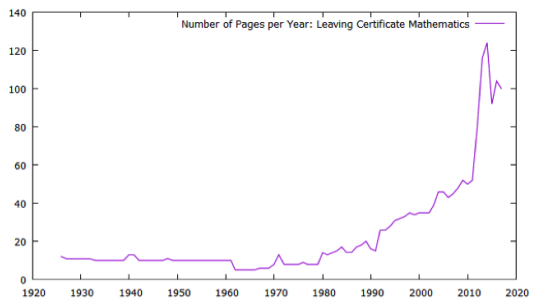
or

B How is aluminium anodised?

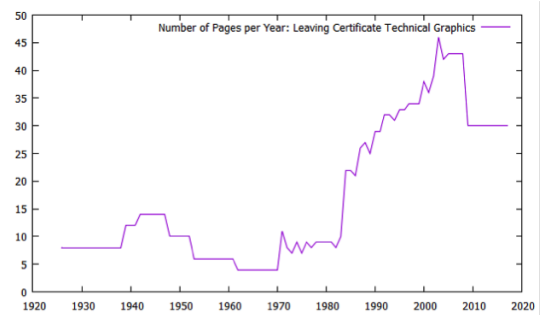
Page 5 of 12

Number of Pages per Year

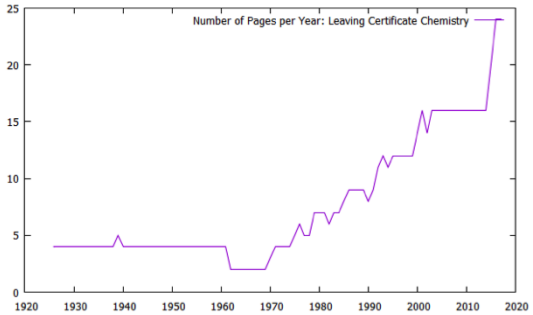
Mathematics



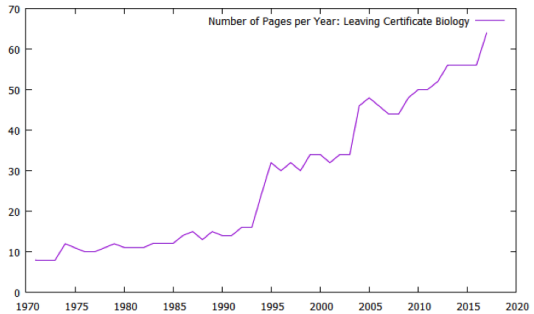
Technical Graphics



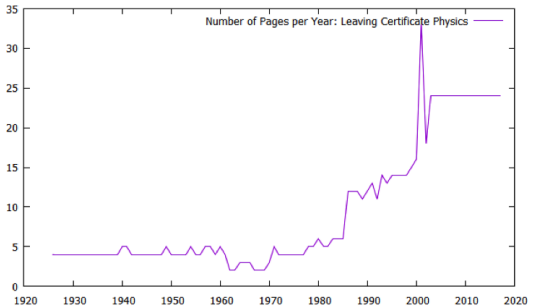
Chemistry



Biology



Physics



AN ROINN OIDEACHAIS

(Department of Education)

INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

MATHEMATICS (Arithmetic).

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INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

MATHEMATICS (Arithmetic).

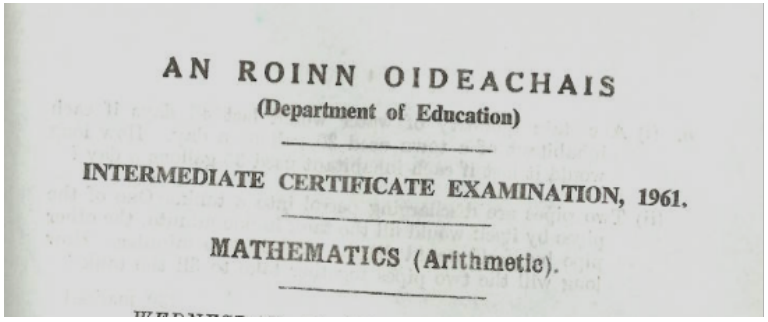
AN ROINN OIDEACHAIS

(Department of Education)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—ARITHMETIC.

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



AN ROINN OIDEACHAIS

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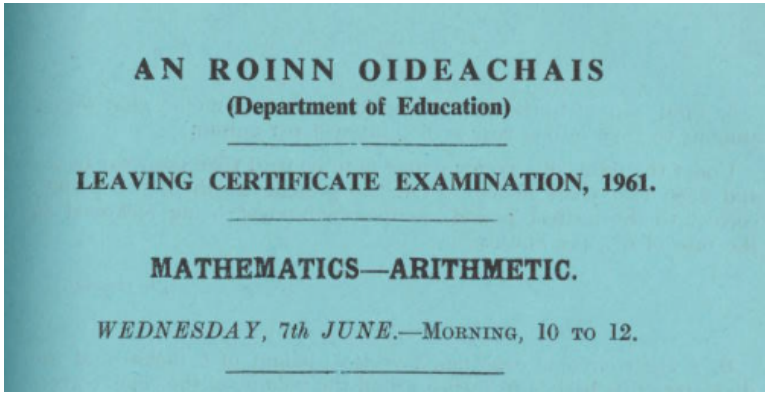
INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

MATHEMATICS (Arithmetic).



AN ROINN OIDEACHAIS

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LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—ARITHMETIC.

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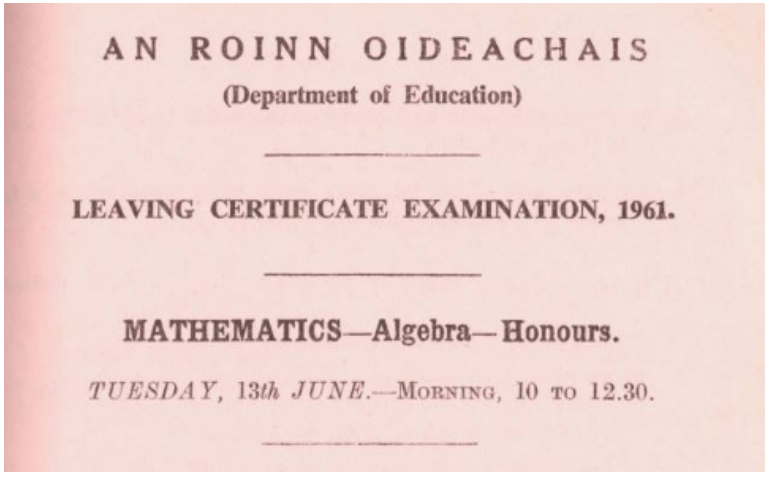

AN ROINN OIDEACHAIS

(Department of Education)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—Algebra—Honours.

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

AN ROINN OIDEACHAIS
(Department of Education)

INTERMEDIATE CERTIFICATE EXAMINATION, 1961.

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)

LEAVING CERTIFICATE EXAMINATION, 1961.

MATHEMATICS—Algebra—Honours.

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 Repont: 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.*

Modern thinking

There is lots of modern thinking.
A 1898 review of the previous exam system said that the papers set at the examination should be of such a character as (i) to test true educational work, as distinct from the mere overloading of the memory, and (ii) to be within the capacity of a well-taught pupil of average ability"

That system had three levels of exam. It took reviews in 1904, 1919 the establishment of Saorstát Éireann, the establishment of the Department of Education to actually kick off implementation in 1924!

(They also used to pay teachers based on the number of students that passed!)

Physics

- Traditional: mechanics, optics, heat, electricity, magnetism.
- Originally more essays, with odd calculations.
- Units are mixed CGS, SI and Imperial up to 1969.
- First nuclear question in 1956: *Write a note on the structure of the atom.*
- Similar in 1960, 1963 then explosion in 1964 on photons, radioactivity, X-rays, cathode rays, isotopes, . . .

Biology

- Until 1971 there is no biology!
- Two subjects: Botany and Physiology & Hygiene.
  What are the symptoms of Diphtheria? What precautions should be taken to prevent infection? How is recovery brought about? (1935)
- Gets straight down to business: *Q11(i) Draw a diagram of the urino-genital system of the male mamal. Label the parts and list their main function.*

Need to go back and scan Botany and Physiology & Hygiene at some point.

Inter (now Junior) Cert Science

- Amalgam of Natural Philosophy, Chemistry & Drawing.
- Came in several different versions:
  - A (physics, heat, chemistry, mechanics),
  - B (physics, chemistry, botany, hygiene),
  - C (cookery, needlework, hygiene, household),
  - D (physics, heat, chemistry, hygiene),
  - E (non-experimental).
- Reformed over time. By 1969 only A and C. After 1989 one version, two levels.
- Has timeless questions like: *The change of a solid directly to a gas on heating is called?*, *What is the difference between melting and dissolving?*, A stone from a bridge falls into a river. The workman lifting it out claims it gets heavier. Explain.
- Older questions about mercury barometer, newer about renewable energy.

Technical/Mechanical Drawing/Graphics

Already technological — included CAD from relatively early on.

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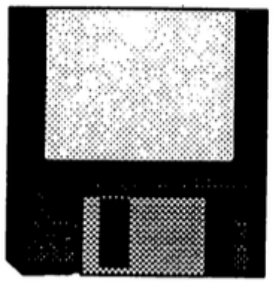
3 Identify the components at (a) and (b), below.

(a) 

(b) 

(a) _____

(b) _____

Is it harder?

That's a hard question. Let's look at an example.

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That's a hard question. Let's look at an example.

> *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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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.
2. A series $\sum a_n$ is convergent if there is a number l so that $\forall \epsilon > 0$ we can find $N > 0$ so that

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

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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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.

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

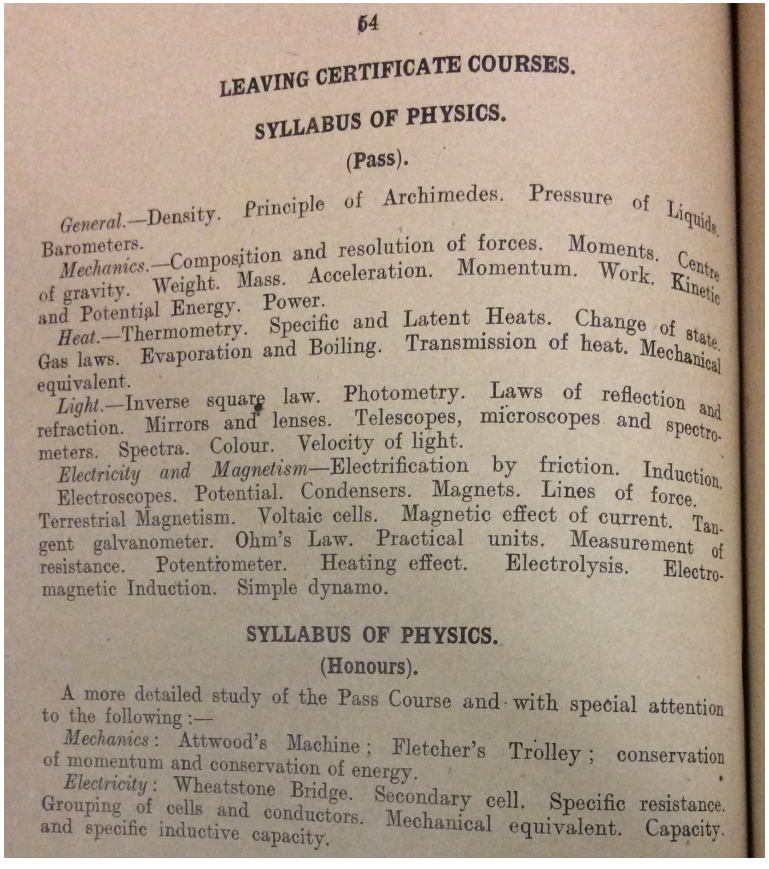
$$\sum_{k=1}^{n} u_{2k-1} - u_{2k},$$

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*~~*.*

True, but work depends on what you know.

Context



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LEAVING CERTIFICATE COURSES.

SYLLABUS OF PHYSICS.

(Pass).

General.—Density. Principle of Archimedes. Pressure of Liquids. Barometers.

Mechanics.—Composition and resolution of forces. Moments. Centre of gravity. Weight. Mass. Acceleration. Momentum. Work. Kinetic and Potential Energy. Power.

Heat.—Thermometry. Specific and Latent Heats. Change of state. Gas laws. Evaporation and Boiling. Transmission of heat. Mechanical equivalent.

Light.—Inverse square law. Photometry. Laws of reflection and refraction. Mirrors and lenses. Telescopes, microscopes and spectrometers. Spectra. Colour. Velocity of light.

Electricity and Magnetism—Electrification by friction. Induction. Electroscopes. Potential. Condensers. Magnets. Lines of force. Terrestrial Magnetism. Voltaic cells. Magnetic effect of current. Tangent galvanometer. Ohm's Law. Practical units. Measurement of resistance. Potentiometer. Heating effect. Electrolysis. Electromagnetic Induction. Simple dynamo.

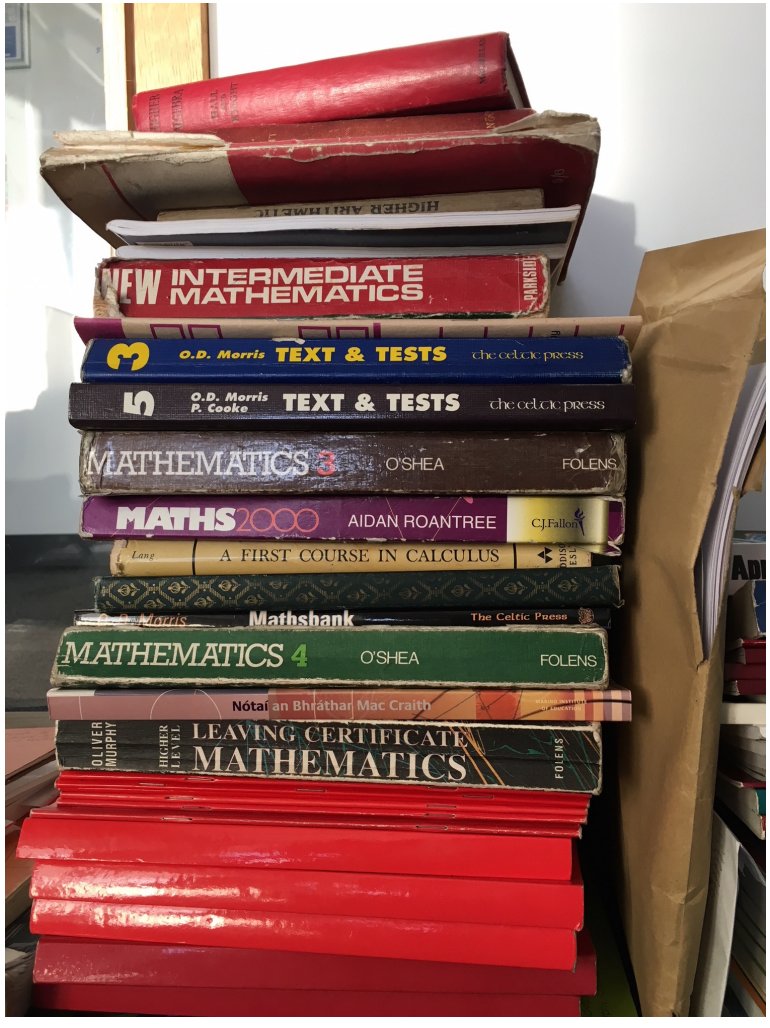
SYLLABUS OF PHYSICS.

(Honours).

A more detailed study of the Pass Course and with special attention to the following :—

Mechanics : Attwood's Machine ; Fletcher's Trolley ; conservation of momentum and conservation of energy.

Electricity : Wheatstone Bridge. Secondary cell. Specific resistance. Grouping of cells and conductors. Mechanical equivalent. Capacity. and specific inductive capacity.



Thanks

Questions?

Tony O'Farrell, John Evans, Janice Love, Ann Creaner, Padraig O Briain, Noel Cunningham, Dominick Donnelly, Eugene Gath, Neil Hallinan, Aoife O'Brien, Bill Lynch, Joseph Terry, Tomás Mac Eochagáin, Joe Lyons, Kieran Tummon, Richard Terry, Paul Nugent, Randal Henly, Declan Kennedy, Eamonn Toland, Seamus Murphy and the State Examination Commission.