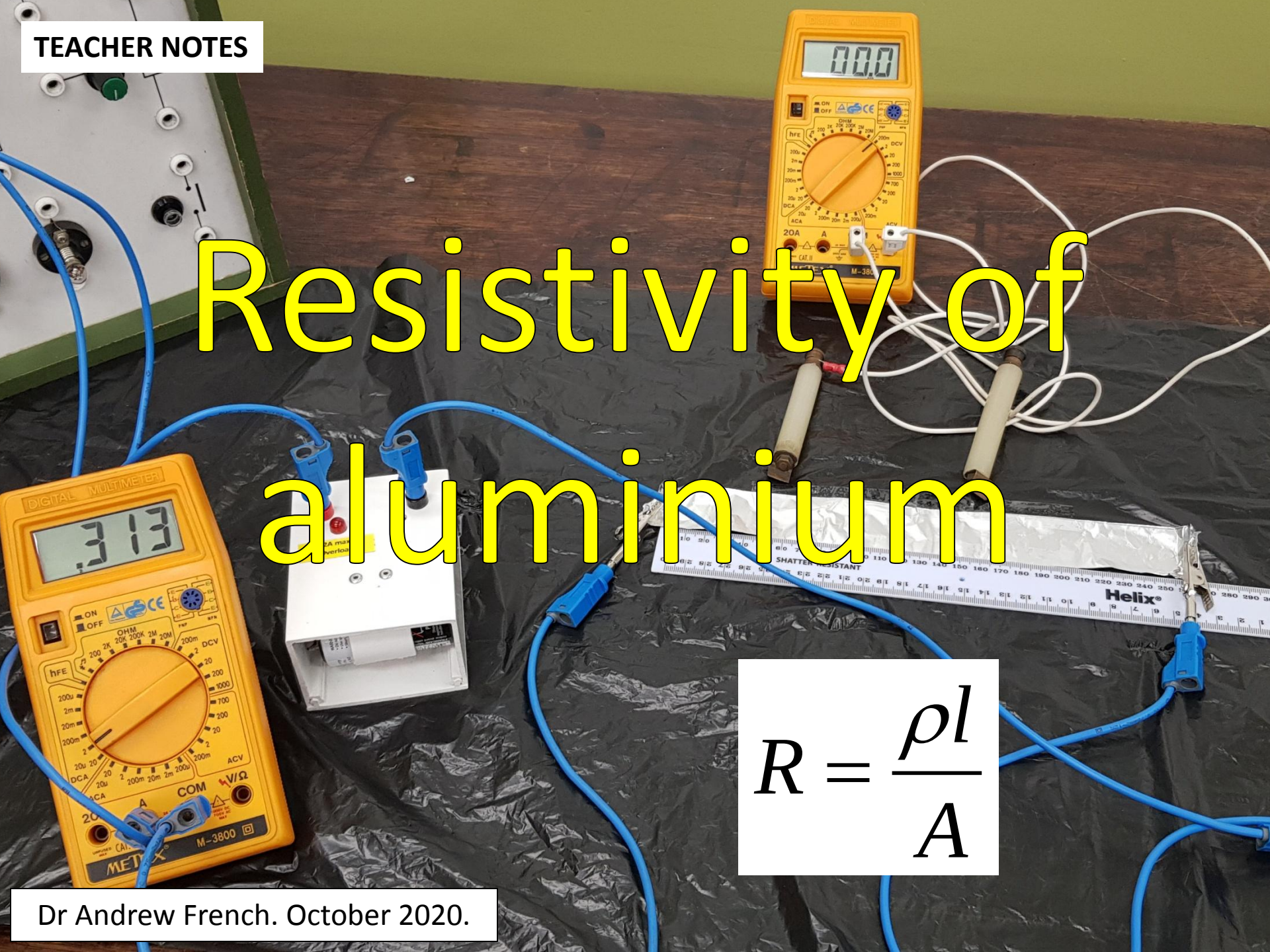
TEACHER NOTES

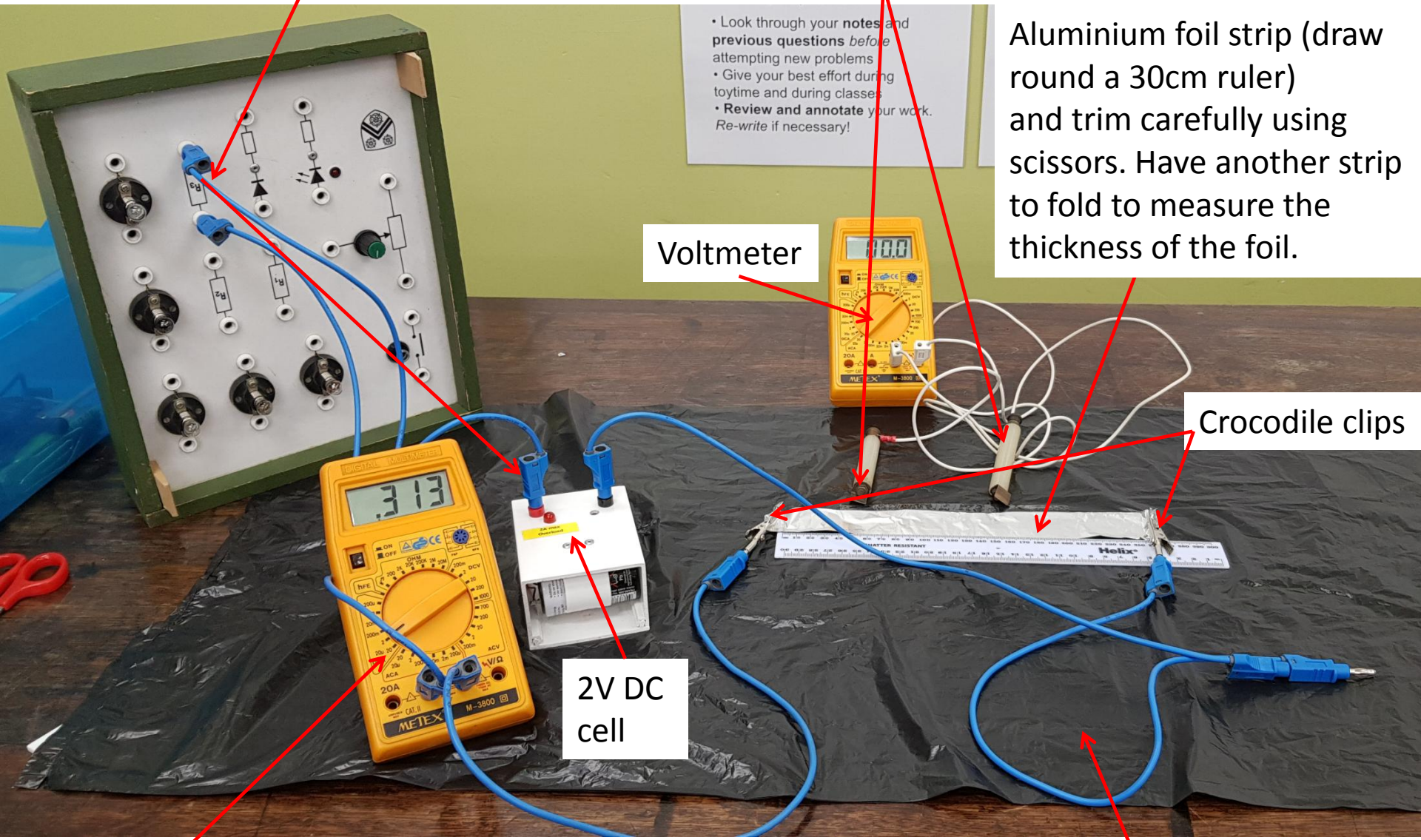
Resistivity of aluminium



$$R = \frac{\rho l}{A}$$

Dr Andrew French. October 2020.

Equipment

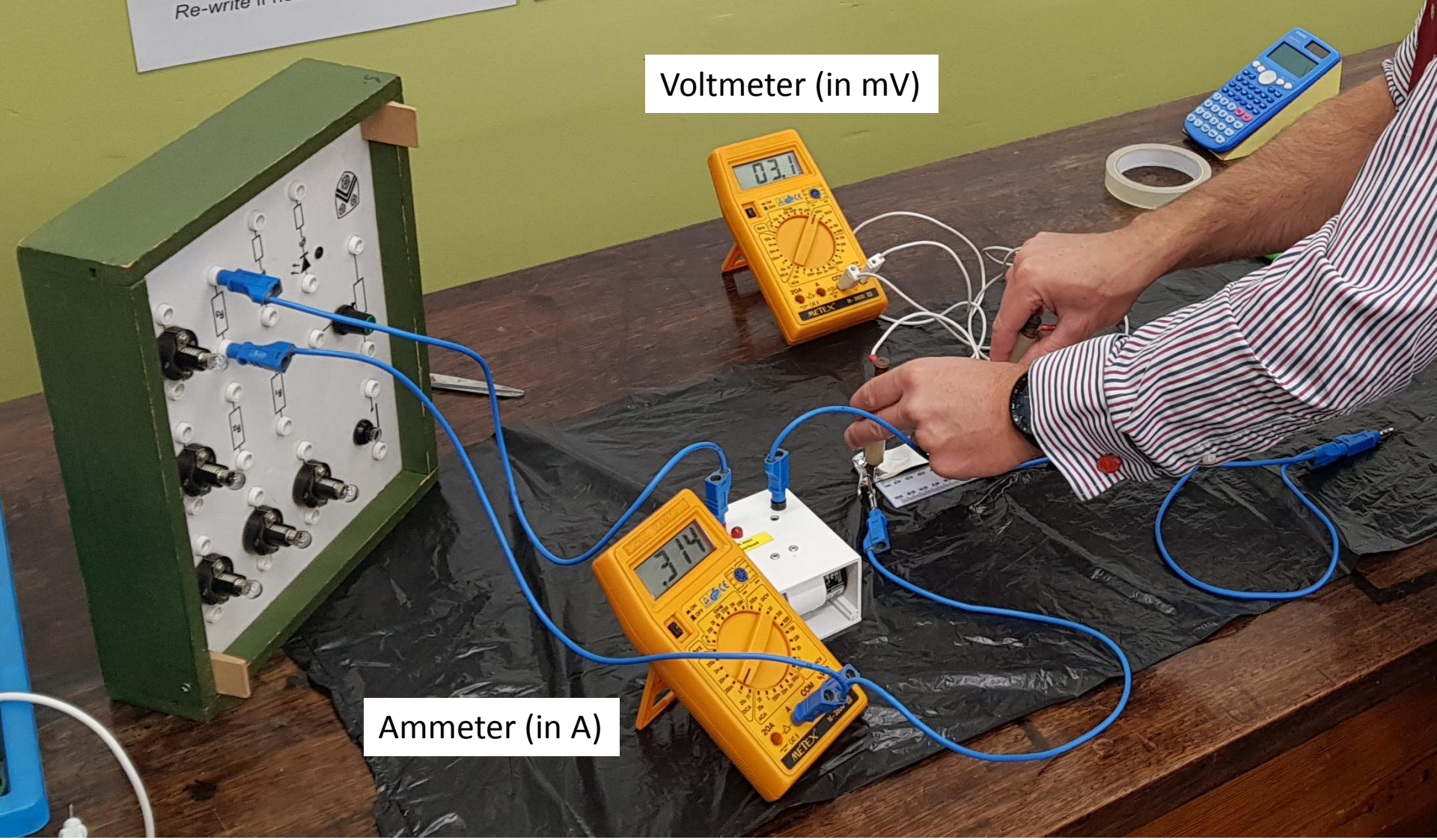

10 to 20 ohm fixed resistor
Pair of electrodes with insulating handles
Aluminium foil strip (draw round a 30cm ruler) and trim carefully using scissors. Have another strip to fold to measure the thickness of the foil.
Voltmeter
Crocodile clips
2V DC cell
Ammeter
Black plastic sack (insulating material)
• Look through your notes and previous questions before attempting new problems
• Give your best effort during toytime and during classes
• Review and annotate your work. Re-write if necessary!

Carefully cut out foil strip from outline of a 30cm ruler. Make sure the width is the same!

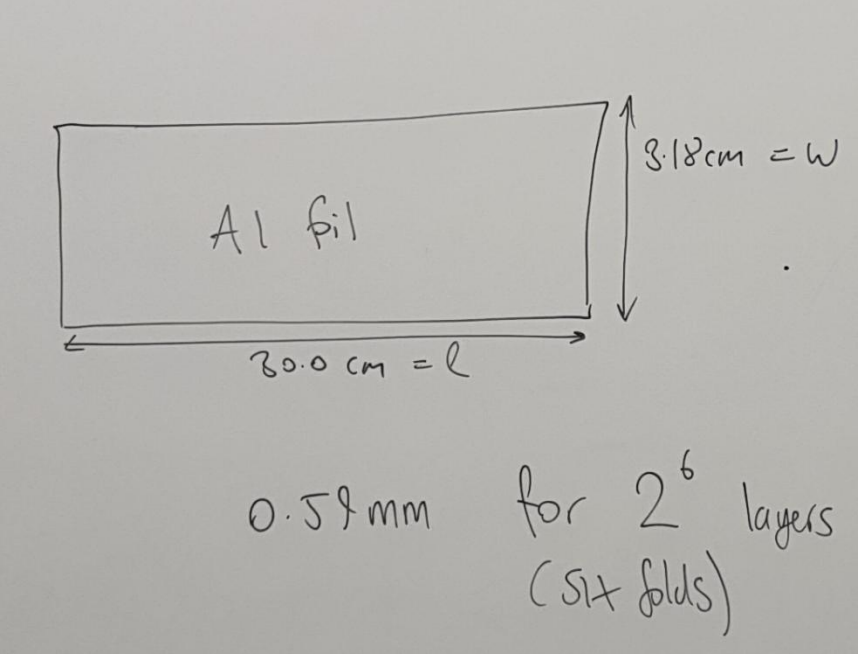
Roll of aluminium foil

Measure length and width of foil strip with a ruler

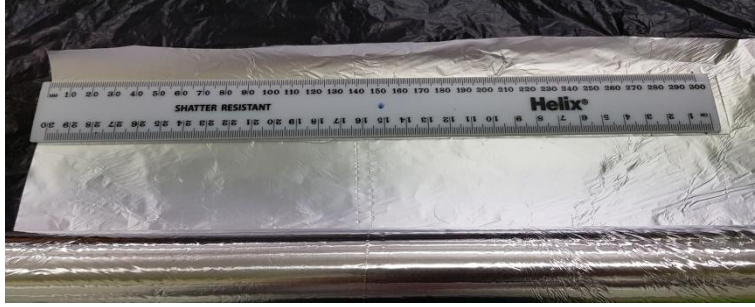
Measure thickness (of 2^6 sheets, i.e. strip folded six times) using a digital calliper



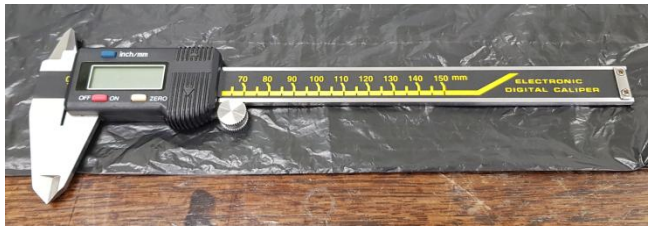
Note contact resistance of crocodile clips is likely to *not be negligible*, so use a *pair* of electrodes rather than one wired to the negative terminal of the cell. Push these electrodes onto the foil at 1cm intervals. Record the voltage for each position. Also use a small (10 to 20 ohm) fixed resistor to prevent dangerously large currents being drawn from the 2V cell



Measure length and width of foil strip with a ruler.



Measure thickness using a digital calliper.

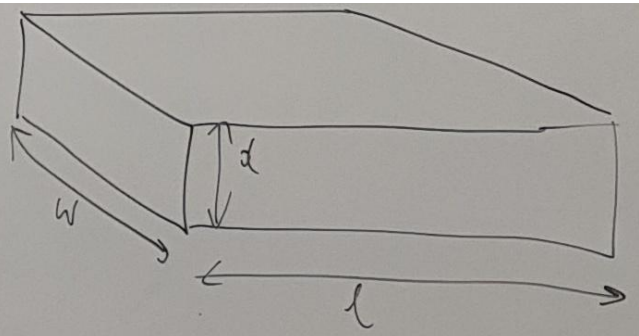


0.59 mm for 2^6 layers (6 folds)

$\therefore$ thickness x

$$x = \frac{0.59 \times 10^{-3}\ m}{2^6}$$

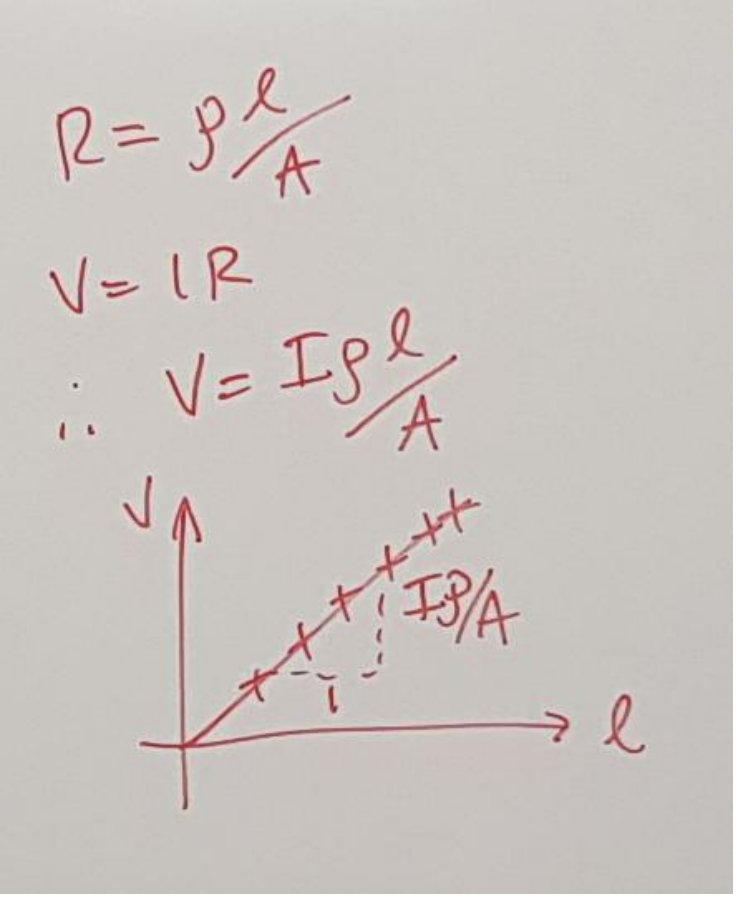
$$\boxed{x = 9.22 \times 10^{-6}\ m}$$



Combine width and thickness to calculate cross sectional area of aluminium strip.

$$\therefore A = 9.22 \times 10^{-6}\ m \times 3.18 \times 10^{-2}\ m$$

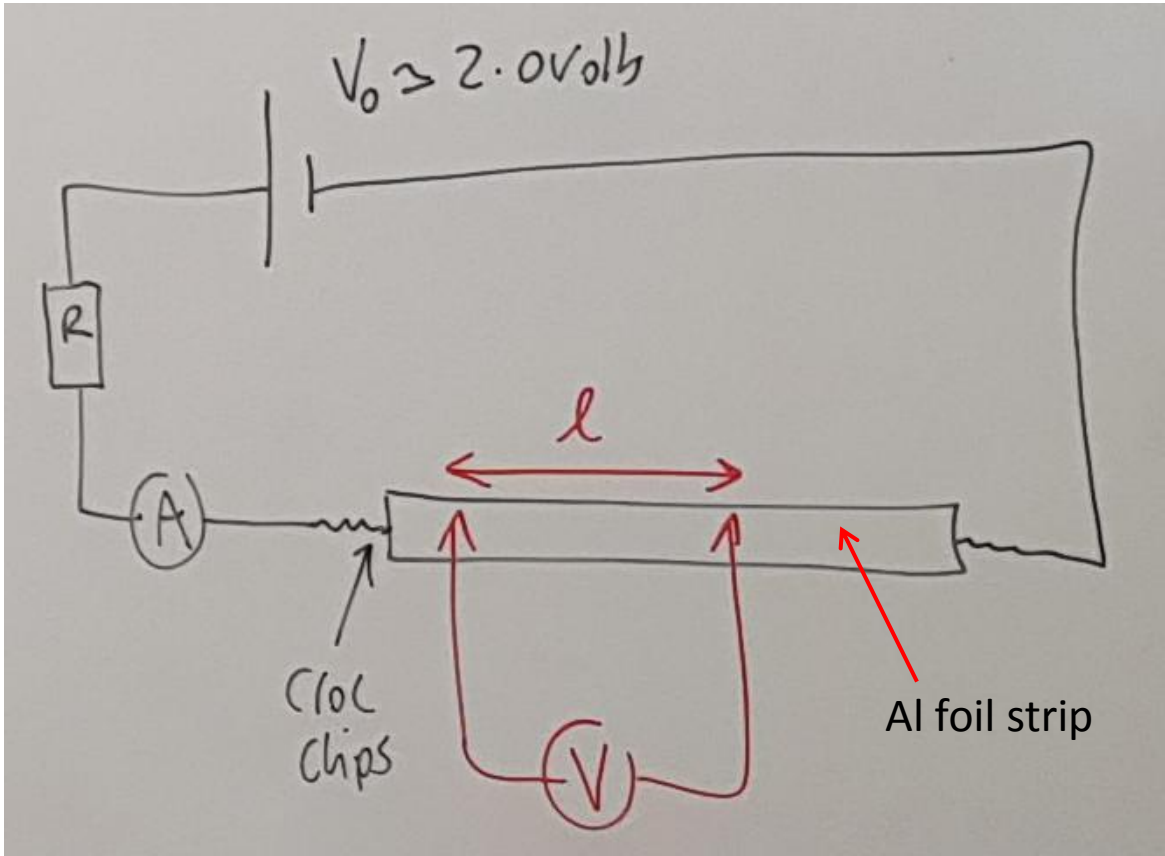
$$= \boxed{2.93 \times 10^{-7}\ m^2}$$



$$\rho = \frac{\text{gradient of graph} \times \text{A}}{I}$$

Calculation of resistivity of aluminium from measurements taken.

Note contact resistance of crocodile clips is likely to *not be negligible*, so use a *pair* of electrodes rather than one wired to the negative terminal of the cell.



RESISTIVITY OF ALUMINIUM

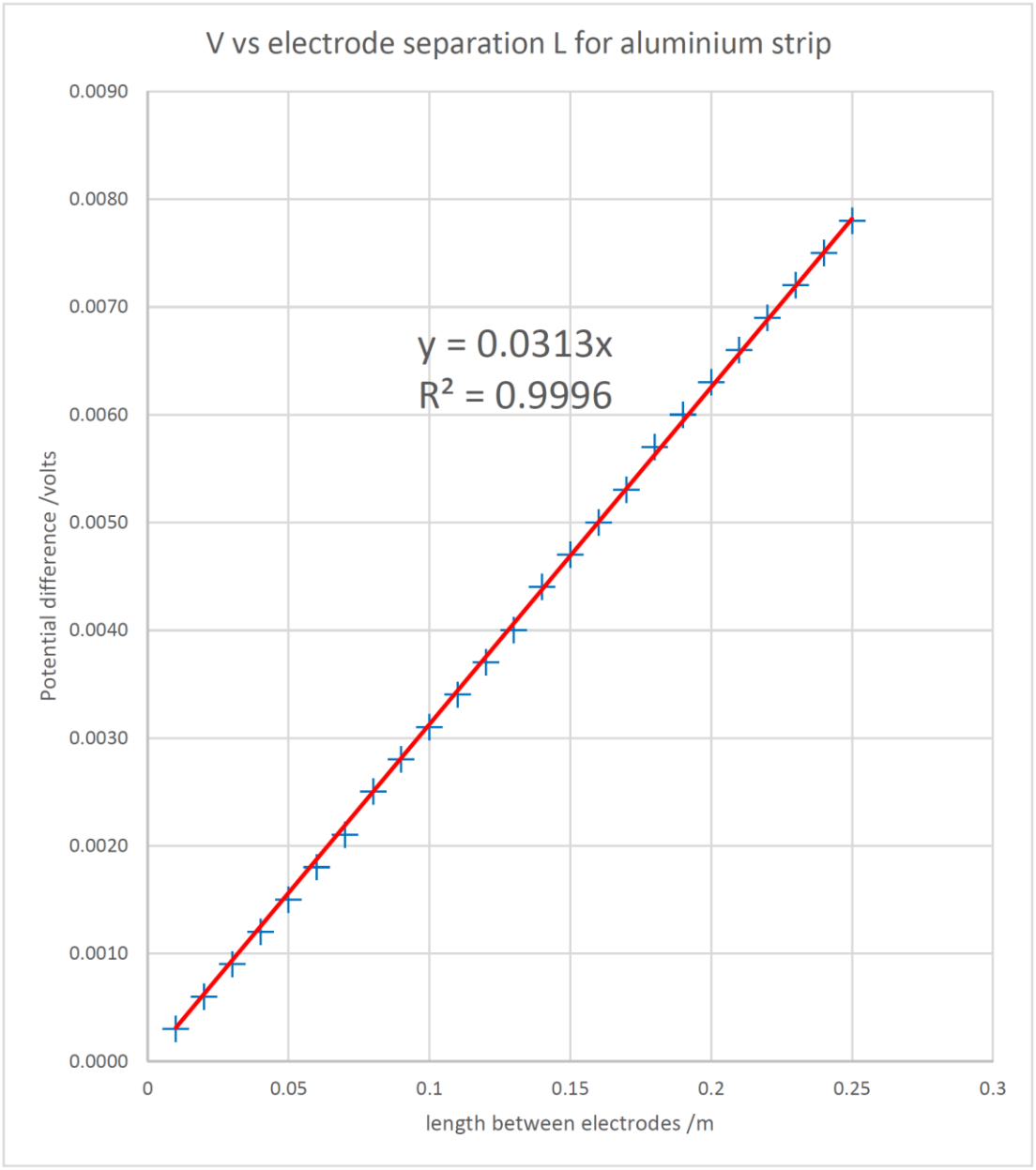
A. French. Wincheter College P5. 20/10/2020

Current I /A 0.314

Aluminium foil strip (measured round a 30cm ruler)

total length /cm	30.00
width /cm	3.18
thickness of six folds /mm	0.59
cross sectional area A /m^2	2.93E-07

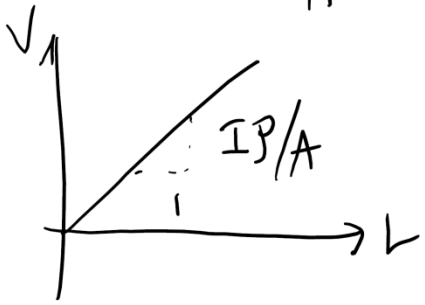
voltage /mV	V /volts	L /cm	L /m
0.3	0.0003	1	0.01
0.6	0.0006	2	0.02
0.9	0.0009	3	0.03
1.2	0.0012	4	0.04
1.5	0.0015	5	0.05
1.8	0.0018	6	0.06
2.1	0.0021	7	0.07
2.5	0.0025	8	0.08
2.8	0.0028	9	0.09
3.1	0.0031	10	0.1
3.4	0.0034	11	0.11
3.7	0.0037	12	0.12
4	0.0040	13	0.13
4.4	0.0044	14	0.14
4.7	0.0047	15	0.15
5	0.0050	16	0.16
5.3	0.0053	17	0.17
5.7	0.0057	18	0.18
6	0.0060	19	0.19
6.3	0.0063	20	0.2
6.6	0.0066	21	0.21
6.9	0.0069	22	0.22
7.2	0.0072	23	0.23
7.5	0.0075	24	0.24
7.8	0.0078	25	0.25



$V = IR$

$R = \rho L / A$

$V = I\rho L / A$



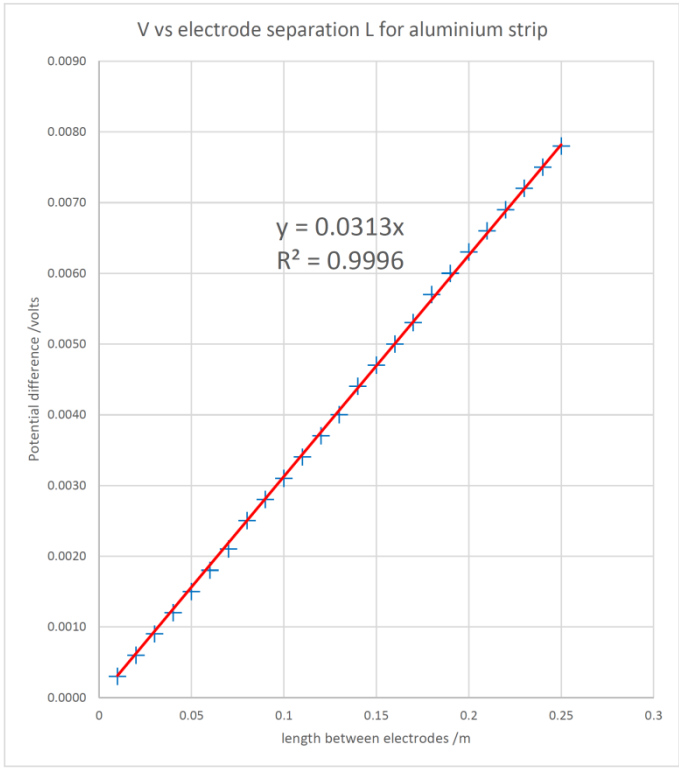
$I\rho/A = 0.0313$

$\therefore \rho = \dfrac{0.0313 \times 2.93 \times 10^{-7}}{0.314}$

$\rho = 2.92 \times 10^{-8}\ \Omega m$

[Pure Aluminium:
$\rho = 2.82 \times 10^{-8}\ \Omega m$]

Note Al foil is an ALLOY



$$\rho = \frac{\text{gradient of graph} \times A}{I}$$