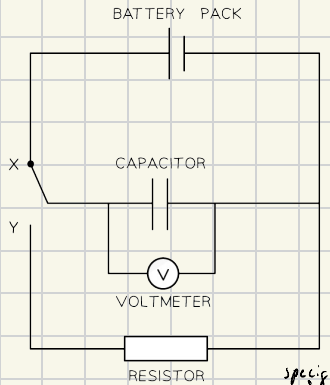
Capacitors: Required Practical

Apparatus	Purpose
Switch	To switch between the charging and discharging circuit
Capacitor	To measure the capacitance
10 kΩ Resistor	To discharge the capacitor
Battery pack (power supply)	To provide the potential difference across the capacitor
Voltmeter	To measure the potential difference across the capacitor
Stopwatch	To measure the time taken for the capacitor to discharge



Resolution:
voltmeter = 0.1V
stopwatch = 0.01s

Variables:
independent = time (t)
dependent = potential difference (V)
control = Resistance of resistor
current of circuit

Discharge

specified
C = 1000 μF
V = 6V
R = 15 kΩ
μ = x10⁻⁶

Potential difference (V)	Time (t/s)				ln(V)
6	0	0	0	0	1.792
5.5	1.72	1.81	1.39	1.31	1.70
5	2.80	2.65	2.70	2.71	1.61
4.5	4.11	4.29	4.31	4.21	1.50
4	5.48	5.36	6.15	6.00	1.39
3.5	8.29	8.30	8.09	8.22	1.25
3	10.21	10.04	10.05	10.31	1.1
2.5	13.60	12.66	13.2	13.09	0.916
2	15.92	16.23	16.94	16.33	0.69
1.5	21.86	20.81	19.65	20.91	0.41
1	26.11	27.05	26.96	26.92	0
	T_1	T_2	T_3	mean	

2dp

Method:

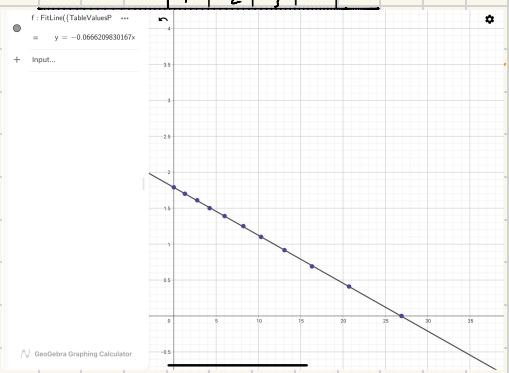
1 Set up the apparatus like the circuit above, making sure the switch is not connected to X or Y (no current should be flowing through)

2 Set the battery pack to a potential difference of 10 V and use a 10 kΩ resistor. The capacitor should initially be fully discharged

3 Charge the capacitor fully by placing the switch at point X. The voltmeter reading should read the same voltage as the battery (10 V)

4 Move the switch to point Y

5 Record the voltage reading every 10 s down to a value of 0 V. A total of 8-10 readings should be taken



$g \sim -0.0666$

equation:

$I = I_0 e^{-(t/RC)}$

$\frac{I}{I_0} = e^{-(t/RC)}$

$\ln\left(\frac{I}{I_0}\right) = -\frac{t}{RC}$

$\ln(I) - \ln(I_0) = -\frac{t}{RC}$

gradient $= -\frac{1}{RC}$

capacitance $(C) = \frac{1}{R \times \text{gradient}}$

errors:

systematic:
- digital voltmeter — unit 0.01 on a value.
- parallax error — with ammeter

Random:
- Resistor with large resistance so slow discharge

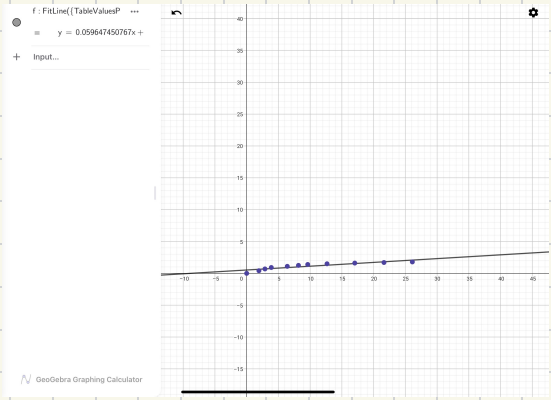
Safty:
- don't use a too Low Resistor
- don't touch while charged
- make sure no fluid touches electronics

$\frac{1}{0.0659} \times 15000 = C = 1 \times 10^{-3}\ F = 1021\ \mu F$

$\frac{21}{1000} = 2.1\%$ uncertainty

charge

V	time
1	0
1.5	1.93
2	2.44
2.5	3.88
3	6.4
3.5	8.16
4	9.62
4.5	12.66
5	17.01
5.5	21.6.3
6	26.10



$$\frac{1}{0.06 \times 15000} =$$

$$= 1.01 \times 10^{-3} \text{ F} = 1011 \mu\text{F}$$

$\frac{1}{1000} = 1.1\%$ uncertainty

The practical went incredibly well with my accuracy below 5%.

to further my experiments accuracy I would use a stop watch with more accurate readings for more accurate time readings. as the uncertainty stems from parallax error and my reaction speed when starting/stopping the stop watch.