OBJECTIVE 2

DETERMINATION OF HYDRAULIC COEFFICIENTS FOR CIRCULAR ORIFICE [EXPERIMENTALLY]

MATERIALS REQUIRED:

- Supply tank with orifice
- Measuring tank
- Circular orifice plate
- Measuring scale
- Water supply with motor
- Stopwatch
- Needle setup (for jet trajectory tracing)

THEORY :

When water flows through an orifice, it form a jet whose properties deviate from ideal theoretical behavior due to contraction, friction & turbulence.

The following three coefficients quantify these deviations:

→ **Coefficient of Contraction (C_c):**

- ratio of area of jet at vena contracta to the area of orifice.

i.e., $C_c = \dfrac{A_{vc}}{A_0}$

→ **Coefficient of velocity (C_v):**

- ratio of actual velocity of jet to theoretical velocity

i.e., $C_v = \dfrac{V_{actual}}{V_{th}}$

→ **Coefficient of Discharge (C_d):**

ratio of actual discharge to theoretical discharge.

$$C_d = \frac{Q_{act}}{Q_{th}} = C_c \times C_v$$

Also,

$$V_{th} = \sqrt{2gH}$$

$$Q = A \times V = \frac{\text{Volume}}{\text{time}}$$

$$A_0 = \frac{\pi d^2}{4}$$

PROCEDURE:

1) ~~Fill~~ the supply tank was filled with water using pump until a desired steady head (H) is maintained above the orifice centre.
2) ~~Measure~~ the head of water above the orifice centre was measured.
3) Allow the water flow through orifice & collect the discharged water in measuring tank for known time using a stopwatch
4) The volume of collected water was measured
5) The jet trajectory was traced to measure horizontal distance (x) and vertical distance (y).
6) Finally, the hydraulic coefficients were measured.

OBSERVATION & CALCULATION:

Head of water $(H) = 21.5\ cm$

$x = 22.2\ cm$

$y = 6\ cm$

Area of orifice $(A_o) = \dfrac{\pi \times 1^2}{4} = 0.785\ cm^2$

$$V_{th} = \sqrt{2gH}$$

$$= \sqrt{2 * 981 * 21.5}$$

$$= 205.38\ cm/s$$

$x = Vt \quad ; \quad t = \dfrac{x}{V}$

$y = \dfrac{1}{2} g t^2$

$$= \frac{1}{2} * g * \frac{x^2}{V^2}$$

$$\Rightarrow V^2 = \frac{1}{2} * \cancel{9.81}\ 981 \times \frac{(22.2)^2}{6}$$

$$\Rightarrow V = 200.72\ cm/s$$

$\therefore$ Coefficient of velocity $(C_v) = \dfrac{V}{V_{th}} = \dfrac{200.72}{205.38} = 0.98$

For C_d:

Area of measuring tank $(A) = 1200\ cm^2$

Time $(t) = 30\ s$

$h_1 = 4.1 cm$

$h_2 = 7.1 cm$

$h = 3 cm$

$\therefore$ Volume of water collected $= 1200 \times 3 = 3600\ cm^3$

So Actual discharge $(Q_{act}) = \frac{3600}{30} = 120\ cm^3/s$

$Q_{th} = 0.785 * V_{th} = 0.785 * 205.38 = 161.22\ cm^3/s$

Hence, $C_d = \frac{Q_{act}}{Q_{th}} = \frac{120}{161.22} = 0.74$

Finally, $C_c = \frac{C_d}{C_v} = \cancel{\frac{0.98}{0.74}}\ \frac{0.74}{0.98} = 0.75$

RESULT:

→ coefficient of discharge $(C_d) = 0.74$

→ coefficient of velocity $(C_v) = 0.98$

→ coefficient of contraction $(C_c) = 0.75$

PRECAUTIONS:

→ Maintain constant head during the experiment.

→ stopwatch reading should be accurate.

→ Take multiple reading to minimize human/instrumental error.

→ Avoid splashes or spillage while collecting water in measuring tank.

OBJECTIVE | 1 | MEASUREMENT OF VOLTAGE AND CURRENT IN DC CIRCUIT

EQUIPMENT REQUIRED |:

DC Power supply
Multimeter
Bread board
Resistor
Connecting wires

THEORY |:

According to Ohm's law, current (I) flowing through a resistor is directly proportional to voltage across it,

i.e.,
$$I \propto V$$
$$\Rightarrow I = \frac{1}{R} V \quad ; \quad \frac{1}{R} \text{ is proportionality constant, R being resistance}$$
$$\Rightarrow V = IR$$

In a simple DC circuit consisting of a resistor connected to a voltage source, we can measure:

→ Voltage (V): across the resistor terminals using a multimeter in voltmeter mode {connected in parallel}

→ Current (I): through the resistor using a multimeter in ammeter mode (connected in series).

This experiment demonstrates the fundamental use of a multimeter to measure these parameters in a real DC circuit.

OBSERVATION :

Table 1:

Voltage (V)	Resistance (R)	Current ($I = V/R$)
5V	1kΩ	4.95mA
9V	1kΩ	8.9mA

RESULT :

→ The voltage & current in a DC circuit were successfully measured using a multimeter

→ The experimental values were found consistent with the theoretical calculations.

PRECAUTIONS :

1) Always connect the ammeter in series & voltmeter in parallel
2) Double check the polarity before connecting to avoid damaging components.
3) Switch off the power supply while making connections.
4) Ensure the multimeter is properly set to voltage or current mode before measuring.

OBJECTIVE 2 VERIFICATION OF KRICHOFF'S VOLTAGE & CURRENT LAW

INSTRUMENTS REQUIRED :

- DC Power supply
- Multimeter
- Bread board
- Resistors
- Connecting wires

THEORY :

KRICHOFF'S CURRENT LAW (KCL)

Statement : At any node in an electrical circuit, the sum of currents entering the node is equal to the sum of current leaving the node.
This is based on conservation of charge.

i.e., $\sum I_{in} = \sum I_{out}$

Krichoff's Voltage law (KVL)

In any closed loop of an electrical circuit, the algebraic sum of all voltages is zero.
This is based on conservation of energy.

i.e., $\sum V_{source} - \sum V_{drop} = 0$

or, $\sum V = 0$

Multimeter is used to measure voltage or current across the loads.

OBSERVATION :

For KCL :

Voltage = 5V (constant)

Current (I) = 56 mA

Current through R_1 (I_1) = 49.9 mA

Current through R_2 (I_2) = 4.2 mA

Current through R_3 (I_3) = 2.1 mA

Verification :

$$I_1 + I_2 + I_3 = 49.9 + 4.2 + 2.1$$
$$= 56.2 \approx 56$$
$$= I \quad \#$$

For KVL :

Source voltage = 9V

Voltage drop through (R_1) = 3.1V

Voltage drop through (R_2) = 2.2V

Voltage drop through (R_3) = 3.9V

Verification:

$$\Sigma V_{source} - \Sigma V_{drop} = 0$$
$$\Rightarrow 9 - (3.1 + 2.2 + 3.9) = 0$$
$$\Rightarrow 0.2 \approx 0 \quad \#$$

RESULTS :

→ Krichoff's current law (KCL) was verified at the node.

→ Krichoff's voltage law (KVL) was verified in the loop.

PRECAUTIONS :

(i) Ensure all connections are tight and correct before powering the circuit.

(ii) Connect ammeter in series & voltmeter in parallel.

(iii) Switch off the power supply before modifying the circuit.

OBJECTIVE | 3 |:

VERIFICATION OF OHM's LAW

EQUIPMENTS REQUIRED:

- DC Power supply
- Multimeter
- Resistor
- Breadboard
- Connecting wires

THEORY:

Ohm's law states that the current (I) flowing through a conductor is directly proportional to the voltage (V) across two points, provided the temperature & other physical conditions remain same.

i.e., $I \propto V$

$$\Rightarrow I = \frac{1}{R} V$$

$$\Rightarrow V = IR \quad ; \; R = \text{resistance of conductor.}$$

~~but~~

A graph plotted between voltage & current should be a straight line or linear, confirming the Ohm's law.

OBSERVATION TABLE:

V	I	R = V/I
0.17	0.15	1.133
0.35	0.30	1.167
0.66	0.57	1.157
1.12	0.96	1.167
1.73	1.47	1.176
2.27	1.93	1.176
3.07	2.60	1.180
3.56	3.01	1.182
4.50	3.83	1.174
5.09	4.33	1.175

RESULT :

The experiment confirms that the current increases linearly with voltage, keeping resistance constant (approximately).
Hence, Ohm's law is verified.

PRECAUTIONS :

(i) Connect the multimeter correctly for current & voltage measurements
(ii) Take multiple readings for more accurate results.
(iii) ~~Ensu~~ Ensure all connections are tight and secure before switching on the power.
(iv) Keep the temperature & other physical conditions constant.

plot graph yorself guys!!

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OBJECTIVE-4

MEASUREMENT OF AMPLITUDE, FREQUENCY, TIME PERIOD, Average and RMS VALUE USING OSCILLOSCOPE

EQUIPMENTS USED:

- Oscilloscope
- Function generator
- Connecting probes
- Power supply (AC)

THEORY:

A cathode ray Oscilloscope is a powerful electronic test instrument used to observe varying signal voltages. It displays the waveform of electrical signals and enables measurement of various parameters.

Amplitude(A): ~~~~ maximum vertical deflection of waveform (volts)

Time period (T): Time taken to complete one full cycle of waveform.

Frequency (f): The number of cycles per second.

$$f = \frac{1}{T}$$

Average value (V_{avg}) = For a full sine wave, average value over a period is zero.
So, over a half cycle

$$V_{avg} = \frac{2}{\pi} A$$

RMS value (V_{rms}) = Root mean square value of sinusoidal waveform

$$V_{rms} = \frac{A}{\sqrt{2}}$$

These values can be measured directly from the waveform displayed on CRO screen by counting divisions & multiplying by the scale (volts/div or time/div)

OBSERVATION & CALCULATION

Amplitude = 2 divisions × 1 V/div

= 2 Volts

Time period(T) = 3.4 divisions × 0.1 ms/div

~~= 2.942 × 10~~

$= 0.34 \times 10^{-3}$ s

Frequency (f) $= \frac{1}{T} = \frac{1}{0.34 \times 10^{-3}} = 2.942$ KHz

$V_{Average} = \frac{2}{\pi} \times 2 = 1.27$ V

$V_{rms} = \frac{2}{\sqrt{2}} = 1.41$ V

Frequency of wave generated in function generator = 2.56 KHz

difference in frequency of wave observed in CRO & wave generated in function generator = 2.942 − 2.56

= 0.382 KHz

This shows that CRO is very sensitive instrument.

RESULT:

→ The amplitude, time period, frequency, Average & RMS values of the input sine wave ~~are~~ were measured using oscilloscope.

PRECAUTION:

(i) set appropriate volt/div and time/div settings to avoid distorted waveforms.

(ii) Always calibrate the oscilloscope before taking readings.

(iii) Take readings only after waveform is stable.

(iv) Handle probe connections carefully to prevent ~~loss~~ loose contact.

OBJECTIVE 5

TO STUDY V-I CHARACTERISTICS OF A PN-JUNCTION DIODE IN FORWARD BIAS CONDITION

APPARATUS REQUIRED:

PN JUNCTION Diode characteristic Apparatus
Variable DC Power supply
connecting probes

THEORY:

A PN-junction diode allows current to pass in only one direction which is called forward biasing of the diode. In reverse bias, it offers high resistance & negligible current.

In forward bias condition, P-side of diode is connected to positive terminal & current increases exponentially after threshold voltage (~0.3 V for Ge).

The V-I graph is non-linear.

OBSERVATION Table:

Volt division	V (volt)	I (mA)
0	0	0
1	0.05	0
2	0.1	0
3	0.15	0
5	0.25	0.2
6	0.30	0.4
7	0.35	1
10	0.5	1
12	0.6	1.4
15	0.75	1.8
20	1	2.8
25	1.25	3.8
30	1.5	4.8
40	2	6.8
50	2.5	8.8
57	2.85	10
60	3	~

3V - dC

60 divisions → 3V
1 div → $\frac{1}{20}$ V

mA - current

50 divisions → 10 mA
1 div → $\frac{1}{5}$ mA

RESULT :

→ The forward bias characteristics of PN junction diode shows a non linear rise in current after the threshold voltage ($\sim 0.3V$).

~~PREA~~ PRECAUTIONS

→ Ensure all connections are tight & correct.
→ Ensure there is correct polarity in the circuit components.
→ Avoid parallex error while observing the value.