10

LAB REPORT FOR EXPERIMENT 4

Date: ----------

Name:----

Partner's Name

Registration No:---

Registration No:---

Physics Section:---

Instructor's Name:---

PHYSICS LAB EXPERIMENT 4: POWER TRANSFER

I. PURPOSE

to find the condition under which maximum power is transferred to the load resistance that connected across a power source.

II. DATA AND DATA ANALYSIS:

1. Use the equation **P = VI to calculate P_L** the power dissipated by the load resistor R_L and enter the calculated values in Table (4.1) below:

Table 4.1

$R_s = 100\ \Omega$				
Reading	R_L (Ω)	I_L (mA)	V_L (V)	P_L (mW)
1	20	54	0.8	43.2
2	40	46	1.5	69
3	60	40	2	80
4	80	36	2.2	79.2
5	100	31	2.8	86.8
6	200	21	3.7	77.7
7	400	12	4.4	52.8
8	600	10	4.7	47
9	800	8	4.9	39.2

2. **Plot** on a graph paper the power $\mathbf{P_L}$ as dependent variable **versus** the load resistor $\mathbf{R_L}$. Find the value of the load resistor for which the power dissipated is **maximum**. How is this value related to the series resistance $\mathbf{R_s}$.

$R_L = 100$ and $R_L = R_s$

3. For what value of the load resistance $\mathbf{R_L}$ was:

1) The load current a maximum? 20 Ω

2) The load voltage a maximum ? 800 Ω

4. Using the expression for $\mathbf{P_L}$ **power dissipated in the load resistance** as a function of the load resistance $\mathbf{R_L}$, determine the condition for the **maximum** power (differentiate P_L with respect to R_L and set $\frac{dp_L}{dR_L} = 0$)

$P_L = I^2 R = \frac{V^2}{(R_L+R_s)^2} \cdot R_L$

$I = \frac{V}{R}$ $\frac{dP}{dR_L} = \frac{V^2 R_L + V^2 (R_L+R_s) - V^2 (R_L+R_s)^2}{(R_L+R_s)^4} = 0$

$(R_s+R_L) V^2 = 2 R_L V^2 (R_s+R_L)$

$R_s + R_L = 2R_L$ $\boxed{R_s = R_L}$

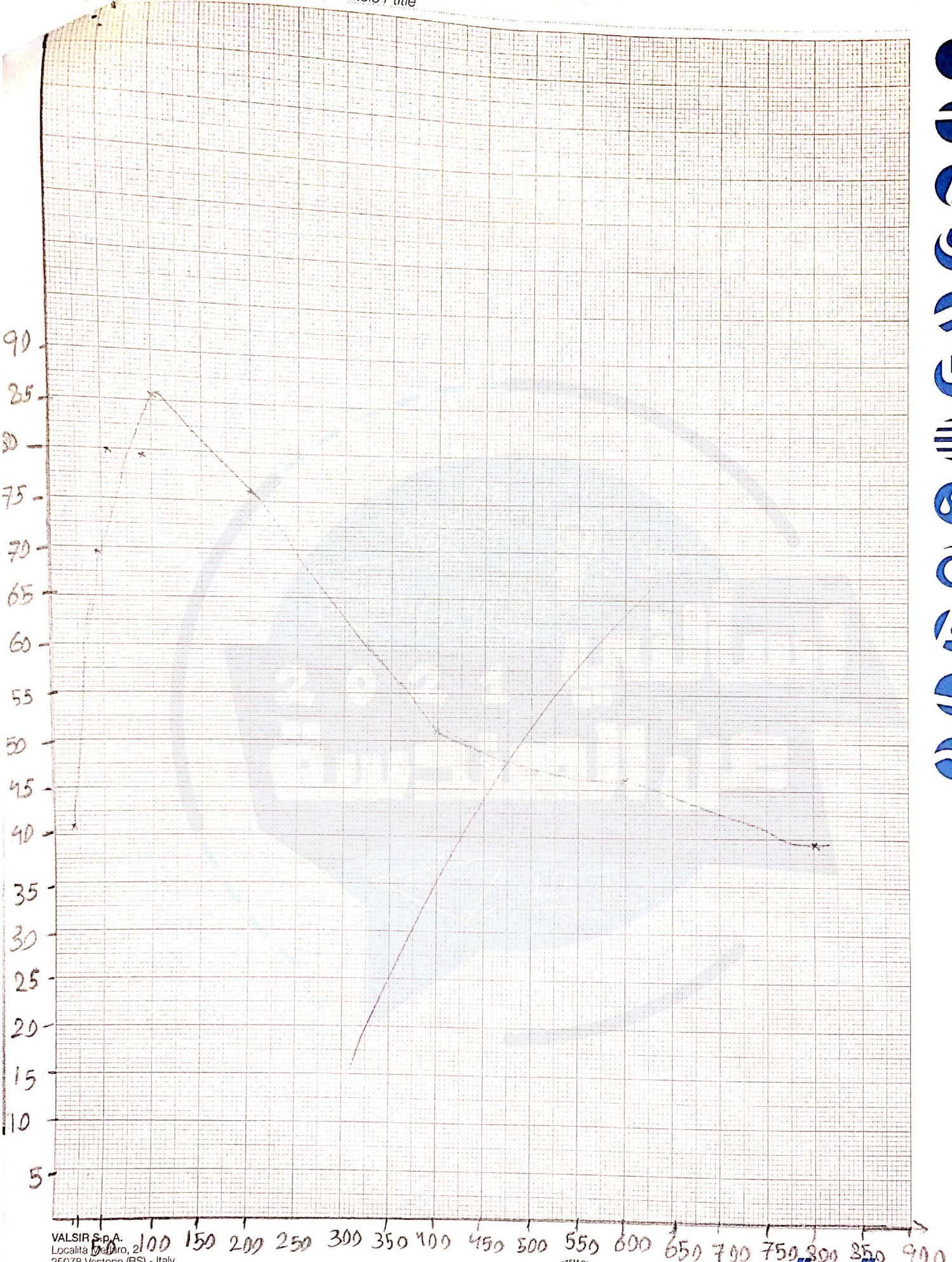
5- Compare the value of R_L at maximum power found in (2) with that found in (4) above.

the same result

6- If the internal resistance, $\mathbf{R_s}$, is larger than the load resistance R_L, which resistance will dissipate more power?

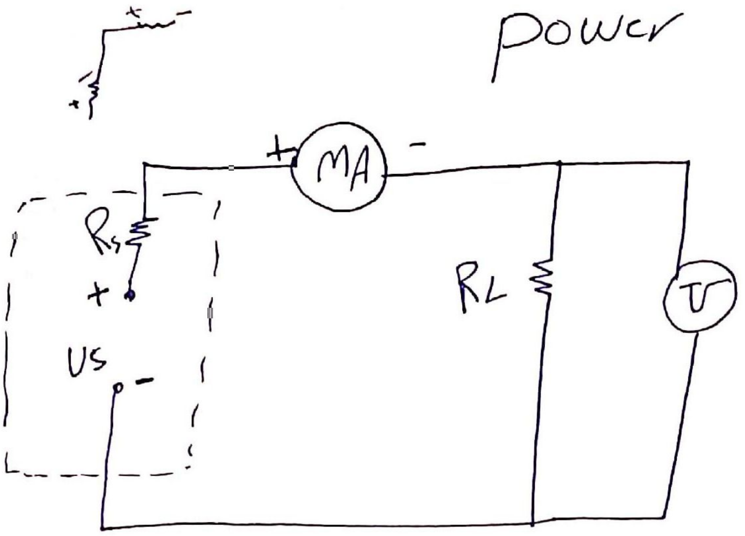
$R_s > R_L$ $P_s = I^2 R_s$, $P_L = I^2 R_L$ (the same current)

R_s will dissipate more power.



VALSIR S.p.A.
Località Dellaro, 2
25078 Vestone (BS) - Italy
Tel. +39 0365 877.011
Fax +39 0365 81.268
P.IVA 00700170988
e-mail: valsir@valsir.it
www.valsir.it

power transfer



- موجودة صورة التوصيلة ع العتوبه -

Power desipated in Load Resistance → بدي أحسب

$P = IV$

$R_L (\Omega)$	$I_L (mA)$ من خلال الأميتر	$V_L (V)$ من خلال فولتميتر	$P_L (mW)$

| $R_L = R_s$ | max. power ※ When $R_{source} = R_L$ |

- عندي أي R_L power

- الجزء العملي ※

الادوات :

power supplay / resistance box مدرج من 20-1000 / ال source resistance القطعة الشفافة هي

Ameter / Voltmeter

1] بوصّل + ال power supplay مع ال source resistance

2] بعدها سالب ال source resistance مع موجب RL ← مش مهم فيها أقطاب أصلا

3] موجب ال (A) مع القطب الاخر من RL

4] سالب ال (A) مع ال - ال power supplay

5] بوصل - ال Voltmeter مع السلك لكي واصل مع الأميتر مع الموجب فوقه وال + مع ال اللي واصل مع RL "فوقه"

لاشتقاق P_{max} ← مطلوب #

$$P_L = I_L U_L$$

$$= I_L (I_L R_L)$$

$$= I_L^2 R_L$$

$$I_L = \frac{U_s}{R_L + R_s}$$

$$P_L = \left(\frac{U_s}{R_L + R_s}\right)^2 R_L$$

To find at what value of R_L P_L is max

$$\frac{dP_L}{dR_L} = 0$$

$$\frac{dP_L}{dR_L} = \frac{-U_s^2 (2(R_L + R_s))}{(R_L + R_s)^4}$$

$$-U_s^2 2(R_L + R_s) = 0$$

$$R_L + R_s = 0$$

$$R_L = R_s \quad \#$$

$$\frac{dP_L}{dR_L} = \frac{U^2 (R_L (2(R_L + R_s)) - U^2 (R_L + R_s)^2}{(R_L + R_s)^4} = 0$$

$$U^2 R_L (2(R_L + R_s)) = U^2 (R_L + R_s)^2$$

$$2R_L = R_L + R_s$$

$$\therefore R_L = R_s \quad \#$$

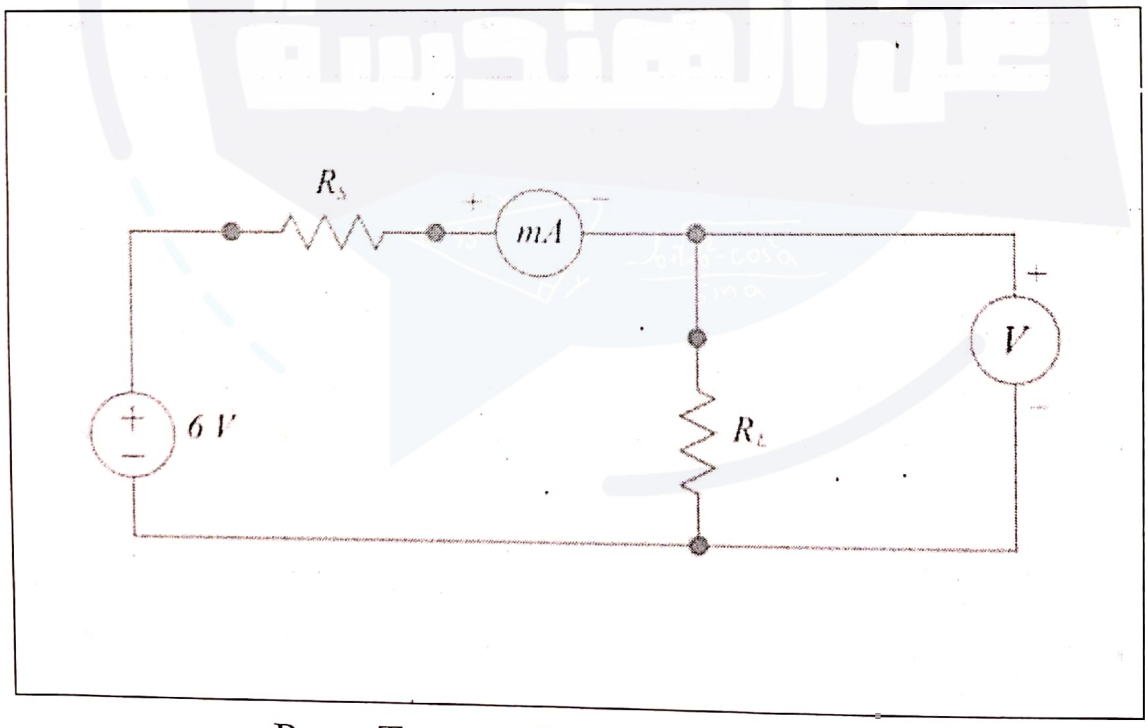
EXPERIMENT 4
POWER TRANSFER

- The Power P is defined as the rate at which energy is delivered to the resistor.
(تم تعريف القدرة الكهربائية على أنها معدل انتقال أو مرور الطاقة خلال المقاومة الكهربائية)

$$P = I\,\Delta V$$
$$And\ Since\ \Delta V = I\,R$$
$$P = I^2\,R = (\Delta V)^2 / R$$

- SI units of Power are *Watts* (W):
  - 1 W= 1 A × 1 V
  - Therefore, 1 mW = 1 mA × 1 V

- In the **Power Transfer** experiment, we will investigate the circuit requirements (Conditions) for the transfer of **Maximum Power, P_{MAX},** from the power source to the load resistance in a DC circuit.



POWER TRANSFER CIRCUIT CONFIGURATION

- The configuration of this circuit is based on two resistors connected in series.
- These resistors are the Load resistor R_L (الحمل أو العبئ على الدائرة) and the Internal resistor R_S (المقاومة الداخلية لمصدر فرق الجهد أو البطارية).
- Since the power supply is made of matter, there is a resistance to the flow of charge within the power supply (battery). This resistance is termed the Internal resistance R_S.
- The Load resistance or the External Resistance, mostly called the Load Resistance R_L. This R_L might be some electrical device such as a toaster, electric heater, or even a light bulb connected to the power supply.
- The MilliAmmeter will measure the Current flowing throw the Load Resistor R_L which is the same current that passes also through the Internal resistor R_S (Series Combination).
- The Voltmeter will measure the Voltage across the Load Resistor R_L Only.
- In today's experiment, we want to:
  - **Build up simple electric ciruit** using different **circuit elements** including:
    - **Electric wires** (considered as perfect conductors eventhough they tend to heat up during the experiment, hence, their power dessipation is gnored).
    - **Power Supply** to supply an electric power to the electrical load or ciruit.
    - **Two** different **Resistors:**
      - External or Load resistance $\boldsymbol{R_L}$: Resistance Box (30 – 1000 Ω).
      - Internal resistance $\boldsymbol{R_S}$: (110 Ω).
    - **Voltmeter** (0 – 6 V) to register the potential drop across the load resistance, which is connected in parallel to the load resistance.
    - **Milli Ammeter** (0 – 100 mA) to register the current passing through the ciruit, which is usually connected in series with the resistances.
  - **Calculate** the power delevired to the load resistance in this circuit configuration.
  - Plot P_L versus R_L and answer the questions as requested in the report.