EXPERIMENT 1: CAPACITOR

Course Learning Outcome:
Solve problems of electric current, **electronics**, magnetism, optics, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will able to explain the experiment to
i. determine the time constant of an RC circuit.
ii. determine the capacitance of a capacitor using an RC circuit

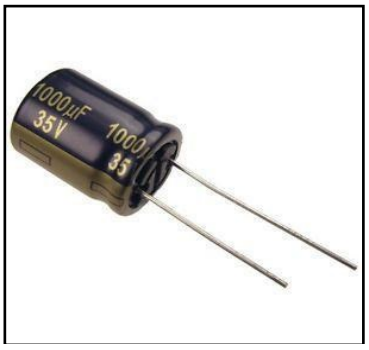
Student Learning Time:

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. Figure below shows a capacitor.



   a. What is the function of capacitor?

   ……..

   b. What is meant by 1000 μF?

   ……

2. *'Time constant, τ is a measurement of how fast the capacitor charges or discharges'.*

   a. What is meant by time constant for current during discharging process?

   ……

   ...…….

   b. What is the relationship between time constant, τ, resistance, R and capacitance, C.

   ……

3. During charging and discharging process what is the different in terms of their time constant.

   ……

Experiment

4. Sketch and label the circuit diagram of the experiment?

5. From this experiment, identify

a. the manipulated variable,

…….

b. the responding variable

…….

6. During the experiment, why we need to short circuit the capacitor when measure time t of discharging process?

…….

7. Which circuit combination will discharge faster? Explain your answer.

…….

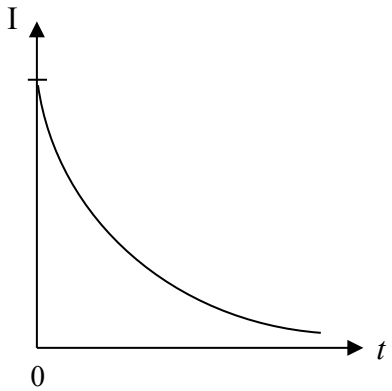
Data Analysis

8. Two capacitors, C_1 and C_2 can be connected either in series or parallel. Write the formula of effective capacitance for both combinations.

Series :

Parallel :

9. The graph shows the current, *I* versus time, *t* for discharging capacitors.



a. How to determine time constant, τ from the graph.

b. What is the physical meaning of I when t = 0.

...…….

c. For the capacitance in parallel combination C_1 and C_2, how do we determine the capacitance, C_2.

10. Why micro ammeter is used instead of ammeter in the experiment?
……

11. Why large resistance is used in the experiment?
……

EXPERIMENT 2: OHM'S LAW

Course Learning Outcome:
Solve problems of **electric current**, electronics, magnetism, optics, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will able to explain the experiment to:
i. verify Ohm's Law.
ii. determine effective resistance of resistors in series and parallel by graphing method

Student Learning Time:

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. Define Ohm's Law

   ……

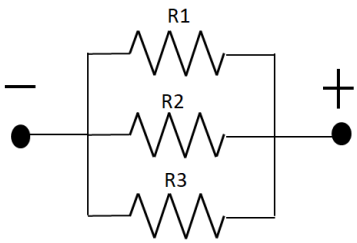
   ……

2. Sketch the Graph of Voltage against current for an Ohmic's conductor at a constant temperature T (K).

3. What is the quantity which represent the gradient of the Graph 1 Above

   ……

4. Name the configuration for the following resistors arrangement

Configuration A	Configuration B
 Figure 1	 Figure 2

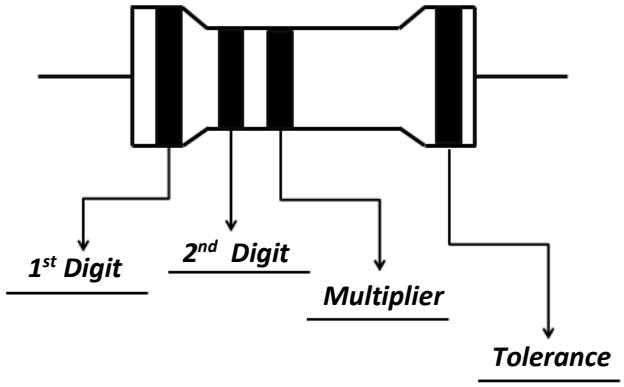
5. If each of the resistors has a resistance of 27 Ω, determine the effective resistance for

   i. Configuration A : ……

   ii. Configuration B : ……

6. What does each of the band on the resistor represent and determine the resistance for each of the resistor.

4 Band Resistor

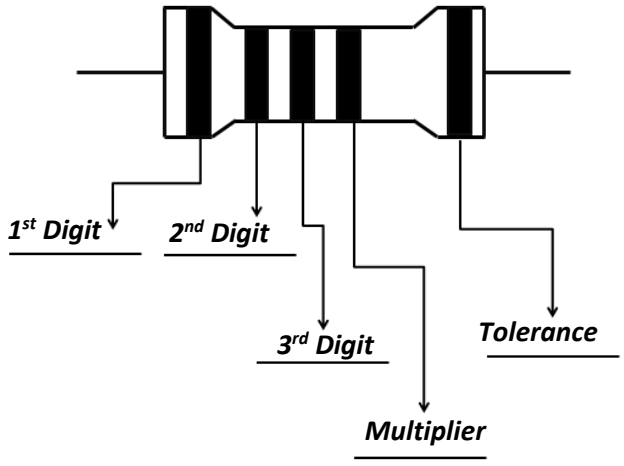


a. Determine the resistance of the resistor if

1st band : …….
2nd band : …….
Multiplier : …….
Tolerance : …….

Resistance : …….

5 band Resistor



b. Determine the resistance of the resistor if

1st band : …….
2nd band : …….
3rd band : …….
Multiplier : …….
Tolerance : …….

Resistance: …….

7. What does the tolerance band of the resistor tells you?

……

……

Experiment

8. What is the used of the miliammeter/ammeter and voltmeter in the circuit and how they are connected with the resistors?
   Miliammeter/Ammeter: ……
   Voltmeter: ……

9. In the step three of the experimental procedure, you were asked to find the minimum current and voltage in the circuit, explain the relevant of this particular step.
   ……

10. In the experiment, milliammeter is used to measure current in a series circuit and ammeter is used for the parallel circuit. Explain.
    ……
    ……
    ……

11. Explain why only voltmeter is provided instead of milivoltmeter in the experiment to measure the voltage.
    ……
    ……

12. How do you determine the sensitivity of the measuring instruments (Voltmeter/Miliammeter/Ammeter).
    ……

Data Analysis

13. The equation use to plot the graph is
    $$V = IR$$
    Sort the quantities from the equation according to its component below

Component	Quantity
Y-Axis	
X-axis	
m, gradient	
c ,Y-Intercept	

14. What is the unit for the gradient
    ……

15. Which of the graph is expected to have a bigger gradient, the series or the parallel circuit? Explain your answer.

    ……

    ……

    ……

EXPERIMENT 3: POTENTIOMETER

Course Learning Outcome:
Solve problems of electric current, **electronics**, magnetism, optics, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will able to explain the experiment to determine internal resistance, r of a dry cell by using potentiometer.

Student Learning Time:

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. What is the function of galvanometer?

   ……

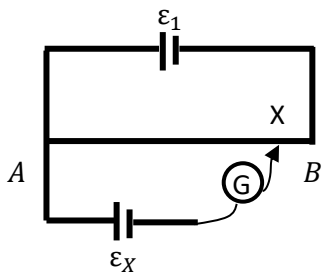
2. Explain the working principle of potentiometer

   ……

   ……

   ……

   ……



3. State 2 uses of potentiometer.

   i. ……

   ii. ……

4. What is the relation between resistance and length of wire?

   ……

5. State the SI unit and symbol for internal resistance and emf.

   ……

6. In a circuit as shown in the **FIGURE 1**, cell E_1 has emf of 2.0 V and internal resistance, which can be neglect. The length of the potentiometer wire AB is 100 cm and when switch S is open, the balance length AX is 75 cm. When switch S is closed, the balance length AX is 60 cm. What is the internal resistance of E_2?

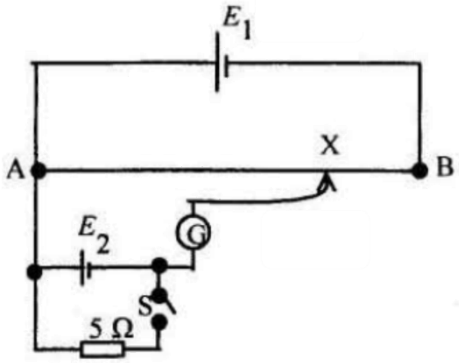


FIGURE 1

Experiment

7. State:

   a. Manipulative variable : …….

   b. Responding variable : …….

   c. Constant variable : …….

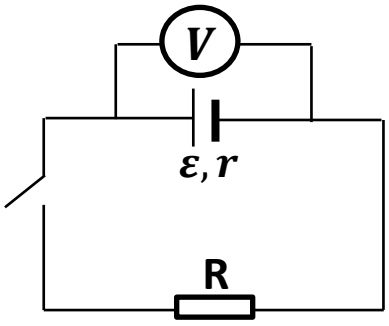
8. Predict what happen if you change polarity of the dry cell?

   ……

9. Why the jockey should not be drag on the wire, instead the jockey should be pointed carefully?

   ……

10. Given the circuit diagram below, discuss the reading of the voltmeter when the switch is OPEN and CLOSED.



*Where V is voltmeter, $\boldsymbol{\varepsilon}$ is emf, R is resistor and r is internal resistant.

Switch Open – ……

Switch Closed - ……..

Data Analysis

11. The internal resistance can be determine by using the following equation:

$$\frac{l_0}{l} = r\left(\frac{1}{R}\right) + 1$$

The equation given is the straight-line graph that satisfy y = mx + c.

a. Sketch an appropriate graph of $\frac{l_0}{l}$ against $\frac{1}{R}$.

b. What does the gradient of the graph represent?

...……

c. In your opinion, how do we find the uncertainty of internal resistance, Δr?

...……

12. List down **THREE** precautions of the experiment:

i. …….

ii. …….

iii. …….

EXPERIMENT 4: MAGNETIC FIELD

Course Learning Outcome:
Solve problems of electric current, electronics, **magnetism**, optics, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will able to explain the experiment to determine the value of the horizontal component of the earth's magnetic field, B_E.

Student Learning Time:

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. What is the meaning of magnetic field?

   ……

2. What is the symbol and SI unit for magnetic field?

   ……

3. What is the magnitude of the earth's magnetic field and it's important in daily life?

   ……

   ……

4. What are other sources of magnetic field?

   ……

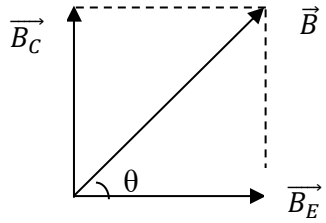
5. Without the current in the solenoid, the compass needle is pointed to north direction. Why the needle is deflected from the north when there is current in the solenoid?

   ……

   ……

   ……

6. From the diagram



   a. state the relation between B_E and B_C in term of θ

   ...……

   b. Since $B_c = \frac{\mu_o NI}{D}$, derive tan θ in terms of B_E and I

Experiment

7. State the:
   i. Manipulative variable : ……
   ii. Responding variable : ……
   iii. Constant variable : ……

8. What is the relation between magnetic field strength of a coil (B_C) and number of turns (N) in the coil?

   ...……...……

9. How do we set up a solenoid with the rheostat, the ammeter, the power supply and the switch in the lab?

   ...……...……

10. What is the function of decreasing the resistance of the rheostat?

    ...……...…

Data Analysis

11. An equation for a straight line graph (linear graph) is y = mx + c, where y is the quantity on the vertical axis and y is the quantity on the horizontal axis as shown in **FIGURE 1**.

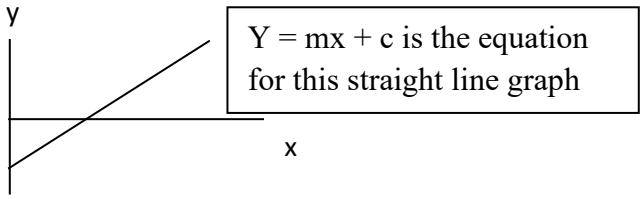


FIGURE 1

a. What is the meaning of m and c on the straight line equation y = mx + c?

m = ……

c = ……

b. The angle of a deflection (θ) is related to its electric current (I) by the following equation :

$$\tan\theta = \frac{\mu_0 N}{D\,(B_E)} I \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where B_e is the earth magnetic field.

i. How do we transform equation (1) so that we can plot a straight line graph relating this variable angle (θ) and electric current (I) ? (i.e. How do we linearize equation (1) ?)

ii. How do we determine the value of B_e from this graph ?

12. State TWO precautions for this experiment:

i. …….

ii. …….

EXPERIMENT 5: GEOMETRICAL OPTICS

Course Learning Outcome:
Solve problems of electric current, electronics, magnetism, **optics**, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will able to explain the experiment to determine the focal length of a convex lens.

Student Learning Time:

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. What is a convex lens and how is it used in daily life?

   ...……...…

   ...……...…

2. Write the thin lens equation and define each symbols

3. Complete the table for each sign convention

Quantities	Positive (+ve)	Negative (-ve)
Object distance, u		
Image distance, v		
Focal length, f		

4. An object is placed far away (**u>2f**) from the convex lens.
   i. Sketch the ray diagram

ii. State three characteristic of image formed

...

...

...

5. An object is placed 4 cm from a convex lens with focal length of 6 cm.

i. Calculate the distance of the image

ii. Calculate the magnification of the image

iii. State the characteristic of the image formed and justify your answer

...

Experiment

6. State the:
   i. Manipulative variable : ……
   ii. Responding variable : ……
   iii. Constant variable : ……
   iv. Operational definition : ……

7. State the hypothesis of this experiment.

...

8. What is the focal length, f and its relation to the thickness of the lens?

….....

9. How do we set up the convex lens to get the estimation of its focal length?

….....

….....

….....

10. How do we calculate the percentage difference between the value ***f*** experiment and ***f*** standard? .Take ***f*** standard = 10 cm

Data analysis

11. The focal length of a convex lens (***f***) is related to its ***v*** and ***u*** also the magnification by the following equation:

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \qquad \text{.....(1)}$$

$$M = -\frac{v}{u} \qquad \text{.....(2)}$$

    a. Rearrange equations (1) and (2) so that we can plot a straight line graph relating the variable ***M*** and ***v***

    b. How do we determine the value of ***f*** from this graph?

    c. Determine the focal length from the graph when M=-1?

12. Sketch the expected graph and state the physical quantities that can be obtain from the gradient, m

13. State THREE precautions for this experiment
    i. ...
    ii. ...
    iii. ...

EXPERIMENT 6: DIFFRACTION GRATING

Course Learning Outcomes:
Solve problems of electric current, electronics, magnetism, **optics**, quantization of light, wave properties of particles and nuclear physics.
(C4, PLO 4, CTPS 3, MQF LOD 6)

Learning Outcomes:
At the end of this lesson, students will be able to explain the experiment to:
i. Determine the wavelength of laser beam using a diffraction grating.
ii. Determine the number of diffraction grating lines per unit length.

Face-to-face	Non face-to-face
1 hour	1 hour

Direction: Read over the lab manual and then answer the following question.

Introduction

1. What is diffraction grating?

   ...……...…….

2. State one function of a diffraction grating.

   ...……...…….

3. Can diffraction be produce with white light or only with monochromatic light? Justify your answer.

   ...……...…….
   ...……...…….
   ...……...…….

4. Make a sketch of the diffraction pattern that you expect to see on an observation screen behind the diffraction grating.

5. If the distance between two consecutive lines of the diffraction grating is $6.71 \times 10^{-6} m$ determine the number of slits

   $\text{Given } d = 6.71 \times 10^{-6} m$

   a. per millimeter of the grating

   b. per meter of the grating

Experiment

6. State the:
   i. Manipulative variable : ……
   ii. Responding variable : ……
   iii. Constant variable : ……
   iv. Operational definition : ……

7. State the hypothesis of this experiment

   …….

8. Why it is important that the laser ray is pointed perpendicular to the diffraction grating in procedure (1)? Explain your answer.

   …….

   …….

9. Suggest the best way to measure the length of each respective order of diffraction pattern on the observation screen in procedure (2)

   …….

10.

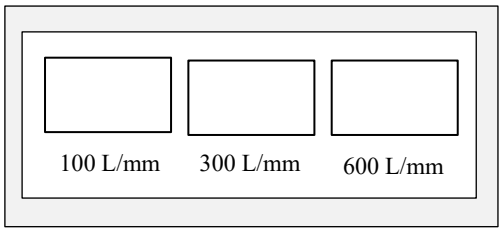


Figure 1: Diffraction Grating

State the meaning of 300 L/mm on diffraction grating in Figure 1 above.

…….

Data Analysis

11. From the operational definition, state the unit of $\sin\theta_n$. Justify your answer by deducing the unit of $\sin\theta_n$ in given equation.

12. A straight line graph (linear graph) was plotted in order to calculate the wavelength of laser beam, λ as shown in Figure 1.

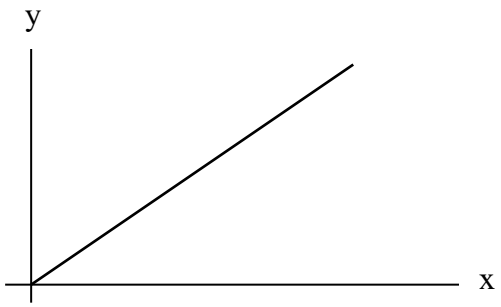


Figure 2: Straight line graph

i. State the representation for the y-axis, and x-axis of the graph for this experiment.

…….

ii. How do you determine the wavelength of laser beam, λ from this graph?

……

……

……

13. How to determine the number of lines per mm, N of grating B from the second graph by using the wavelength of laser beam, λ from the first graph (to fulfill objective (ii))

From the gradient, m:

14. List THREE precaution steps taken during this experiment.

    …….

    …….

    …….