# CHAPTER 5 CONCLUSION

In this study, the as-prepared glass samples in the composition of $(100\text{-}x)B_2O_3 : x$PbO with $x$ = 30, 40, 50, 60 and 70 wt% were prepared. The high purity starting chemicals used in the preparation were PbO (UNILAB, 99.99%) and $H_3BO_3$ (UNIVAR, 99.99 %). The chemical powder batches about 30 g were melt at 1100 °C by placing them in an electrical furnace for an hour. After complete melting, the homogenized molten glass was casted in preheated stainless-steel mold. The quenched glasses were annealed at 500 °C for 3 hours to reduce the thermal stress and were then cooled to room temperature. At the last process, the prepared glass samples were cut and finely polished to a dimension of 1.0cm x 2.0cm x 0.3cm for further studies. The physical, optical, and gamma ray-shielding properties of PbO-$B_2O_3$ glass system have been studied. From the entire analysis, the following observation is made.

## 5.1 Density and Molar Volume

The determined density of lead borate glass samples for different PbO concentrations incresed with higher PbO content. The result indicates that replacing $B_2O_3$ by addition of some amount of PbO results in the increase of the average molecular weight of oxide ions in the glass due to PbO has a higher relative molecular weight than that of $B_2O_3$.

Based on the measured density, when the PbO content less than 40 wt%, the entered PbO may act as a network former, so molar volume of glass decreased. Beyond 40 wt%, interactomic spacing increased due to more ionic bond are created and generated more NBOs in borate network due to PbO act as modifier. Then molar volume were increased.

## 5.2 UV-Visible Absorption Study

From UV-Visible absorption spectra, the position of cutoff wavelength of these glasses shifted toward longer wavelength which corresponding to color of the glasses as the content of PbO increase.

## 5.3 Optical Band Gap and Refractive Index

From the band theory view, the addition of PbO concentration in all glass samples results in the slightly decreased in the optical band gap and shifted the absorption edge to the longer wavelength. The refractive index has been estimated on the basis of optical band gap. It is established that there is a general trend of decreasing of optical band gap with increasing refractive index when the $Pb^{2+}$ cation plays the role of network modifier will appear.

## 5.4 Optical Basicity

In this section, The obtained optical basicity values are increased with higher PbO concentration for all glass samples indicates the increasing of negative charges on the oxygen atoms thus, increasing covalency force in the cation-oxygen bonding. This relation shows that the increase of optical basicity means the higher ability of oxide ions to transfer electrons to the surrounding cations.

## 5.5 Gamma-Rays Shielding Properties

Gamma-ray shielding properties at 662 keV of lead borate glasses have been studied theoretical and experimental. The experimental values of mass attenuation coefficient show good agreement with the theoretical values, which evaluated from WinXCom software. All interested shielding parameters; mass attenuation coefficients, effective atomic number and effective electron density were found to increase with increasing of PbO concentration. From WinXCom calculation, the behavior of total mass attenuation is increased due to increasing the photoelectric absorption.

In addition, the comparison of shielding properties with some standard radiation shielding concretes in term of half value layer has been investigated. The results found that the glasses in this work were better radiation shielding materials in term of their volume required for shield design and with advantage of being transparent to visible light.