**NATIONAL UNIVESITY OF SCIENCE AND TECHNOLOGY**

**APPLIED PHYSICS DEPARTMENT**

**SPH 1203– THERMAL PHYSICS**

**BSc HONOURS APPLIED PHYSICS: PART I:**

**MAY 2013 DURATION: 3HOURS**

ANSWER ALL PARTS OF QUESTION ONE IN SECTION A AND ANY THREE QUESTIONS FROM SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS.

*SHOW ALL YOUR STEPS CLEARLY IN ANY*

**SECTION A**

*1. (a) (i) Explain, briefly the differences between:*

*Heat Conduction and Heat Convection. Define the quantities involved in*

*the laws of each. [6]*

*(ii) State Stefan Boltzmann Law defining the quantities involved. [4]*

*(b) A gas with an initial volume of 0.30 exerts a pressure*

*At this pressure, it expands to a final volume of . Find the work done by the gas. [6]*

*(c) A liquid is irregularly stirred in a well-insulated container and thereby*

*undergoes a rise in temperature. If we regard the liquid as the system*

1. *Has heat been transferred?*
2. *Has work been done?*

*(ii) What is the sign of ? [6]*

*(d) Show that [4]*

*(e) Show that in an adiabatic process this equation holds T where A is a constant. [4]*

*(f) (i) Given that an hydrostatic system has the thermodynamic coordinates P, V, T show by defining the thermodynamic quantities involved that:*

*. where have their usual meaning. [6]*

***SECTION B***

*2. (a) Explain the first law of thermodynamics [4]*

*(b ) (i) Draw a schematic diagram of an elementary refrigirator showing*

*the role of each section in the cycle. [6]*

*(ii) Show the cycle in a p – V diagram that includes arrows that*

*indicate the direction of the process and that of the heat flow. [6]*

1. *From (ii) derive an expression for the efficiency of the cycle. [4]*

*3. (a) Make a comparison of a reversible and an irreversible processes. [4]*

*(b) Show that the efficiency of a thermal engine operating according to a reversible Carnot cycle is independent of the working substance and depends only on the two*

*temperatures. [10]*

*(c) Compare the efficiency of the Carnot cycle to that of the Stirling cycle. [6]*

4 a) Show that is the equation of state for an adiabatic transformation of an ideal gas if A is a constant. [6]

b) For the same final volume, show that a gas which experiences an adiabatic expansion has a final pressure, which is less than if the expansion is isothermal. [10]

c) Explain what you have just shown in b). [4]

5. (a) If Maxwell’s distribution of speeds of molecules is given as:

1. Find an expression for the most probable speed of the molecules [4]
2. From this distribution show how you would compute the of the molecules. [6]
3. Express as a function of pressure and density of the molecules of an ideal gas. [10]

6. (a) State at least four ways in which a substance may be stimulated to emit electromagnetic radiation [4]

(b) Define the following: Blackbody and temperature gradient. [4]

(c) Write down an expression for the heat transferred by radiation between two bodies of differing temperatures [6]

(d) Write down the fundamental Law of Heat Conduction defining all the quantities involved. [6]

**END OF EXAMINATION**