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**University Examinations 2016/2017**

THIRD YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE PHYSICS AND BACHELOR OF EDUCATION SCIENCE (PHYSICS / MATHS)

**SPH 3302: THERMAL PHYSICS II**

**DATE: December, 2016 TIME: HOURS**

**INSTRUCTIONS:** *Answer questions* ***one*** *and any other* ***two*** *questions.*

**QUESTION ONE - (30 MARKS)**

1. (i) Define a heat engine. (1Mark)

(ii) A refrigerator transfers heat at the rate of 300 Watts from a food chamber at $-10^{°}C$ to $30^{°}C$. Assuming no other heat losses calculate the average power consumed by the refrigerator. (3 Marks)

1. (i) Differentiate between Gibb’s free energy and enthalpy. (2 Marks)

(ii) State the second law of thermodynamics interms of entropy. (1 Mark)

1. A gas is expanded isothermally so that the volume doubles. Calculate its change in entropy given that the universal gas constant R= 8.31 Joules/mole/k. (3 Marks)
2. (i) What is Joule –Thomson effect in gases? (1 Mark)

(ii) A gas has an inversion temperature of 148.5K. Calculate its critical temperature.

(3 Marks)

1. Briefly explain the carnot cycle. (4 Marks)
2. An isobaric process occurs in such a way that the volume of a gas increases from 240$cm^{3}$to 960$cm^{3}$. If the gas has specific heat capacity at constant pressure of 11.31J/mol/k. Calculate the entropy change. (3 Marks)
3. Given that the change in internal energy of a gas under isothermal condition is;



Show that for an ideal gas the internal energy is independent of its volume. (5 Marks)

1. State any two applications of Maxwel’s thermodynamic equations. (2 Marks)

**QUESTION TWO (20 MARKS)**

1. Calculate the change in entropy when 10g of ice at $-20℃$ is converted to steam at 100$℃$(specific heat capacity of ice = 3000J/kg/k latch heat of fusion of ice = 3.36 x $10^{5}$J/kg; specific heat capacity of water = 4200J/kg/k) (10 Marks)
2. The Gibb’s free energy is given by;

G= H – Ts while enthalpy H = U + PV. Derive the Maxwell’s equation;

  (10 Marks)

**QUESTION THREE (20 MARKS)**

1. A refrigerator is working between temperatures of 3$℃$ and 33$℃$ . If the energy supply has a power of 300 Watts. How long will it take to cool 1kg of water from 50$℃$ to $10℃$.

 (9 Marks)

1. Calculate the change in enthalpy when 2 moles of a gas are compressed isothermally from 1 to 20 atmospheres, given that the J-T coefficient $μ=1.08$ and $C\_{p }=\frac{36J}{mol}/k$(5 Marks)
2. Draw the carnot cycle and briefly explain the processes. (6 Marks)

**QUESTION FOUR (20 MARKS)**

1. Show that the efficiency of a carnot engine from the carnot cycle is given by;

 (10 Marks)

Identify all the processes and variables used.

1. In a diesel engine temperatures before ignition is 915K and after ignition its 2040K. The adiabatic expansion ratio of the engine is 12.5. Given that $r=1.39.$ Find the efficiency of the engine.
2. The compression ratio of a petrol engine is 4. Calculate its efficiency. (4 Marks)

$$r=1.4$$