NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE (MAJOR AND MINOR)	
QUALIFICATION CODE: 07BOSC	**LEVEL:** 6
COURSE CODE: TPH601S	**COURSE NAME:** THERMAL PHYSICS
SESSION: JUNE 2019	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION PAPER	
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MODERATOR:	DR. SYLVANUS ONJEFU

INSTRUCTIONS	
1.	Write all your answers in the answer booklet provided.
2.	Read the whole question before answering.
3.	Begin each question on a new page.

PERMISSIBLE MATERIALS

Non-programmable Scientific Calculator

THIS EXAMINATION QUESTION PAPER CONSISTS OF 6 PAGES

(INCLUDING THIS FRONT PAGE)

QUESTION 1 **[30]**

Choose the correct answer. Each question weighs two (2) marks

1.1 The real or imaginary surface or border that separates the system and environment. (2)

A. The system
B. Boundary
C. Internal energy
D. Surrounding

1.2 When a gas expands adiabatically, (2)

A. negative work is done by the gas.
B. temperature decreases
C. there is change in internal energy of the gas.
D. the temperature of the gas increases.

1.3 In a cyclic process involving an ideal gas, _____ (2)

A. the net entropy of the gas is zero.
B. no heat is added to the system.
C. no heat transfer between the system and surrounding.
D. the net work done is always positive.

1.4 During an isothermal compression of a thermodynamic system, _____ (2)

A. the work done by the system is negative.
B. heat is added to the system.
C. temperature decreases.
D. the internal energy of the gas is constant.

1.5 The process by which volume of an ideal gas container is expanded at a constant temperature is called _____. (2)

A. isothermal expansion
B. isothermal expansion
C. thermal equilibrium
D. mechanical equilibrium

1.6 A process occurring in an isolated system so that the system cannot be taken back to its initial state is known to be a(n) _____. (2)

A. irreversible process and entropy increases
B. reversible process and entropy increases
C. entropic process and entropy decreases
D. adiabatic process and entropy is constant

1.7 During the Carnot cycle, heat is absorbed at a high temperature into the system by; (2)

A. environment
B. working substance
C. water only
D. thermal reservoir

1.8 Heat required to convert a substance from one form into another is considered to be; (2)

A. latent heat
B. heat of fusion
C. heat of vaporization
D. thermal energy

1.9 The useful energy that remains as a result of heat extracted by an engine from the surrounding per cycle is known as _____. (2)

A. kinetic energy
B. mechanical energy
C. internal energy
D. work

1.10 The energy required to create a system after the spontaneous energy transfer from the environment has taken place is known as _____. (2)

A. Gibbs free energy
B. Helmholtz free energy
C. Enthalpy
D. Internal energy

1.11 The quantitative measure of a level of disorder in a system is known; (2)

A. isobaric
B. entropy
C. air conditioners
D. enthalpy

1.12 The engine with the largest possible efficiency uses a _____. (2)

A. Brayton cycle.
B. Joule cycle.
C. Carnot cycle.
D. Otto cycle.

1.13 Suppose you are an astronaut in space hard at work in your sealed spacesuit. The only way that you can transfer excess heat to the environment is by (2)

A. conduction
B. radiation
C. convection
D. both B and C

1.14 A skinny-dipper who is standing on Walvis Bay beach (3.0°C) has a skin temperature of 28.0°C and a surface area of 1.8 m^2. What is her net rate of radiative heat loss if her surface emissivity is 0.9 (in W)? (2)

A. 233
B. 322
C. 244
D. 332

1.15 An athlete loses 7 J of energy via heat loss during strenuous activity. The athlete consumes enough food during the activity to keep the average internal energy and temperature constant. If the athlete's work efficiency is 28%, what is their energy intake? (2)

A. 7.92 J
B. 9.72 J
C. 8.94 J
D. 5.04 J

QUESTION 2 **[20]**

2.1 State the 1st law of thermodynamics (2)

2.2 Complete the table by filling in the correct information. Write down the correct answer and the corresponding answer according to the first law the thermodynamics. (5)

Process	Restriction	Outcomes
Closed cycle	***(i)***.....	***(ii)***.....
Free Expansion	***(iii)***.....	$\Delta U = 0$
(iv).....	$Q = 0$	***(v)***.....

2.3 Study the following *p-V* diagram in figure 1 and answer the questions below.

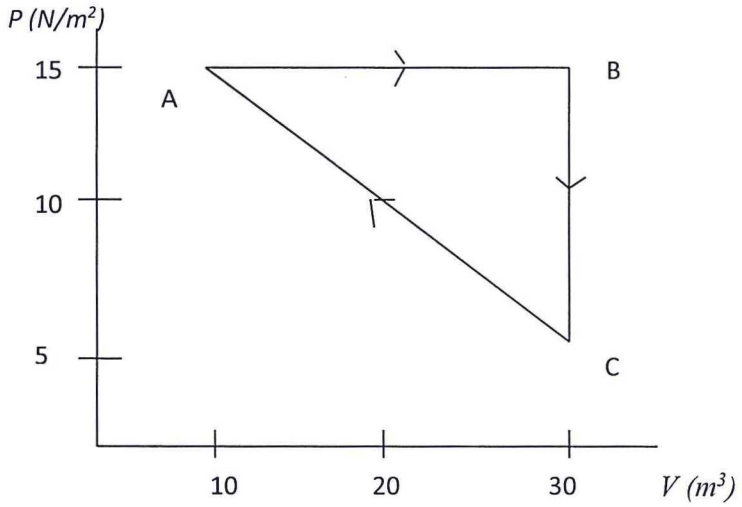

Figure 1

Calculate:

(a) Work done through process A to B (W_{AB}) (3)
(b) work done through the process B to C (W_{BC}): (3)
(c) internal energy U_{AB}, if 120 J of energy as heat enters the system. (3)
(d) the net work done by the system. (4)

QUESTION 3 **[20]**

3.1 On a brisk autumn day (25.0°C) the tires of a car were inflated to a pressure of 2.90×10^5 Pa. The tire gauge reads 1.9×10^5 Pa, but this is the excess above atmospheric pressure, which is about 1.00×10^5 Pa. Assuming that the tires and air inside are in equilibrium with the outside air, what is the temperature of the air inside on the Kelvin scale? (2)

3.2 Calculate the amount of heat needed to raise the temperature of 50.0 kg of lead ($c = 1.28 \times 10^{-2}$ J/kg.K) from 4.7 °C to 93.0 °C. (3)

3.3 At 22.7 °C, a brass cube has an edge length of 300 mm. What is the increase in the cube's surface area when it is heated from 22.7 °C to 81.0 °C? The coefficient of linear expansion for brass is given by $\alpha = 19.00 \times 10^{-6}$/°C. (3)

3.4 Draw a **temperature-entropy diagram** of a Carnot Cycle and explain all states (on a *T-S* diagram) including the entropy, temperature, heat transfer. (12)

QUESTION 4 **[20]**

4.1 Show that $C_P - C_V = R$ (8)

4.2 Ten litres of an isolated ideal gas expands into a vacuum of equivalent volume.

Show that the internal energy and hence the temperature of the gas remains constant. (5)

4. 3 Derive thermodynamic Maxwell equation based on Gibb's Free Energy. (7)

QUESTION 5 **[10]**

5.1 Evaluate using enthalpy definition only; (10)

(i) The specific heat capacity of a gas assuming pressure and volume are not constant.

END OF EXAM!!!!!