

2nd SEM.2012/2013



**UNIVERSITY OF SWAZILAND
MAIN EXAMINATION PAPER**

PROGRAMME: BSC ABE (4)

COURSE CODE: ABE 406

TITLE OF PAPER: CROP PROCESSING AND STORAGE

TIME ALLOWED: TWO (2) HOURS

**SPECIAL MATERIAL REQUIRED: CALCULATOR &
PSYCHROMETRIC CHART**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER
QUESTIONS.**

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN
GRANTED BY THE CHIEF INVIGILATOR**

SECTION ONE: COMPULSORY

QUESTION ONE

- (a) (a) Define refrigeration (3 Marks)
- (b) **Figure 1** is a sketch of a Vapour Compression Refrigeration (VCR): cycle. Name the components indicated by letters A, B, C, and D and describe the thermodynamic state of the refrigerant in flow sections labeled 1, 2, 3, and 4. (16 marks)

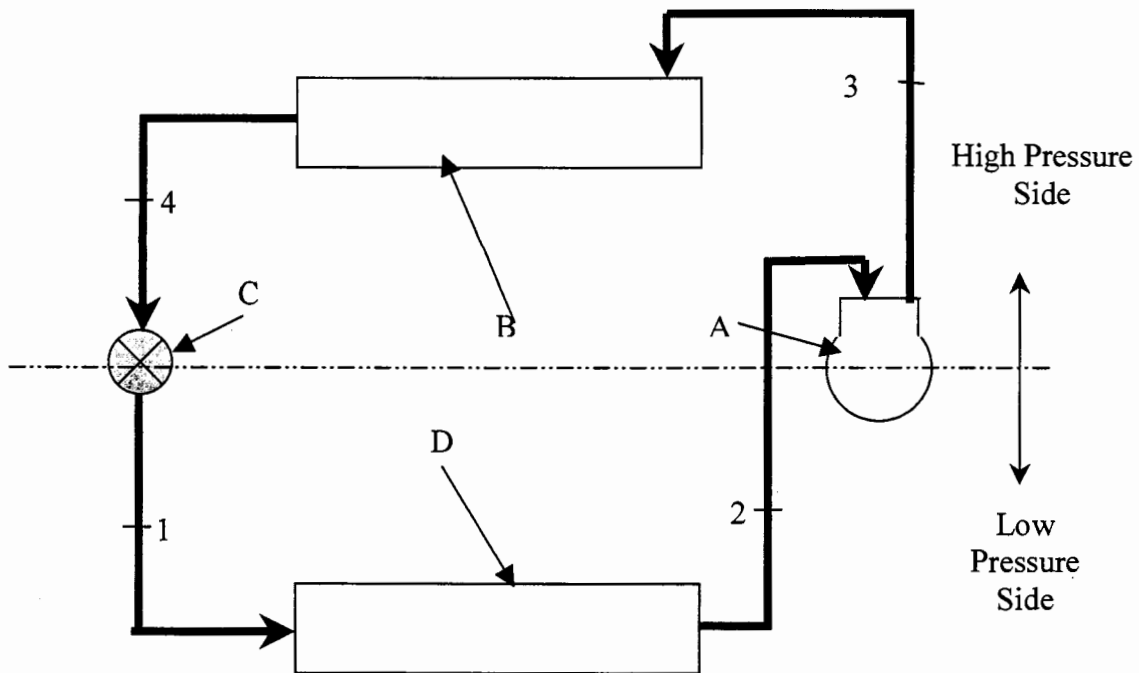


Figure 1. Vapour compression refrigeration cycle

- (c) The efficiency of a maize crib depends on its dimensions, and orientation. With the aid of a labeled sketch of a crib (indicating the optimum dimensions and orientation) discuss the operational importance of each dimension and the orientation. (10 Marks)
- (d) Define grain porosity (3 Marks)
- (e) What is the significance of grain porosity in post-harvest handling of grain? (3 Marks)

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- (f) In a practical session, a student fills a 500 ml container with maize grain and carefully transfers the grain into a graduated cylinder partially filled with some liquid to the 300 cm³ mark. The completely immersed maize grain displaces the liquid in the cylinder to the 607 cm³ mark.

Determine the following parameters:

- | | | |
|------|--|-----------------|
| i. | the volume of void spaces in the grain | (1 Mark) |
| ii. | the volume of grain solid particles | (1 Mark) |
| iii. | porosity of the maize grain | (3 Mark) |

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

- (a) Give a full description of the oven method for determining grain moisture content. **(20 Marks)**
- (b) Grain moisture content is expressed either on wet basis (Mc_{wb}) or dry basis (Mc_{db}) as shown in equations (I) and (II) below:

$$\% \text{ moisture content, wet basis } (Mc_{wb}) = \frac{\text{Mass of water } (M_w)}{\text{Mass of water } (M_w) + \text{Dry mass of grain } (M_d)} \times 100 \text{-----(I)}$$

$$\% \text{ moisture content, wet basis } (Mc_{db}) = \frac{\text{Mass of water } (M_w)}{\text{Dry mass of grain } (M_d)} \times 100 \text{-----(II)}$$

- (c) Develop equations in which;
- (d) Mc_{wb} is the subject expressed as a function of Mc_{db} **only** **(5 Marks)**
- (e) Mc_{db} is the subject expressed as a function of Mc_{wb} **only** **(5 Marks)**

QUESTION THREE

- (a) Give a brief description of agricultural processing and state the advantages of processing agricultural produce. **(10 Marks)**
- (b) A bin full of maize grain is to be dried with air at a dry bulb temperature of 50°C and an airflow rate of 33 m³/min. The ambient air conditions are 30°C (Td.b.) and 22°C (Tw.b.) while the outgoing air is fully saturated, determine:
- (i) The amount of heat required per hour to heat the air.
- (ii) The amount of water removed per hour from the grain.

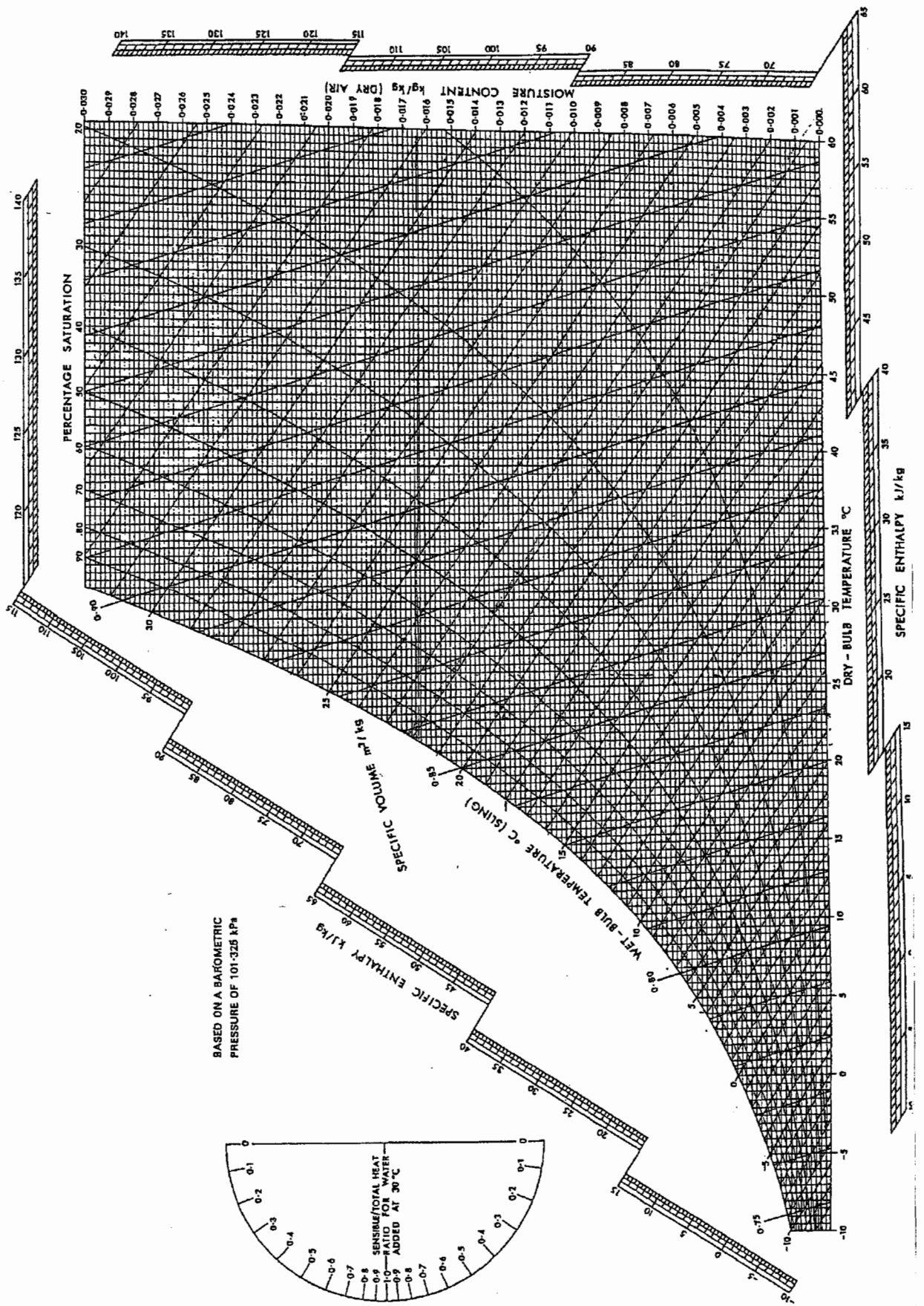
(20 Marks)

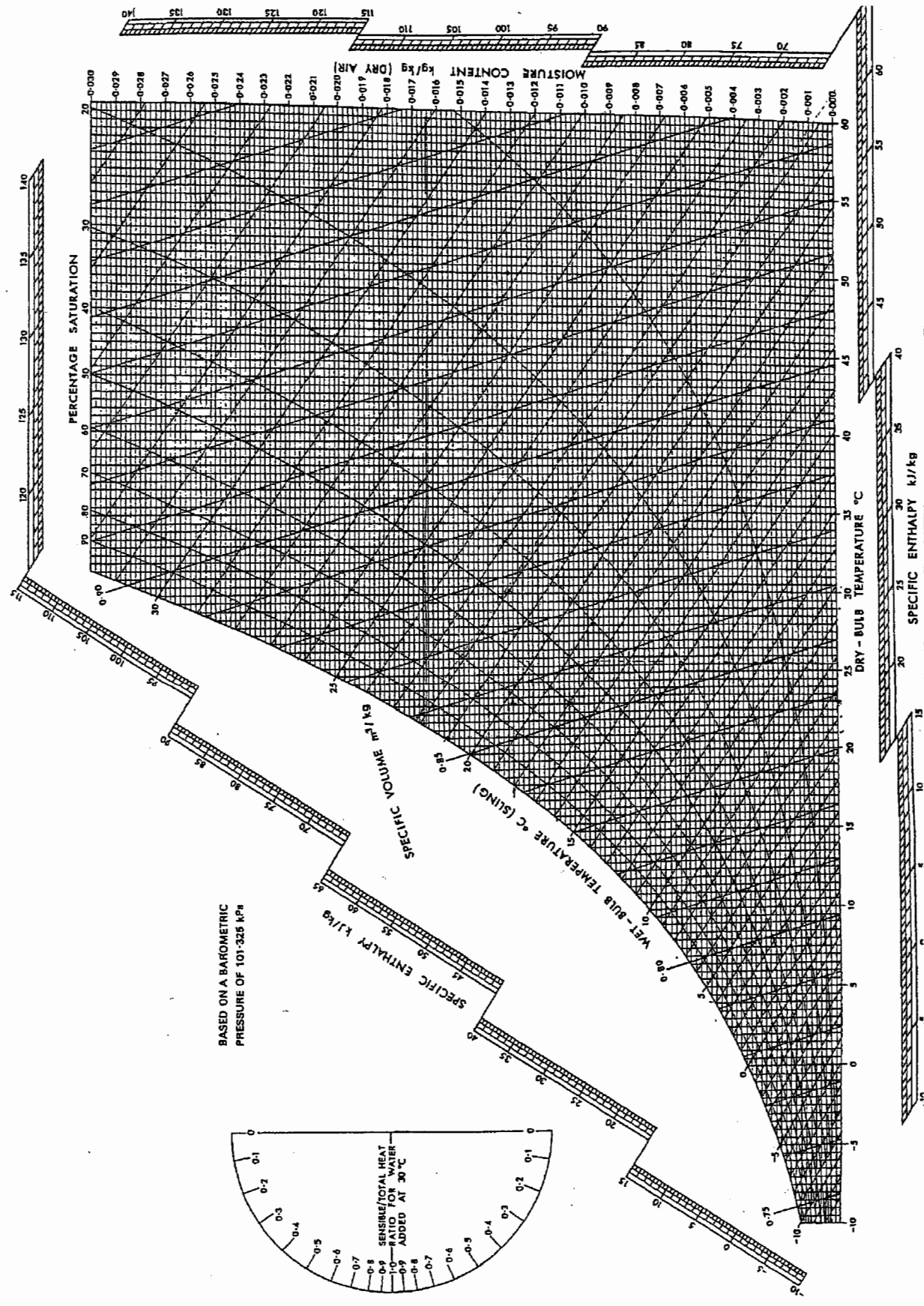
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QUESTION FOUR

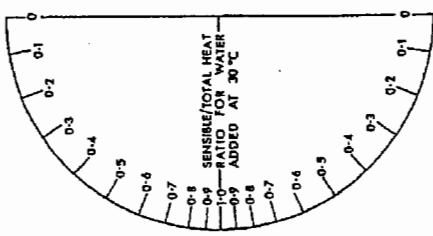
- (a) Write notes on maize physiological maturity **(10 Marks)**
- (b) With the aid of a diagram, describe the physical structure and biochemical composition of a cereal grain of your choice. **(10 Marks)**
- (c) Briefly discuss **ONE** principal cause of post-harvest losses from each of the following categories:
- a. Biological,
 - b. Physical,
 - c. Technical,
 - d. Human-induced

(10 Marks)





BASED ON A BAROMETRIC
 PRESSURE OF 101.325 kPa



SPECIFIC ENTHALPY kJ/kg

SPECIFIC VOLUME m³/kg

WET-BULB TEMPERATURE °C (SLING)

PERCENTAGE SATURATION

MOISTURE CONTENT kg/kg (DRY AIR)

DRY-BULB TEMPERATURE °C

SPECIFIC ENTHALPY kJ/kg