ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION, INNOVATION, SCIENCE AND TECHNOLOGY DEVELOPMENT

HIGHER EDUCATION EXAMINATIONS COUNCIL (HEXCO)

NATIONAL CERTIFICATE

IN

REFRIGERATION AND AIR CONDITIONING

MODULE: Commercial and Industrial Refrigeration Systems Assembly **PAPER NO: 359/22/M04**

DURATION: 3 Hours

NOVEMBER/ DECEMBER 2025 EXAMINATION

REQUIREMENTS

1. Answer booklet.
2. Non- programable scientific calculator.

INSTRUCTIONS TO CANDIDATE

1. Answer all questions in Section A each question carries one (1) mark. Twenty (20) marks.
2. Answer all questions from Section B. Each question carries five (5) marks. Fifty (50) marks.
3. Answer any three (3) questions from Section C. Each question carries 10 marks. Thirty (30) marks.
4. Answer each question on a fresh page.
5. Do not write your name inside or outside the answer script.
6. Do not write anything in the question paper.

This paper consists of 5 printed pages.

SECTION A (20 marks)

Answer all questions from Section A. Each question carries one (1) mark.

QUESTION 1

a) The subcooling is a process of cooling refrigerant in vapour compression refrigeration system before_____ (1 mark)

b) Out of all refrigeration systems, the ____ system is the most important system from the stand point of commercial and domestic utility. (1 mark)

c) _____ refrigerants are those circulating substances which are first cooled with the help of primary refrigerants and then employed for cooling purposes. (1 mark)

d) ___ pressure of a refrigerant should be low so as to have low condensing pressures. (1 mark)

e) A ___ pressure gauge can measure both below and above the atmospheric pressure. (1 mark)

f) The process of changing copper tubing so that two (2) pieces may be joined without the use of a fitting is called_____ (1 mark)

g) A ____ maybe used to determine surface temperature and the temperature of inaccessible location by indicators located at convenient points. (1 mark)

h) ____ is the process of loss of moisture from the surface of the product by evaporation into the surrounding air. (1 mark)

i) ___ freezing is brought about by forced circulation of cold air necessary for freezing the food in storage cabinets. (1 mark)

j) An opening through which air is returned or exhausted from the air-conditioned space is called_____ (1 mark)

k) The function of a ___ is to arrest the solid impurities such as soot, ash, smoke, fumes, living organisms such as virus, bacteria and fungi spores. (1 mark)

l) A system in which handling unit is separated from the condensing unit is called a ____ system. (1 mark)

m) The rate at which the body produces heat is termed ____ (1 mark)

n) ____is the effect of products when the relative humidity is high and the air velocity is also high. (1 mark)

o) The temperature at which wax will start precipitating out of a mixture of 90% refrigerant and 10% oil by volume is known as____ (1 mark)

p) The ozone layer surrounding the earth's atmosphere is being depleted by contact with _____ (1 mark)

q) A humidistat is a device used to _____ (1 mark)

r) ____ is the kind of TEV to use if the pressure drop between input and output of the evaporator is large and so effectively reduces the evaporator surface. (1 mark)

s) For ammonia refrigeration systems, the tubes of a shell and tube condenser are made of _____material. (1 mark)

t) ____ is contained in the shell of a coil within the condenser. (1 mark)

SECTION B (50 marks)

Answer all questions from this section. Each question carries five (5) marks. (50 marks)

QUESTION 2

a) Identify parts which are open or closed when one of the service valves of an open type compressor is:

i) Mid- position (1 mark)

ii) Front seated (2 marks)

iii) Back seated (2 marks)

b) Give an account when a service technician is required to test a control circuit of a suspected faulty 3- phase compressor motor not starting. (5 marks)

c) Describe the process of super heat setting on an expansion valve by a technician when the valve is flooding the evaporator with liquid refrigerant. (5 marks)

d) Outline the benefits of refrigeration maintenance activities involved with respect to improving energy efficiency. (5 marks)

e) i) Define the term ozone layer. (2 marks)

ii) Calculate the total equivalent warming impact (TEWI) of a domestic refrigerator containing 20kg of R11 in the polyurethane insulating foam, 2kg of R12 in the cooling system and producing 25kg of $C0_2$ for the electric energy supply. GWP of R11 is 4750 and GWP of R12 is 10890. (3 marks)

f) Outline five (5) functions of a suction pressure regulator on a refrigeration system. (5 marks)

g) Describe the function and operation of an oil charging pump of an industrial refrigeration equipment. (5 marks)

h) Outline five (5) importances of having a vapor seal on a refrigeration freezer room for chickens. (5 marks)

i) Briefly explain the process of charging R404a on a system after brazing process. (5 marks)

j) A gas occupies a volume of $400mm^3$ at a pressure of $490KN/m^2$ and a temperature of 30°C. Calculate the volume at STP. (5 marks)

SECTION C (30 marks)

Answer any three (3) questions from this Section. Each question carries 10 marks.

QUESTION 3

Differentiate between liquid charging and vapour charging. (10 marks)

QUESTION 4

Explain in detail how a technician can use the following leak detection methods to leak test a refrigeration system

a) Soap bubbles. (5 marks)

b) Sulphur candles. (5 marks)

QUESTION 5

Discuss briefly the following type of evaporators:

a) Off- cycle defrost models. (5 marks)

b) No- frost or frost – free models (5 marks)

QUESTION 6

With reference to evaporative condensers and cooling towers, define the following terms:

a) Range (2 marks)

b) Approach (2 marks)

c) Continuous bleed (2 marks)

d) Make- up (2 marks)

e) Drift (2 marks)

QUESTION 7

a) Explain the reason why oil used in Refrigeration systems should not be exposed to the atmosphere. (2 marks)

b) Explain in detail the two methods of lubrication commonly used in compressors of refrigeration systems. (8 marks)

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