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Agricultural Engineering Level 6

ENG/OS/AGR/CR/08/6/A

Install refrigeration and Air conditioning systems

July /Aug 2023

TVET CURRICULUM DEVELOPMENT ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

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WRITTEN ASSESSMENT

Time: 3 Hours

INSTRUCTIONS TO THE CANDIDATE

1. This paper has three sections **A** and **B.**
2. You are provided with a separate answer booklet.
3. Marks for each question are as indicated.
4. Do not write on the question paper.

This paper consists of 4 printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing

SECTION A [40 Marks]

Answer all questions in this section.

1. Define the following terms: (4 marks)
   (a) refrigeration;
   (b) air conditioning;
   (c) relative coefficient of performance;
   (d) Standard commercial tonne of refrigeration (TR).

2. Identify FOUR chemical properties of a refrigerant. (4 marks)
3. State FOUR possible causes of compressor burn out. (4 marks)
4. State FOUR indicators that shows a refrigerator is not having enough refrigerant. (4 marks)
5. List FOUR types of expansion valves used in vapour compression refrigeration system. (4 marks)
6. Outline FOUR factors that affect the transfer of heat in evaporators. (4 marks)

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7. Explain the procedure for testing leakages in refrigeration systems. (3 marks)
8. State FOUR basic electrical components of a refrigeration system. (4 marks)
9. List FIVE site conditions factors to consider for installation of refrigeration and air conditioning systems. (5 Marks)
10. State FOUR ways in which non-condensable gases infiltrate sealed systems. (4 marks)

SECTION B [60 Marks]

Answer ANY THREE questions in this section

11. Discuss applications of refrigeration and air conditioning in agriculture. (20 marks)

12. (a) List the equipment required to carry out evacuation process. (2 marks)

(b) With the use of a diagram, explain the procedure of purging a refrigeration system. (8 marks)

(c) You have been approached by a county government of Turkana for a design of a fish cold storage plant for fishing communities along Lake Turkana. You have been provided with the following data

The weight of fish to be stored is 20 tonnes of fish

The temperature of the fish when supplied is 25°C

Storage temperature of fish required is– 8°C

Specific heat of fish above freezing point is 2.93 kj/kg-°C

Specific heat of fish below freezing point is 1.25 kj/kg°C

Freezing point of fish is – 3°C

Latent heat of fish is 232 kj/kg

Assume the system designed works on a Carnot cycle

The cooling is achieved within 8 hours

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Determine:

i). Capacity of the refrigerating plant; (4 marks)

ii). Carnot cycle C.O.P. between this temperature range; (3 marks)

iii). If the actual C.O.P. is 1/3rd of the Carnot C.O.P. find out the power required to run the plant. (3 marks)

13. You have been working for the county government of Garissa as a refrigeration and air condition technician. To Improve learning in their schools, the county government has decided to install a refrigerating machine of 6 tonnes capacity, has an upper limit pressure of 5.2 bar. The temperature and pressure at the start of compression stroke is 1 bar and 16 ^{0}C respectively. The compressed air is cooled at a constant pressure to a temperature of 41 ^{0}C, enters the expansion cylinder. Assuming that both expansion and compression processes to be isentropic with $\gamma = 1.4$, the system works on f Bell-Coleman cycle, The unit is double acting and runs at 240 r.p.m and Stroke length is 200 mm.

Calculate:

(a) the coefficient of performance; (3 marks)
(b) quantity of air in circulation per minute; (5 marks)
(c) piston displacement of the compressor and expander; (4 marks)
(d) bore of the compressor and expansion cylinders., and; (5 marks)
(e) Power required to drive the unit. (3 marks)

14. (a) Identify THREE possible faults, their corresponding possible causes and remedies of an evaporator unit of vapour compression refrigeration systems. (9 marks)

(b) Outline ELEVEN safety measures that should be observed when carrying out installation of refrigeration and air conditioning system. (11 marks)

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