

**NATIONAL BUSINESS AND TECHNICAL EXAMINATIONS BOARD**  
**(GENERAL EDUCATION EXAMINATION)**  
**REFRIGERATION AND AIR-CONDITION WORKS**  
**ESSAY      N/D                      081-1   may/June 2007**

**Question 1:** (a) 3kg of air is expanded at a constant temperature from an initial volume of  $1.9\text{m}^3$  to a final volume of  $3.8\text{m}^3$ . If the initial absolute pressure of the air is 1.38bar. What is the final absolute pressure of the air?

**Answer:**

(b) State the procedure for charging oil into a hermetic compressor.

(a) DATA

Final absolute pressure  $(P_2) = ?$

$P_1$

Initial absolute pressure  $(P_1) = 1.38\text{bar}$

Initial volume  $(V_1) = 1.9\text{m}^3$

Final volume  $(V_2) = 3.38$

Formula  $P_1V_1 = P_2V_2$

Making  $P_2$  subject of formula

$P_2 = P_1V_1/V_2$

$P_2 = \frac{1.38\text{bar} \times 1.9\text{m}^3}{3.38\text{m}^3}$

$P_2 = 1.38\text{bar}/2$

$= 0.69\text{bar}$

- (b) 1. Siphon method  
2. Vacuum 2x 2

**Question 2.** (a) list the major component of vapor compression refrigeration system, identify the function of each component in a simple absorption refrigeration system which carry out the same function.

**Question 1b.**

(b) State THREE compressors commonly used in refrigeration industry.

**Answer:** major component parts of vapor compression system are (6) suction line.

1. Compressor
2. Condenser
3. Evaporator
4. Control
5. Discharge line

In absorption refrigeration system.

1. Compressor is replaced by generator
2. Discharge line is replaced by percolators/separators
3. Condenser is still condenser
4. Evaporation is still evaporator
5. Suction line is replaced by absorber

**Question 2 b.**

**(1) Three types of compressors in use are:**

- (i) Reciprocating
- (ii) Centrifugal
- (iii) Rotary

**Question 3a: With aid of a neat sketch, describe the function of the following air-condition instrument.**

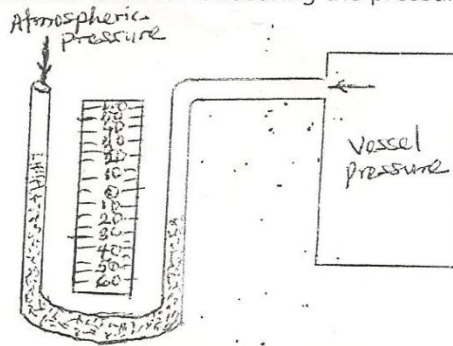
- (i) Manometer
- (ii) Barometer
- (iii) Pilot tube
- (iv) Anemometer
- (v) Velocimeter

**3b. Define ambient temperature.**

- (i) **Manometer** is an instrument used for measuring the pressure of fluid inside a closed vessel.

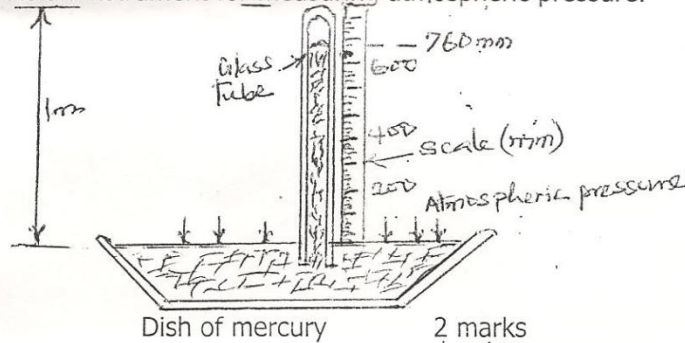
**Figure i.**

**Q 3a**  
1 MANOMETER is an instrument used for measuring the pressure of fluid inside a closed vessel.



2 marks

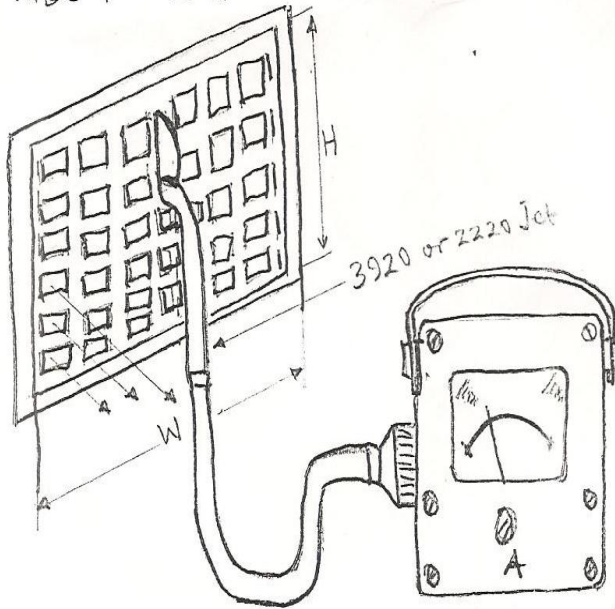
BAROMETER is an instrument for measuring atmospheric pressure.



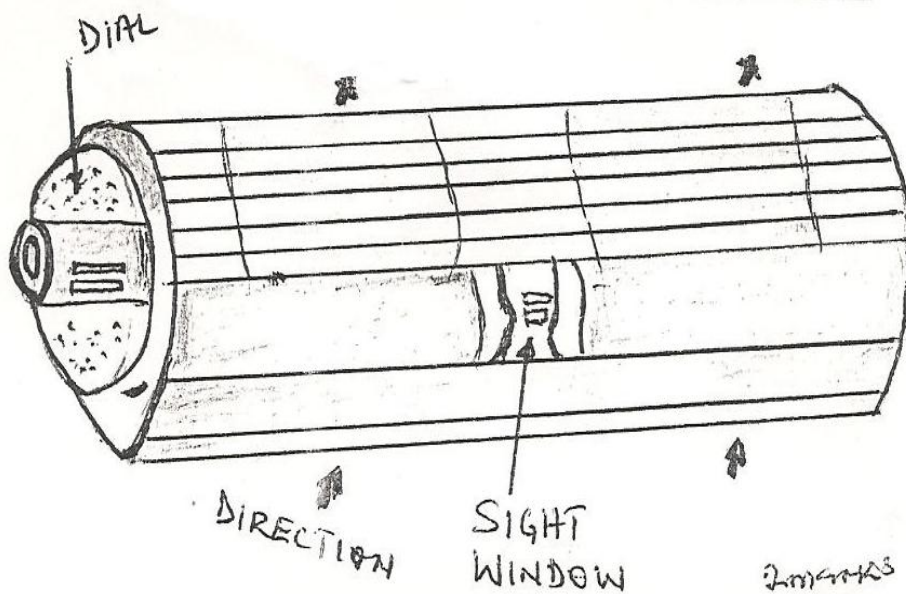
2 marks

(iii) PITOT TUBE : Is a tube used to measure air velocity

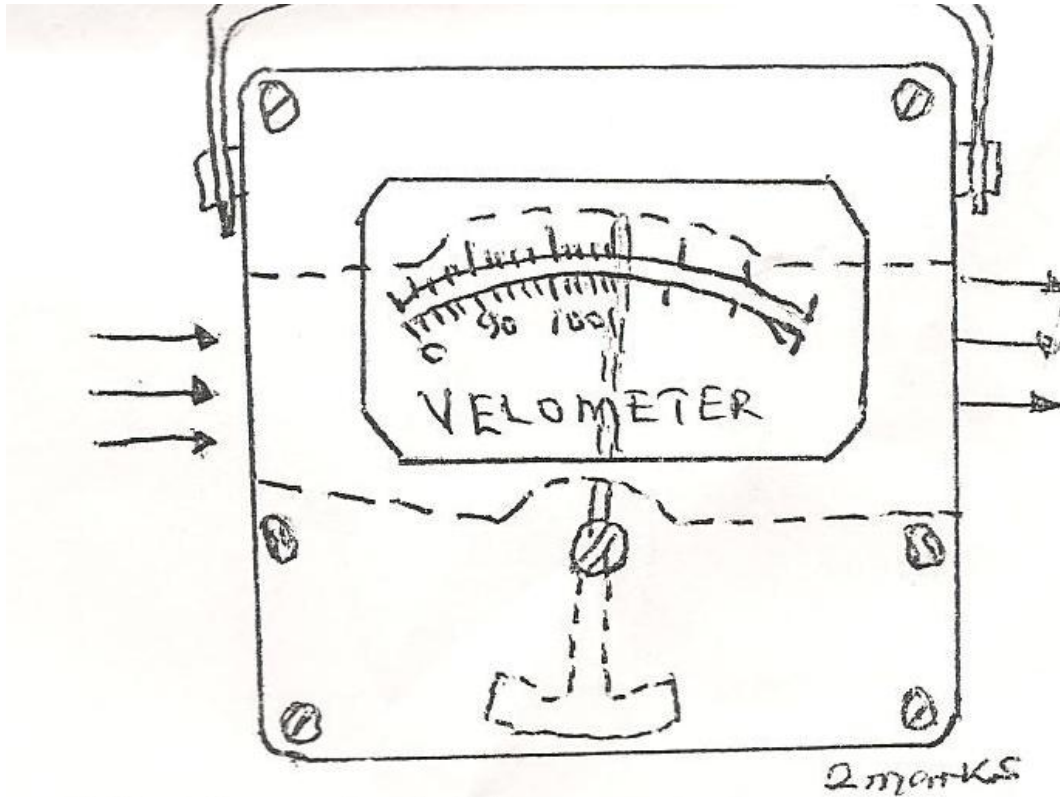
PITOT TUBE :- Is a tube used to measure air velocity .



(iv) ANEMOMETER is an instrument for measuring the rate of air flow or motion



(V) VELOCIMETER is an instrument for measuring air speed using direct reading air speed indicating scale.



4a. A cold room has its wall measuring 4m x 14m. If the conditioned temperature is 8°C and the outdoor temperature is 32°C. calculate the total heat transmitted through the wall. Note U-factor = 0.93W/mk.

b. State and discuss any FIVE good properties tube considered when selecting an insulation material.

**ANSWER:**

**Total heat (Q) is a function of the total surface area (A) by overall conductivity (U) by temperature different (TD)**

$$= Q = A \times U \times TD$$

Given values

Q=?

$$A = 4m \times 14M = 56^2$$

$$U = 0.93W/mk$$

$$T.D. = 32^{\circ}C - 8^{\circ}C = 24^{\circ}C$$

$$\begin{aligned}\therefore Q &= 56 \times 0.93 \text{ W} \times 24 \\ &= 1249.92\text{W}.\end{aligned}$$

**QUESTION 4B.**

Properties of insulation materials

**ANSWER:**

A good insulation material must offer high resistance to heat flow'

It must not support combustion

It must be vermin and rodent proof

It must not be water absorbent

It must be self supporting

If must be easy to come by (availability)

It must be chemically stable

5a. In industrial refrigeration, identify the heat source which constitute the total heat load handled by a cold store.

b. Explain the term U-factor as applied to heat transfer.

**Answer:**

- 5a.    1.    Product load  
          2.    Wall gain load  
          3.    air- change load  
          4.    Miscellaneous load

5b. The term U factor depicts the overall heat transfer co-efficient

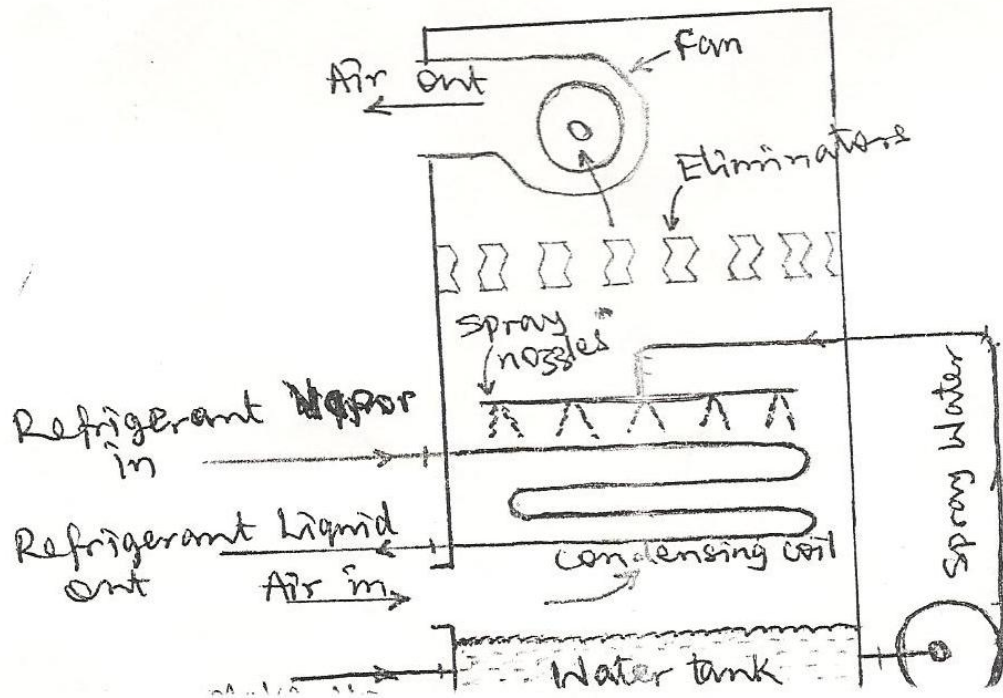
**Question: 6a.** State and explain FOUR factor that affect evaporation capacity.

6b. with the aid of a sketch, explain the working principle of an evaporative condenser.

**Answer:** factors that affect evaporative capacity are:

- I.       Overall effective surface area
- II.      Temperature differences between cooling medium and product
- III.     Over heat transfer co-efficient of the materials used for its construction
- IV.     Rate of flow of cooling medium over the surface are

**Figure ii diagram**



An evaporative condenser is essentially water conservation device and is in effect, a condenser and a cooling tower combined into a single unit. It uses both air and water as cooling medium. The water pumped from the sump up to the spray header sprays down over the refrigerant coils and returns to sump. The air is drawn in from outside at the top of the condenser by action of the blower and is discharged back to the outside at the top of the condenser. In some cases both pump and blower are driven by the same motor in others to separate motor is used. The eliminator installed at the top above the spray header is preventing entrained water from being carried over into the blower by air. The fundamental process here is that of evaporative cooling where water is evaporated from the spray and from the wetted surface of the condenser into air. Latent heat of vaporization is drawn from the condensing refrigerant.

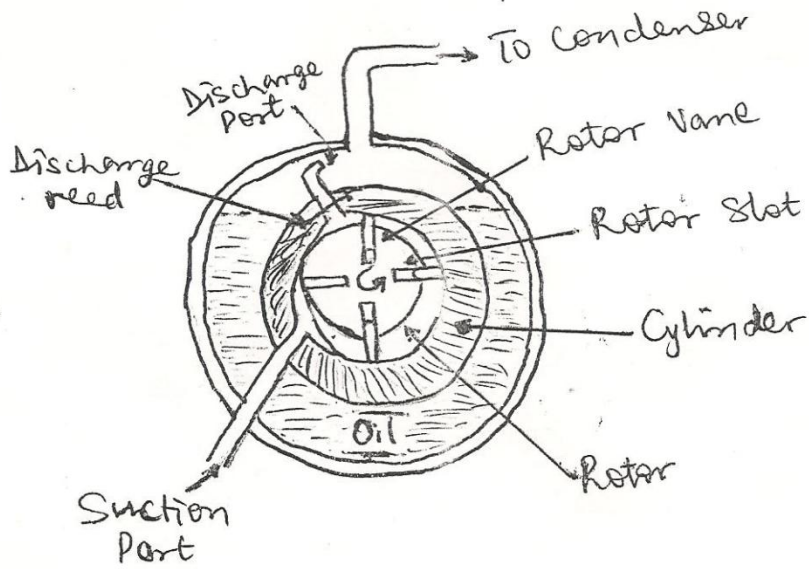
7a. Briefly explain the connection between compressors, motor and generators.

(b) State THREE common compressor uses in the refrigeration industry and sketch any ONE.

**Answer 7a:**

**Diagram**

SKEICH .



5 marks

**QUESTIONS B. Three types of compressors in common use are**

- (1) Reciprocating
- (2) Rotary and
- (3) Centrifugal