



**Answer all the following questions:**

**Question-1**

**[15 marks]**

- a) Mention the sources of indoor air pollution, and classify the contaminants of air inside closed spaces. **(6 marks)**
- b) What are the contents of healthy air? Explain with details the meaning of Indoor Air Quality (IAQ). **(4 marks)**
- c) Air cleaning is one method which is used to control the level of air pollution inside closed spaces. Explain with details this method. **(5 marks)**

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**Question-2**

**[20 marks]**

- a- What is the difference between air conditioning process and the air ventilation processes? **(5 marks)**
- b- Describe using diagrammatic sketch, how the temperature difference between inside places and the outside surrounding can be used to modify the natural ventilation system. **(5 marks)**
- c- Show the difference between the two methods of industrial ventilation system (i.e. dilution and local exhaust), and mention only the disadvantages of each method. **(6 marks)**
- d- Mention the precautions should be considered into account during duct design to obtain the optimum design? **(4 marks)**

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**Question-3**

**[15 marks]**

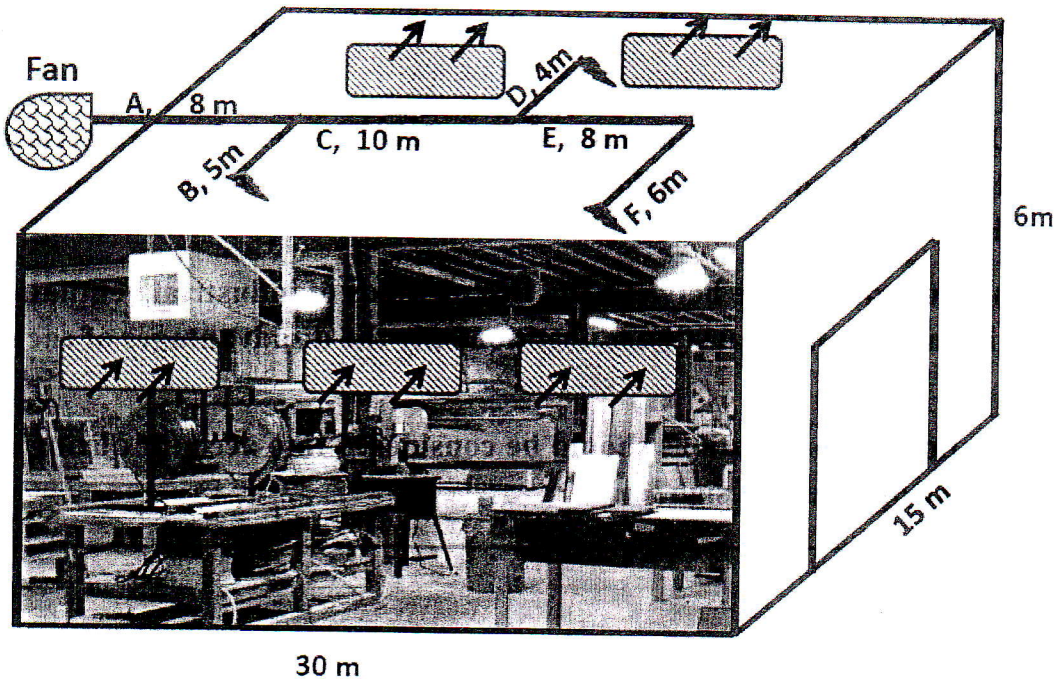
- a- Discuss the difference between fans, blowers and compressors with respect to the pressure ratio. **(5 marks)**
- b- Explain with the aid of diagram the performance curve of fan under specific conditions of fan volume and system static pressure. **(5 marks)**
- c- Mention the different methods are used to control the fan air flow. **(5 marks)**
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**Question-4**

**[50 marks]**

The dilution ventilation is used of the wood factory. The factory has the dimensions 30m×15m×6m as shown in the next figure. Three inlet and two exit openings have the same shape and the same dimensions (0.5m×2m). The difference height between inlet and exit opening (i.e. H) is 1.5 m and the discharge coefficient  $C_D$  is 0.61 for all the openings. The dynamic pressure head at the inlet opening is 1.25 Pa. The average temperature inside the factory is 32 °C while the outside temperature is 24 °C. The air flow rate from duct openings are  $Q_B=20\%$  of the fan flow rate and  $Q_D=Q_F=40\%$  of the fan flow rate. Take the pressure loss coefficients at bend is 0.8 and the exit is 1.0 along the duct. Also, take the velocity for the main duct is 8 m/s and the fan efficiency is 0.85. Assume any required data and calculate the following:

- i- The required air flow rate if ACR=6.
- ii- The natural flow rate based on the wind and the buoyancy effect.
- iii- Design the ventilation duct by using the equal friction coefficient method.
- v- The fan horse Power (HP).



Use the following relations if you need:

$$\frac{\Delta P_f}{L} = \frac{0.022243 \dot{Q}_{air}^{1.85}}{D^{4.973}} \quad , \quad D_{eq,B} = D_{eq,A} \left( \frac{Q_B}{Q_A} \right)^{\left( \frac{1.85}{4.973} \right)} \quad , \quad D_{eq} = 1.3 \frac{(ab)^{0.625}}{(a+b)^{0.25}}$$

$$V_{wind} = \sqrt{\frac{2 \Delta P}{\rho_{air}}} \quad , \quad \dot{Q}_{boy} = A_e C_e \sqrt{\frac{2 g \Delta H \Delta T}{\bar{T}}} \quad , \quad \frac{l}{(A_e C_e)^2} = \frac{l}{(\sum A_i C_i)^2} + \frac{l}{(\sum A_o C_o)^2}$$

*With best wishes*