Assume suitable values for the not-given data

Question (1) **(15 Marks)**

- **a-** What are the advantages and disadvantages of the internal gear pumps? **[2]**

- **b-** Draw and explain, the forces acting on the drive and driven gears of the external gear pump. **[3]**

- **c-** Discuss the performance curves (including Q-P curves, volumetric and overall efficiencies, and noise level) of the external gear pumps. **[4]**

- **d-** Explain with sketch, the principle of balanced vane pump. **[3]**

- **e-** A vane pump is to have a volumetric displacement of **82 cm³**. It has a rotor diameter of **5 cm**, a cam ring diameter of **7.5 cm**, and a vane width of **4 cm**. What must be the eccentricity? What is the maximum volumetric displacement possible? **[3]**

Question (2) **(15 Marks)**

- **a-** Mention four differences between axial piston pumps, swash plate design and wobble plate design. **[2]**

- **b-** What are the disadvantages of piston pumps? **[2]**

- **c-** How to control the displacement of piston pumps, axial type design? **[2]**

- **d-** What are the different applications of piston pumps? Mention its advantages over the other types of positive displacement pumps. **[3]**

- **e-** Explain with sketch, the operation of the axial piston pump, bent-axis design. **[3]**

- **f-** An axial piston pump has **nine** pistons arranged on a circle of **125 mm** diameter. The diameter of each piston is **15 mm**. The cylinder block is set to an offset angle of **10 degrees**. If the pump runs at **1000 rpm** with volumetric efficiency of **94 %**, find the flow rate. If the rated pressure is **350 bar**, what is the power required to drive the pump? **[3]**

Question (3) **(10 Marks)**

- **a-** Explain with sketch, the operation of the radial piston pump, eccentric shaft type. **[3]**

- **b-** Why timing gears are required for lobe pumps? **[1]**

- **c-** What are the advantages of lobe pumps? **[1]**

- **d-** Explain with sketch, the operation of one type of screw pumps. **[3]**

- **e-** What are the advantages and disadvantages of screw pumps? **[2]**

With my best wishes, Dr. Ali M. Abdelsalam

Question (4)   (15 Marks)

a- What are the different principles for pump classifications?   [2]

b- What are the different types of pumps?   [2]

c- Draw the different types of check valves that are used in pumps.   [2]

d- Mention the two different methods that are used for throttling the pump flow rate.   [2]

e- A diaphragm pump that has three different reciprocating volume shapes, is used in a certain application. The crank is rotating at **30 rps** with a stroke length of **50 cm**. Calculate, for the three shapes, the pump flow rate and the required shaft horse power if the overall pump efficiency is **75 %** and pressure difference between pump inlet and outlet is **5 bar**. (1) Cylindrical reciprocating volume shape of **25 cm** diameter.
(2) Conical reciprocating volume shape of **40 cm** base diameter.
(3) Truncated Conical reciprocating volume shape of **40 cm** base diameter and **10 cm** top diameter.   [7]

Question (5)   (15 Marks)

a- What are the different advantages of diaphragm pumps?   [2]

b- Explain, with sketch, the operation theory of the diaphragm pump.   [1]

c- Explain the different methods for moving the diaphragm of the diaphragm pump. [2]

d- What is the material of the diaphragm of the diaphragm pumps?   [1]

e- Compare between the operation theory of the jet pump and air-lift pump.   [2]

f- Explain how is the jet pump used to decrease the static suction head in deep wells. [2]

g- What are the different advantages and disadvantages of jet pumps?   [2]

h- For the air-lift pump shown in the figure, if the liquid-air mixture density is reduced by **70%** due to the air injection. The distance from the air outlet and the free surface (h_s) equals **3 m**. Calculate the liquid-air mixture rise above the liquid free surface (h_1).   [3]

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With my best wishes, Dr. Tarek Abdel Samie Ghonim