(3%) 1. High winds tend to lift roofs from buildings rather than to force them inward. Why?

(3%) 2. Bernoulli equation is an energy equation and is derived from the equation of the conservation of energy. Yes or No. Why?

(3%) 3. When a car passes a truck or bus at high speed, a pronounced side thrust is experienced by the occupants of the car. Explain this phenomenon.

(3%) 4. The flame of a candle may be extinguished more easily by exhaling or by inhaling? Why?
In which instance is the motion more nearly irrotational?

(3%) 5. Why does the concept of fluid head have no physical significance in the motion of a gas?

(3%) 6. Water is always regarded as an incompressible fluid. Yes or No. Why?

(3%) 7. Why is it desirable to have a hydraulic jump form at the toe of a spillway?
How may this be attained?

(3%) 8. Suggest means of measuring both dynamic and kinematic viscosity.

(6%) 9. Boundary-layer theory is based upon the premise

that the thickness δ is very small compared with other linear dimensions. Does this premise eventually fail to be fullfilled
(a) near to or far from the leading edge,
(b) with increasing or decreasing viscosity,
(c) at high or low velocity ?

(5%) 10. What is the cause of vibration in telephone wires in a high wind ?
Under what circumstances could such vibration easily lead to rupture ?

(10%) 11. Explain the "drag crisis". Cite some practical applications.

(8%) 12. When a laminar liquid jet emanating from a long circular pipe is observed, it appears to divide into two jets (A-A) connected by a very thin sheet (B) of liquid (Fig. 1). On the other hand, if a similar jet issues from a short orifice it remains as a single jet (Fig. 2).
Why the difference?

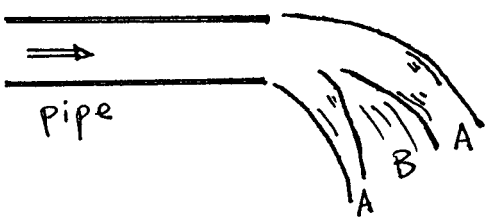


Fig. 1

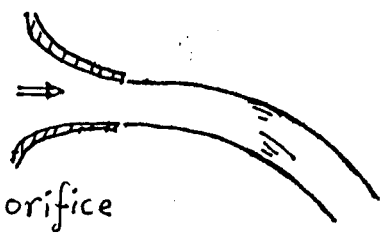


Fig. 2

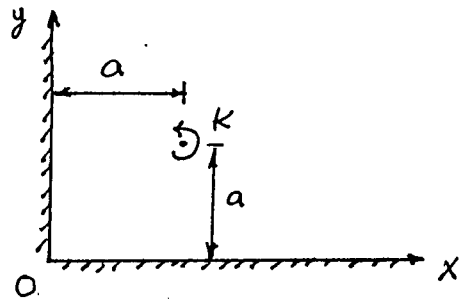
(10%) 13. The power P required to drive a pump depends upon the discharge Q, the pressure rise Δp, the fluid density ρ, the pump size D, and the efficiency e. Use dimensional analysis to determine a general relationship among these variables.

(15%) 14. A counterclockwise vortex of strength K is located in a corner formed by two plates as shown.

(a) Show the image system

(b) carefully sketch some streamlines and equipotential lines

(c) state how you would determine the pressure distribution on the plates (calculation of P is not required).



(7%) 15. Explain the physical meaning of "added mass".

(15%) 16. Consider two-dimensional flow from a nozzle discharging a jet of water ($\nu = 1.2 \times 10^{-5}$ ft²/sec) onto a smooth glass plate. The plate slope is set such that the velocity at the free surface remains constant at 12 ft/sec. The water depth at the exit from the nozzle ($x = 0$) is 0.16 ft. Assuming a turbulent boundary layer over the entire plate, estimate the distance $x = L$

at which turbulent fluctuations should first appear on the free surface. Sketch the velocity distributions at $x = L/2$, L, and $2L$. Would you expect the water depth to remain constant, increase or decrease in the region $0 < x < L$?