Numerical PROBLEMS N°3

1/ What angle α of jet is required to reach the roof of the building shown in Fig. 3–01 with minimum jet velocity v_0 at the nozzle? What is the value of v_0 ?

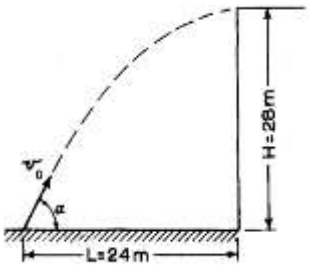
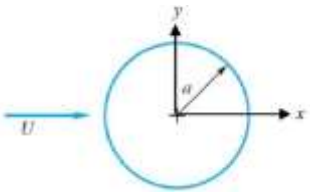


Fig. 3–01

2/ Given the velocity field $\vec{v} = (5x)\vec{\imath} + (15y + 11)\vec{\jmath} + (19t^2)\vec{k}$ (m/s)
Determine the path of a particle which is at (4,6,2) m at time t=3s.

3/ The velocity potential function for an ideal flow around a long cylinder centered at origin is given by: $\phi = \left(\frac{B}{r} + Ar\right) cos\theta$



The cylinder has a radius a and is placed in a uniform flow of velocity U.
1- Determine the constants A and B in terms of a and U using boundary conditions at the surface and at $(x,y) = (0,\infty)$.
2- Determine the location and magnitude of the maximum velocity on the surface

4/ Consider the two-dimensional Poiseuille flow. The fluid between the plates is water at 40°C, let the gap height h=1,6 mm and the pressure gradient dP/dx= -230 N/m^3. Imagine a hydrogen bubble wire stretched vertically through the channel at x=0 (Fig. 3–02). The wire is pulsed on and off such that bubbles are produced periodically to create timelines. Five distinct timelines are generated at t= (0), (2,5), (5,0), (7,5), and 10,0 s. Calculate and plot what these five timelines look like at time t=12,5 s. Let the gap height h = 1,6 mm.
The flow is steady, incompressible, and two-dimensional in the xy-plane. The velocity components are given by:

$$u = \frac{1}{2\mu}\frac{dP}{dx}(y^2 - hy) \qquad v = 0$$

where μ is the fluid's viscosity.

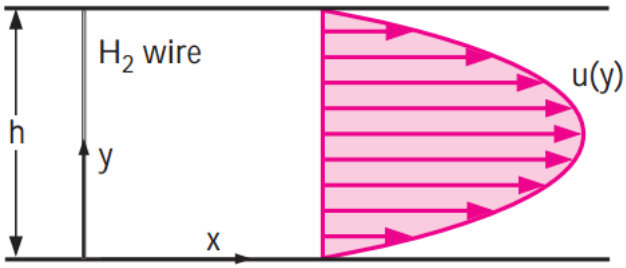


Fig. 3–02

MCQ (Multiple Choice Questions)

1/ Pressure variation for compressible fluid is maximum for which of the following kind of process?
a) Adiabatic
b) Quasi Static
c) Isothermal
d) None of the mentioned

2/ The velocity vector in a fluid is given $V=5x^4+3y^2+2z$(in metre/sec). What is the acceleration of it at point (1,3,4) ?
a) 40 m/s^2
b) 20 m/s^2
c) 60 m/s^2
d) 80 m/s^2

3/ A fluid flow field is given by
$V=x^2yi+y^2z-(2xyz+yz)k$
Calculate it's acceleration at the point (1,3,5)
a) 28i-3j+125k
b) 28i-3j-125k
c) 28i+3j+125k
d) None of the mentioned

4/ A fluid flow field is given by
$V=y^2xi+z^2x-(2xyz+yz)k$
Calculate it's acceleration at the point (2,4,4)
a) 36i-27j+100k
b) 36i-27j-100k
c) 28i+27j+100k
d) None of the mentioned

5/ Which equation must be perfunctorily satisfied while dealing with fluid flow problems?
a) Newton's second law
b) Newton's third law
c) Law of conservation of momentum
d) Continuity equation