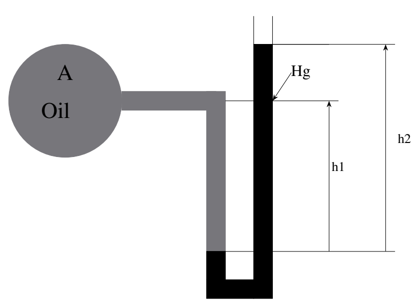
2012-XE: ENGINEERING SCIENCES

EE24BTECH11008-ASLIN GARVASIS

6) In the case of a fully developed flow through a pipe, the shear stress at the centerline is
   a) a function of the axial distance
   b) a function of the centerline velocity
   c) zero
   d) infinite
7) The velocity in a one-dimensional unsteady flow is given by $\left(x^2 - t\right)$, where x is the position and t is the time. The total acceleration at any x and t is
   a) $-1 + xt + x^3$
   b) $-1 + xt + 2x^3$
   c) $-1 - xt - x^3$
   d) $-1 - 2xt + 2x^3$
8) If ψ is the stream function, the Laplace's equation $\Delta\psi = 0$ is true when the flow is
   a) incompressible
   b) incompressible and irrotational
   c) irrotational
   d) compressible
9) A fully developed laminar flow is taking place through a pipe. If the flow velocity is doubled maintaining the flow laminar, the pressure loss would be
   a) halved
   b) unaltered
   c) doubled
   d) trebled

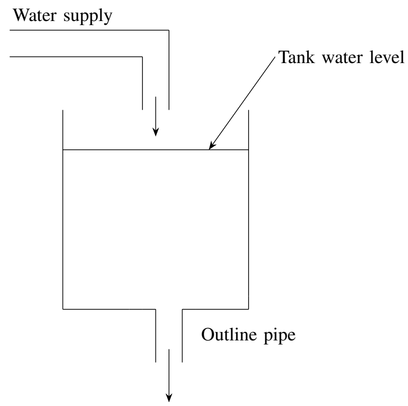
Q.10− **Q.**22 **carry two marks each.**

10) In the following equations, u and v are the velocities in the $x-$ and $y-$ directions, respectively and t is time. The flow field that CANNOT be termed as incompressible is
   a) $u = x^3 + xy^2, v = y^3 + yx^2$
   b) $u = 10xt, v = -10yt$
   c) $u = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}, v = 0\ (\delta = constant)$
   d) $u = 2y, v = 2x$
11) A U-tube mercury (Hg) manometer as shown below is employed to measure the pressure of an oil-filled vessel. The densities of Hg and oil are $13600\left(\frac{kg}{m^3}\right)$ and $800\left(\frac{kg}{m^3}\right)$, respectively. The gravitational acceleration may be taken as $10\left(\frac{m}{s^2}\right)$. The gauge pressure $(inPa)$ at a point A when $h_1 = 0.5\,(m)$ and $h_2 = 0.9\,(m)$, is approximately



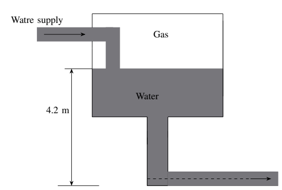
   a) 118.4×10^3
   b) 118.4
   c) 11.84
   d) 1.184

12) Water is supplied to a tank at the rate of $40.02\left(\frac{m^3}{s}\right)$ as shown below. The cross-sectional area of the tank is $1\,(mm)$ and the inner diameter of the outlet pipe is $60\,(mm)$. At a time when the water level in the tank is increasing at the rate of $5\left(\frac{mm}{s}\right)$, the average velocity $\left(in\left(\frac{m}{s}\right)\right)$ of water in the outlet pipe is approximately



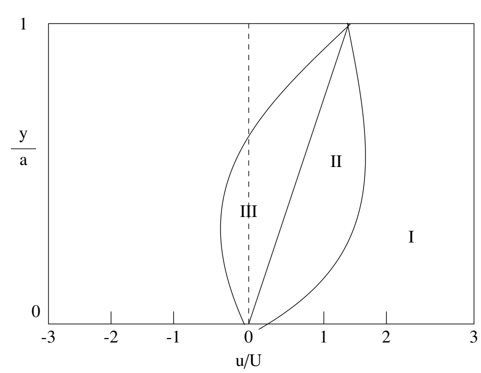
a) 0.005
b) 0.06
c) 5.3
d) 20

13) The water level in a gas-pressurized tank with a large cross-sectional area is maintained constant as shown in the figure below. The water level in the tank is $4.2\,(m)$ above the pipe centerline as indicated in the figure. The gas pressure is $130\,(kPa)$. The atmospheric pressure, gravitational acceleration and density of water may be taken as $100\,(kPa)$, $10\left(\frac{m}{s^2}\right)$ and $1000\left(\frac{kg}{m^3}\right)$, respectively. Neglecting losses, the maximum velocity in $\left(\frac{m}{s}\right)$ of water at any location in the horizontal portion of the delivery pipe for the pressure NOT to drop below atmospheric pressure, is



a) 1.3
b) 4.2
c) 10
d) 12

14) The figure given below shows typical non-dimensional velocity profiles for fully developed laminar flow between two infinitely long parallel plates separated by a distance a along y-direction. The upper plate is moving with a constant velocity u in the x-direction and the lower plate is stationary.



Column I	Column II
P. profile I	$\frac{\partial p}{\partial x}>0$
Q. profile II	$\frac{\partial p}{\partial x}<0$
R. profile III	$\frac{\partial p}{\partial x}=0$

Match the non-dimensional velocity profiles in Column I with Column II

a) $P-2; Q-3; R-1$
b) $P-3; Q-2; R-1$
c) $P-3; Q-1; R-2$
d) $P-1; Q-2; R-3$

15) Air flows over a spherical storage vessel of diameter $4\,(m)$ at a speed of $1\left(\frac{m}{s}\right)$. To find the drag force on the vessel, a test run is to be carried out in water using a sphere of diameter $100\,(mm)$ The density and dynamic viscosity of air are $1.2\left(\frac{kg}{m^3}\right)$ and $1.8*10^{-}5\,(Pa.s)$, respectively. The density and dynamic viscosity of water are $1000\left(\frac{kg}{m^3}\times i\right)$ and $10^{-}3\,(Pa.s)$, respectively. The drag force on the model is $4\,(N)$ under dynamically similar conditions. The drag force in (N) on the prototype is approximately

a) 0.25
b) 0.93
c) 1.08
d) 4

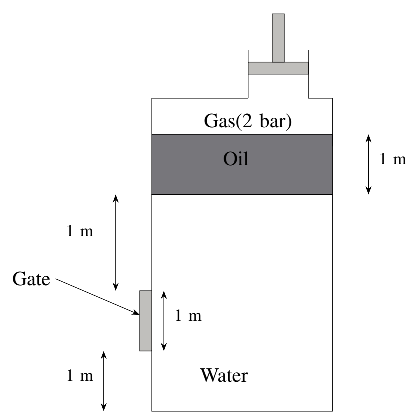
16) The velocity of an air stream is $20\left(\frac{m}{s}\right)$. The densities of mercury and air are $13600\left(\frac{kg}{m^3}\right)$ and $1.2\frac{kg}{m}$, respectively. The gravitational acceleration may be taken as $10\left(\frac{m}{s}\right)$ When a Pitot-static tube is placed in the stream, assuming the flow to be incompressible and frictionless, the difference between the stagnation and static pressure in the flow field $(inmmHg)$ would approximately be

a) 1760
b) 1.76
c) 0.57
d) 0.57×10^{-5}

Common Data Questions

Common Data for Questions 17 **and** 18 :

A vessel containing water $\left(\text{density } 1000\left(\frac{kg}{m^3}\right)\right)$ and oil $\left(\text{density } 800\left(\frac{kg}{m^3}\right)\right)$, pressurized by gas, is shown in the figure below. Assume that the gravitational acceleration is $10\left(\frac{m}{s^2}\right)$.



17) The pressure (in bar) exerted on the wall inside the vessel is approximately

a) 0.238
b) 2.38
c) 23.8
d) 238

18) The gate is $1\,(m)$ wide perpendicular to the plane of the paper. The force (in N) exerted on the gate is approximately

a) 2.23×10^3
b) 2.23×10^4

c) 2.23×10^5
d) 2.23×10^6